THE PLATTEVILLE AND GALENA GROUPS IN NORTHERN ILLINOIS

H. B. Willman and Dennis R. Kolata

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Cover photo: Steeply dipping strata of the Platteville Group on the west flank of the La Salle Anticline, exposed along the Vermilion River at Matthiessen State Park near Oglesby, La Salle County, Illinois (NE NE NE 31, 33W-2E).

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CONTENTS

	Page
ABSTRACT	1
INTRODUCTION	2
DISTRIBUTION	7
STRATIGRAPHIC CLASSIFICATION	7
Rock-stratigraphic classification	7
Biostratigraphic classification	10
Classification of unconformity-bounded units	10
Facies classification	10
Time-stratigraphic classification	10
Geologic time classification	11
CHARACTER AND TERMINOLOGY	11
Limestone and dolomite	11
Shale	14
Chert	14
Bentonite	15
Sandstone	15
FOSSILS	15
ENVIRONMENT OF DEPOSITION	16
SOURCE OF THE SEDIMENTS	16
TIME STRATIGRAPHY	17
Ordovician System	17
Champlainian Series	17
Blackriveran Stage	17
Trentonian Stage	18
ROCK STRATIGRAPHY	18
Platteville Group	18
Plattin Subgroup	24
Pecatonica Formation	24
Hennepin Member	26
Chana Member	26
Dana Member	26
New Glarus Member	26
Medusa Member	26
Oglesby Member	26
Mifflin Formation	27
Grand Detour Formation	28
Cowen Member (new)	30
Stillman Member	30
Forreston Member	30
Nachusa Formation	31
Eldena Member	31
Elm Member	31
Everett Member	32
Quimbys Mill Formation	32
Hazel Green Member	33
Shullsburg Member	33
Strawbridge Member	33
Galena Group	33
Decorah Subgroup	40
Kimmswick Subgroup	42
Spechts Ferry Formation	42
Castlewood Member	43
Deicke Bentonite Bed (new)	43
Glencoe Member	43
Millbrig Bentonite Bed (new)	43
Guttenberg Formation	44
Garnavillo Member	45
Glenhaven Member	45
Elkport Bentonite Bed (new)	45
Dickeyville Bentonite Bed (new)	45
Dunleith Formation	45
Buckhorn Member	47
St. James Member	47
Beecher Member	48
Eagle Point Member	48
Fairplay Member	48
Mortimer Member	48
Rivoli Member	49
Calmar Bentonite Bed (new)	49
Conover Bentonite Bed (new)	49
Sherwood Member	50
Nasset Bentonite Bed (new)	50
Wall Member	50
Haldane Bentonite Bed (new)	50
Loves Park Member (new)	50
Wyota Member	51
Wise Lake Formation	51
Sinsinawa Member	52
Dygerts Bentonite Bed (new)	52
Stewartville Member	52
Dubuque Formation	53
GEOLOGIC SECTIONS	57
REFERENCES	73

TABLES

		Page
TABLE 1.	Mineral analyses	54-55

FIGURES

1	Distribution of the Platteville and Galena Groups	3, 4, 5
2	Classification of the Platteville and Galena Groups	6
3A	Localities mentioned in the text	8
3B	Location of geologic sections	9
4	Grain size of sedimentary rocks	13
5	Columnar section of the Platteville Group	19
6	Correlation of Platteville Group sections from South Wayne, Wisconsin, to near Oglesby, Illinois	20
7	Correlation of Platteville Group sections from near Dickeyville, Wisconsin, to near Durand, Illinois	21
8	Bedding and textures of Platteville strata	22
9	Characteristic fossils of the Platteville Group	23
10	Recorrelation of the Walgreen and Dixon North Geologic Sections	27
11	Columnar section of the Galena Group	34
12	Correlation of Galena Group sections from near Dickeyville, Wisconsin, to near Rockton, Illinois	35
13	Correlation of Galena Group sections from East Dubuque to near Rockford	36
14	Correlation of Galena Group sections from near Oregon to near La Salle	37
15	Correlation of Galena Group sections from near Galena to near Belvidere	38
16	Characteristic bedding in the Galena Group	39
17	Characteristic fossils of the Galena Group	41

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ABSTRACT

The Platteville and Galena Groups are 300 to 350 feet thick in a large area in the central and northwestern parts of northern Illinois, where they form the surface of the bedrock and crop out extensively. These groups consist almost entirely of carbonate rocks and are quarried extensively for building material, agricultural limestone, and other uses. Although largely dolomite, both groups contain limestone in parts of the area. The carbonates are relatively pure and, except for a few thin units, contain less than 10 percent impurities, mostly argillaceous material and chert.

Vertical variations and lateral persistence of the impurities impart distinctive characteristics that serve as a basis for classifying the two groups into 10 formations, 32 members, and 9 beds. Other features including fossil abundance, corrosion surfaces, bentonites, and calcarenites characterize some units. Because most of the area has low relief and the outcrops expose only limited parts of the section, identification of the stratigraphic position of many of the outcrops requires the recognition of minor lithologic variations. In order to identify some units, it is necessary to make detailed comparisions of many geologic sections before subtle but persistent differences in lithology can be recognized.

To make this stratigraphy useful for economic and engineering studies and for areal geology and structural geology mapping, this report gives detailed descriptions of the units, establishes many reference sections, shows the general stratigraphic relations by cross sections, and maps the distribution of the Platteville and Galena Groups.

INTRODUCTION

The Platteville and Galena Groups of Ordovician age are the source of most of the crushed limestone and dolomite used for building purposes, concrete aggregate, road stone, and agricultural limestone in the central and western part of northern Illinois. They also contain the ores of lead and zinc mined in extreme northwestern Illinois. In the Dixon area part of the Platteville Group is used in the manufacture of portland cement.

These groups consist of a nearly continuous sequence of carbonate rocks about 350 feet thick. They are at the surface of the bedrock and are widely exposed in a region of about 2900 square miles (fig. 1). The Platteville and Galena Groups are not only a major mineral resource and an important reservoir for ground water, but their character and physical properties are a major consideration in engineering problems, especially those concerning excavations for foundations, highways, dams, and other structures. The nature of the bedrock formations is increasingly important in regional planning and in evaluation of the environmental impact of new construction.

The principal objectives of this report are (1) to describe the character of the various stratigraphic units in the Platteville and Galena Groups (fig. 2) that can be differentiated in northern Illinois, (2) to describe important reference sections exposed in natural outcrops and quarries, and (3) to present a map showing the distribution of the two groups at the bedrock surface.

Most of the data used in this report are based on studies of the outcrops. Samples and cores from borings are abundant in only a few local areas. Outcrops are particularly common in the extreme northern and western part of the area, where the streams are deeply entrenched. In a few places, 50 to 100 feet of the Platteville and Galena rocks are exposed. In most of the region, however, the valleys are much shallower, the hills of the broad uplands have gentle slopes, and exposures as much as 50 feet high are present in only a few quarries. In parts of the region, the overlying glacial drift is thin, less than 20 feet in large areas, and small exposures of the bedrock are abundant. In a large area extending from near Rochelle in Ogle County to the Rock River Valley near Plano in Kendall County, the glacial drift is thick, the bedrock is not exposed, and few borings penetrate the bedrock.

The ability to identify the stratigraphic position of the outcrops and of the samples and cores from borings is important for a number of reasons:

(1) Certain Galena and Platteville units are more suitable than others for particular uses of limestone and dolomite; the areas in which these units occur can best be located by knowledge of the detailed stratigraphy. Rocks from some parts of the section contain high-purity dolomite that is particularly desirable for concrete and asphalt aggregate and for agricultural stone. Some rocks have more attractive textures and better bedding for quarrying than others and thus have greater potential for building stone. Still other rocks have greater resistance to weather and are more suitable for uses in exposed places, such as riprap for protective embankments.

(2) Although the strata appear in most exposures to be flatlying, they are broadly warped into gentle anticlinal and synclinal structures. Therefore, the strata that crop out in one area may be eroded or deeply buried at the same elevation a mile or two away. The recognition and the mapping of these geologic structures depends on determination of the stratigraphic position and elevation of the many outcrops, supplemented by data from borings. Mapping the structures is important for evaluating sites for the underground disposal of waste materials and for the storage of gas and liquid petroleum products.

(3) In parts of the region the geological structures are more steeply folded, and faults are common. The faults range from many with 10 to 20 feet of displacement to a maximum displacement of about 800 feet in the Sandwich Fault Zone. As the fault planes are seldom exposed, recognition of the presence of a fault depends on recognizing that the strata in nearby exposures at the same elevation are not the same stratigraphic unit. Accurate identification of stratigraphic position permits evaluation of the displacement of the beds along the fault. Recognition of faults can be an important consideration in determining the suitability of a site for quarrying or for construction of major buildings and other facilities. It may be desirable to avoid larger faults because of broken rock in fracture zones and the possibility of abundant solution openings.

Differentiation of the units in a sequence that is almost entirely dolomite and limestone requires recognition of small differences in the lithology of the rocks. Familiarity with the criteria that distinguish the units can best be obtained by examining described sections in the field. The reference sections are described on pages 57 to 72, their locations are shown in figures 3a and b, and their relations are shown in cross sections (figs. 6, 7, 12, 13, 14, and 15). Many of the geologic sections described are skeletal sections, showing only the units present. The more fully described sections give only a summary of the detailed descriptions made in the field.

The area described is confined mainly to the outcrop belt in central-northern and northwestern Illinois. To better show the variations in lithology and thickness of the units that are buried or poorly exposed in Illinois, the bordering parts of the outcrop area in southern Wisconsin and a few exposures in northeastern Iowa are also

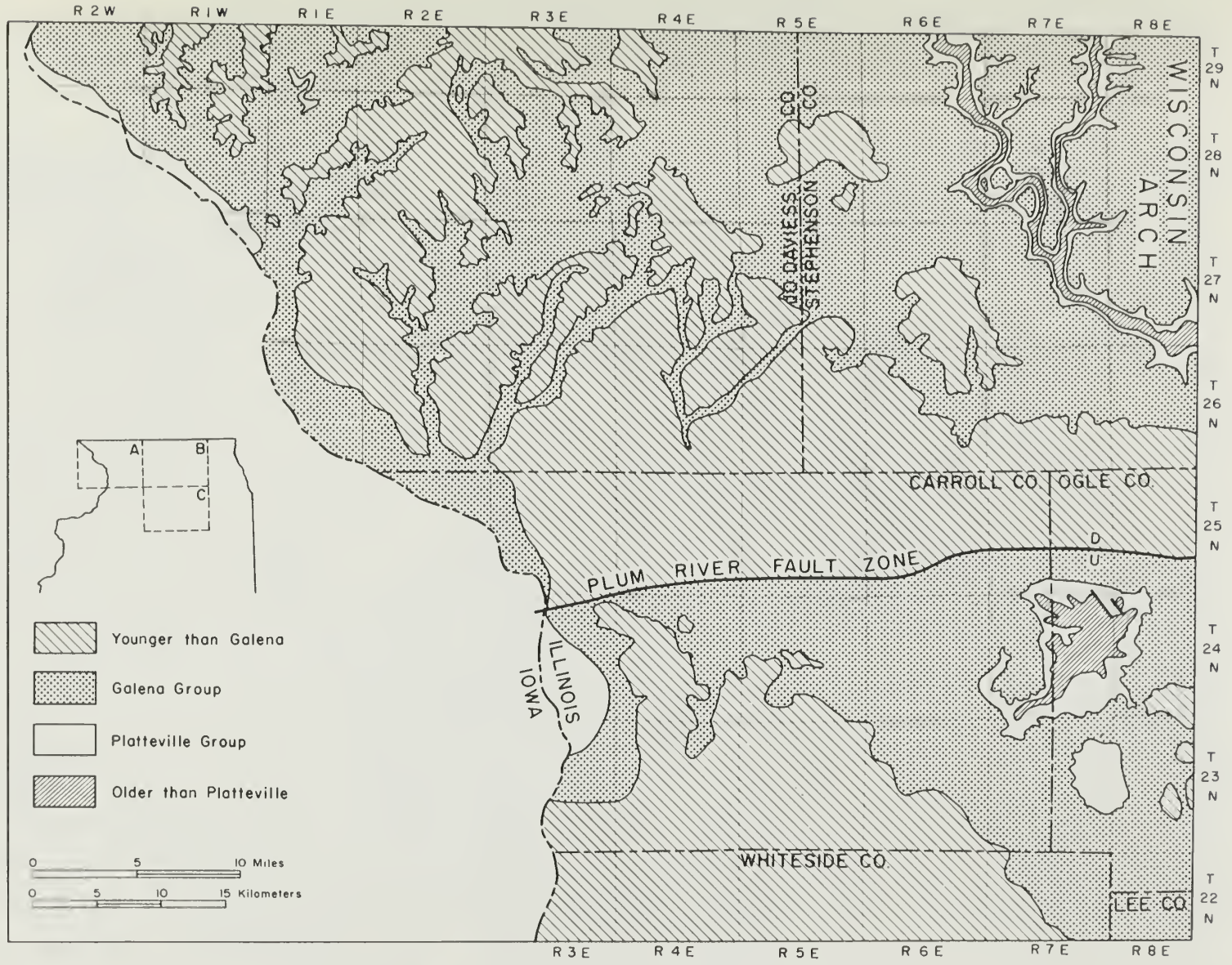

Figure 1A. Distribution of the Platteville and Galena Groups in northern Illinois.

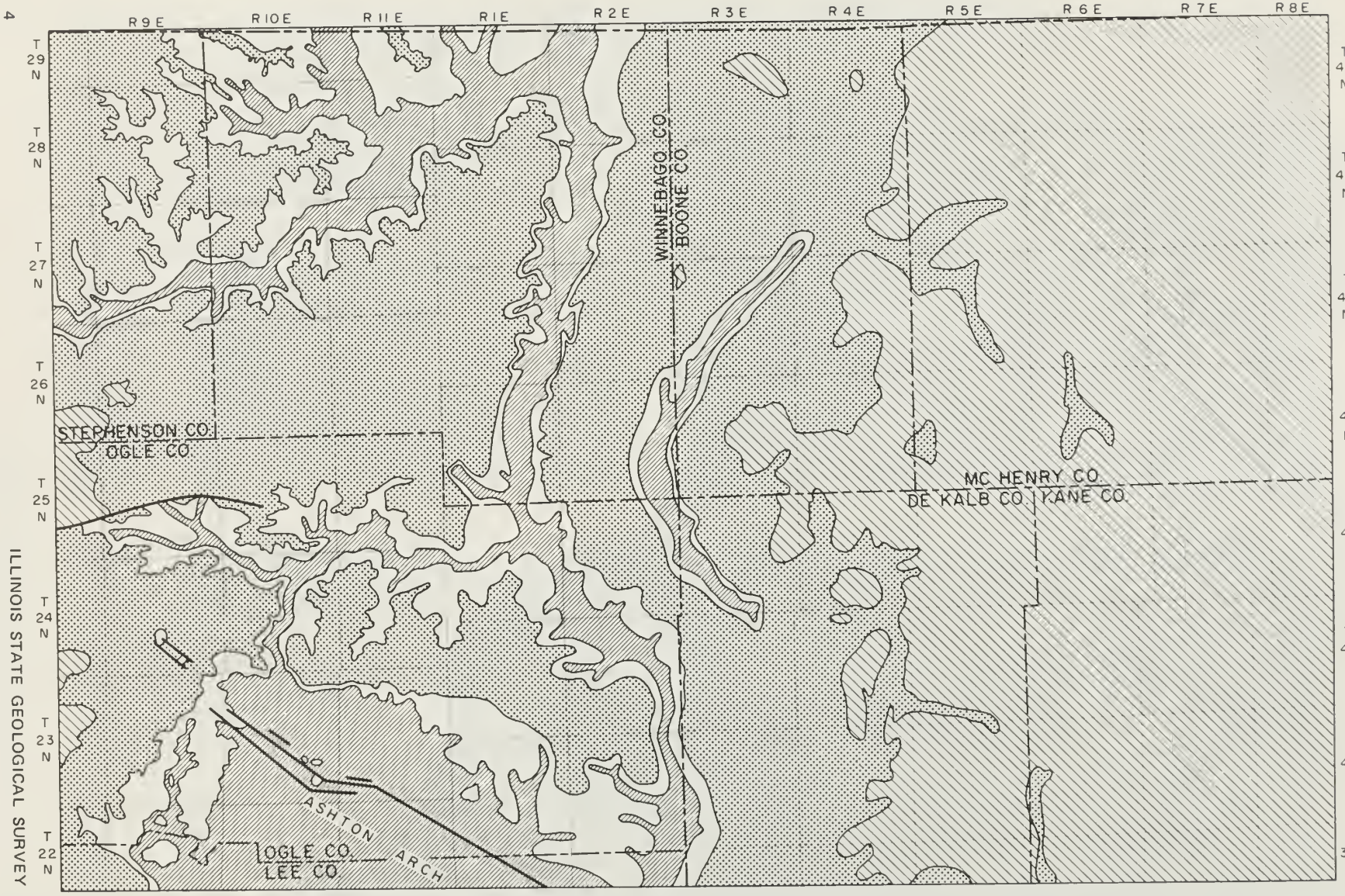

Figure 1B. Distribution of the Platteville and Galena Groups in northern Illinois.

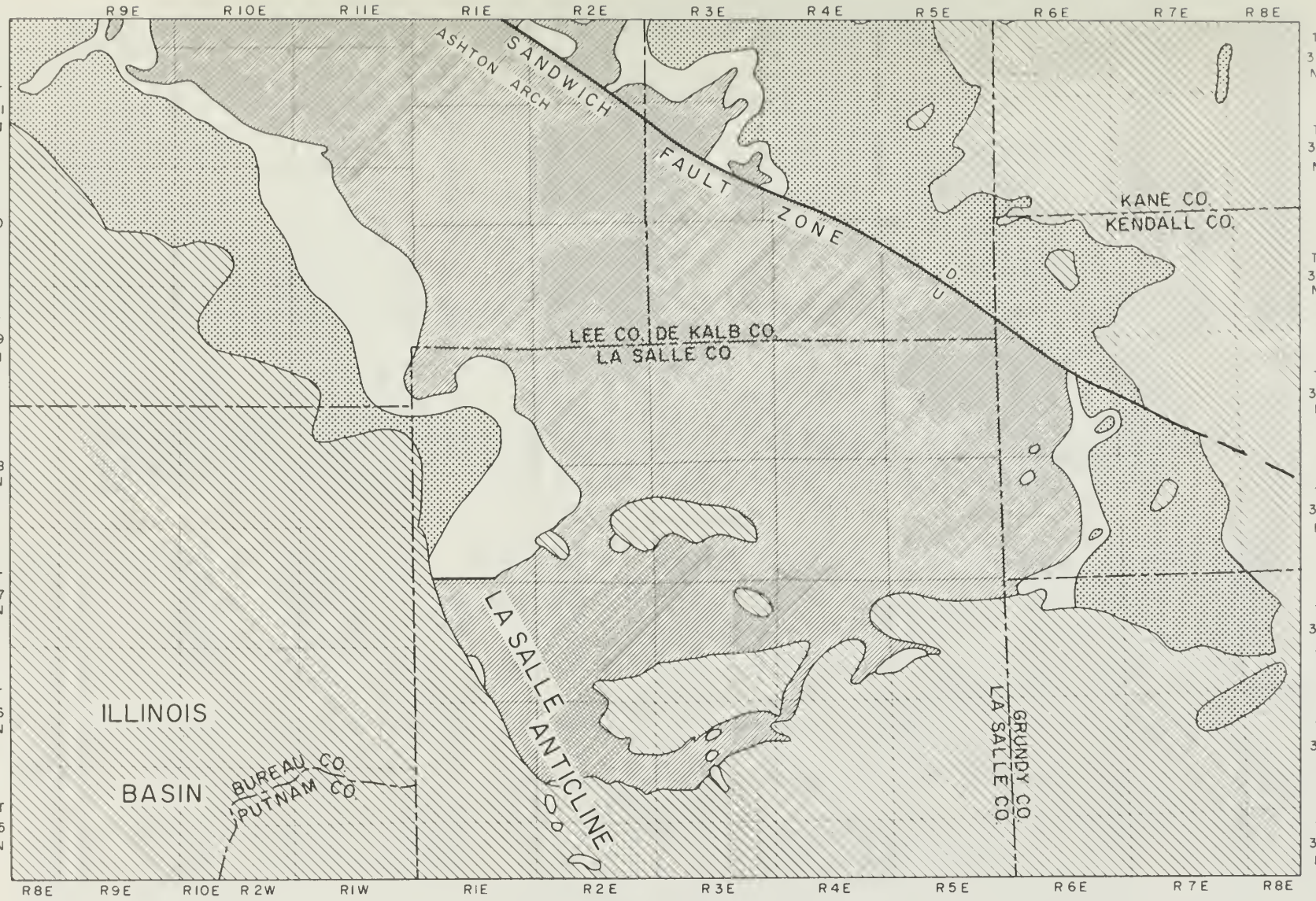

Figure 1C. Distribution of the Platteville and Galena Groups in northern Illinois.

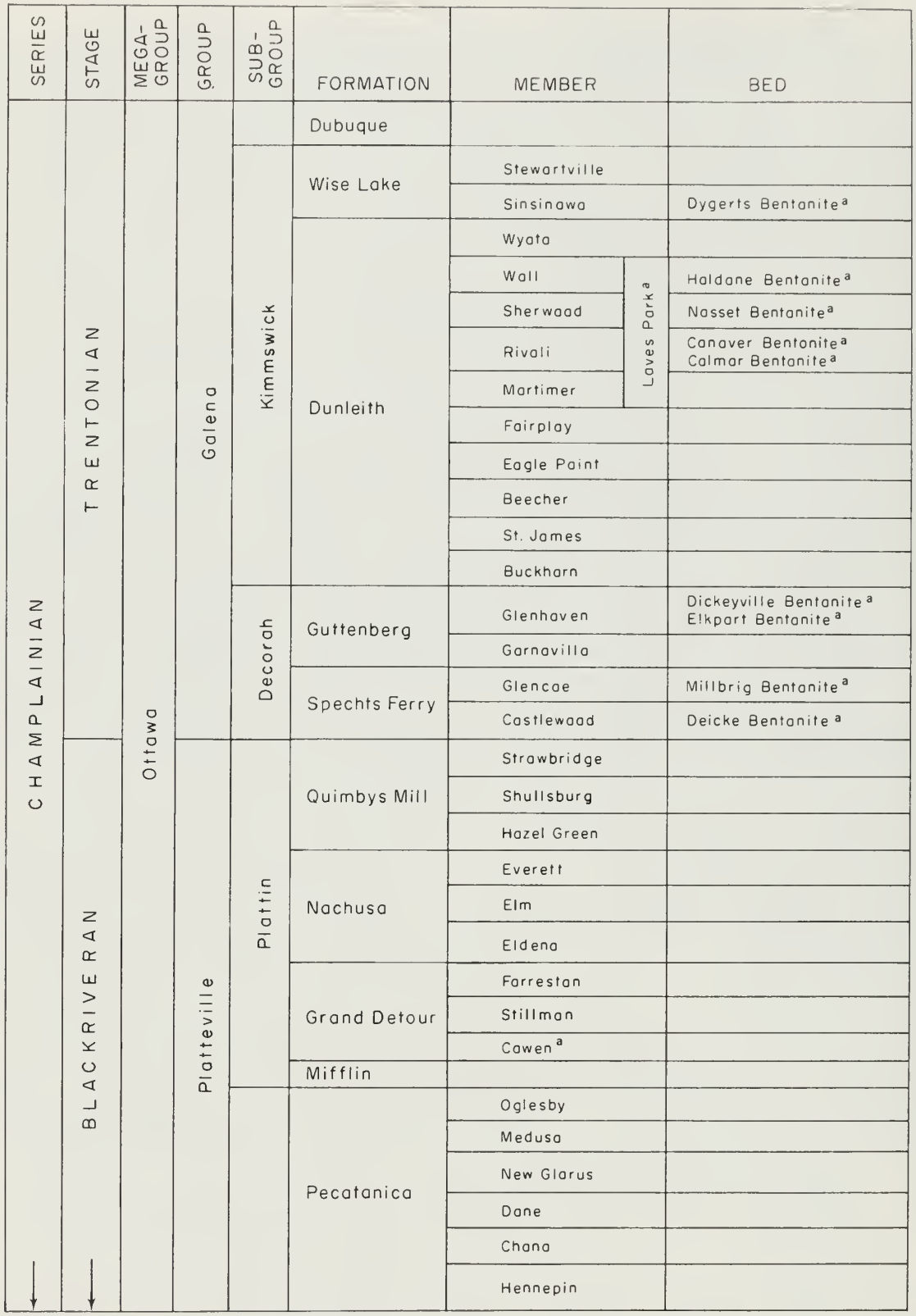

Figure 2. Classification of the Platteville and Galena Groups in northern Illinois.

included. The character and extent of the Platteville and Galena Groups in the subsurface in northeastern Illinois has been described by Buschbach (1964).

DISTRIBUTION

The distribution of the Platteville and Galena Groups in northern Illinois is related principally to the southward projection of the Wisconsin Arch. In Illinois the arch has gentle slopes, averaging about 20 feet per mile. Structurally, the highest part of the arch is in the general vicinity of Freeport in Stephenson County. Because of the gentle slopes, the two groups are at the top of the bedrock surface in a broad area (fig. 1). On the eastern slope of the arch, the Galena Group extends below the Maquoketa Shale Group a short distance east of Rockford along a highly irregular boundary, which results largely from deep preglaciation valleys in the bedrock surface. On the west slope of the arch, the Galena and Platteville Groups decline southwesterly, but underlie much of the surface to the edge of the Driftless Area. In the Driftless Area, deep valleys cut into the Galena strata, but the top of the Platteville Group is exposed only locally along the Galena River.

In the southern part of the outcrop region, the more or less symmetrical configuration of the Wisconsin Arch is terminated by two major fault zones—the Sandwich and Plum River Fault Zones—and by the Ashton Arch and La Salle Anticline, which also bring the Platteville and Galena Groups to the surface of the bedrock. The Platteville Group is generally best exposed near the Sandwich Fault Zone and the Ashton Arch and also on the higher part of the Wisconsin Arch along the Illinois-Wisconsin state line.

STRATIGRAPHIC CLASSIFICATION

The classification of the Galena and Platteville Groups conforms to previous policy (Willman, Swann, and Frye, 1958; American Commission of Stratigraphic Nomenclature, 1961; Templeton and Willman, 1963[1]; Willman and others, 1975). The strata are differentiated in five formal classifications—rock stratigraphy, biostratigraphy, unconformity-bounded units, time-stratigraphy, and geologic time—and in one informal classification—facies classification. The geologic-time classification is based on, and is essentially parallel to, the time-stratigraphic classification. All strata belong to some formation in the rock-stratigraphic classification and to some system in the time-stratigraphic classification. Other units and other classifications are used only where needed.

[1] Subsequent references to ISGS Bulletin 89 by J. S. Templeton and H. B. Willman, 1963, are abbreviated to (T and W, 1963).

Rock-Stratigraphic Classification

The rock-stratigraphic classification is designed to differentiate units that are recognizable in the field on the basis of lithologic characters, and therefore are practical units used for most stratigraphic, economic, and engineering purposes and for geologic mapping.

The dominantly carbonate strata of the Platteville and Galena Groups are characterized by very subtle vertical and horizontal variations in lithology. Detailed studies of many sections by Templeton and Willman (1952, 1963) showed that the sequence could be subdivided into a number of widespread units based mainly on the relative amount of clay and silt, small variations of which affect the physical appearance of the strata. The argillaceous units tend to be finer grained, denser, less dolomitic, and thinner bedded and weather to a lighter colored, smoother vertical face than the purer carbonate units, which are vesicular and vuggy where dolomitic. Other features that are used in differentiating units include chert content, bedding, shale partings, corrosion surfaces, calcarenites, and some fossils. The development of the classification since the terms Galena (Hall, 1851) and Platteville (Bain, 1905) were introduced is shown by Templeton and Willman (1963, figs. 16, 19) along with earlier classifications. The principal studies of these strata since 1963 were made by Levorson and Gerk (1972, 1975) and Kolata (1975).

The classification developed by Templeton and Willman is based on relations throughout Illinois and most of the Upper Mississippi Valley. In the present report, the classification is modified to meet the particular needs in northern Illinois and to correct the miscorrelation of two Platteville sections that include type sections of several members.

The 300 to 350 feet of Platteville and Galena strata are differentiated into 1 megagroup, 2 groups, 3 subgroups, 10 formations, 32 members, and 9 beds (fig. 2). In some regions this entire section would be classified as one formation, but in other regions such as New York and Ontario, the degree of differentiation is comparable to that used here. This degree of differentiation is needed (1) to provide names for the many units that can be identified by minor variations in carbonate lithology and that have wide extent, and (2) to determine precisely the stratigraphic position of numerous small outcrops in extensive areas where the relief is less than 50 feet. This differentiation is particularly needed in heavily populated areas, such as northern Illinois, where the need for close stratigraphic control frequently arises.

The *formations* maintain the generally accepted requirements of adequate distinctiveness, thickness, and extent, and they can be recognized easily after examination of a few typical sections.

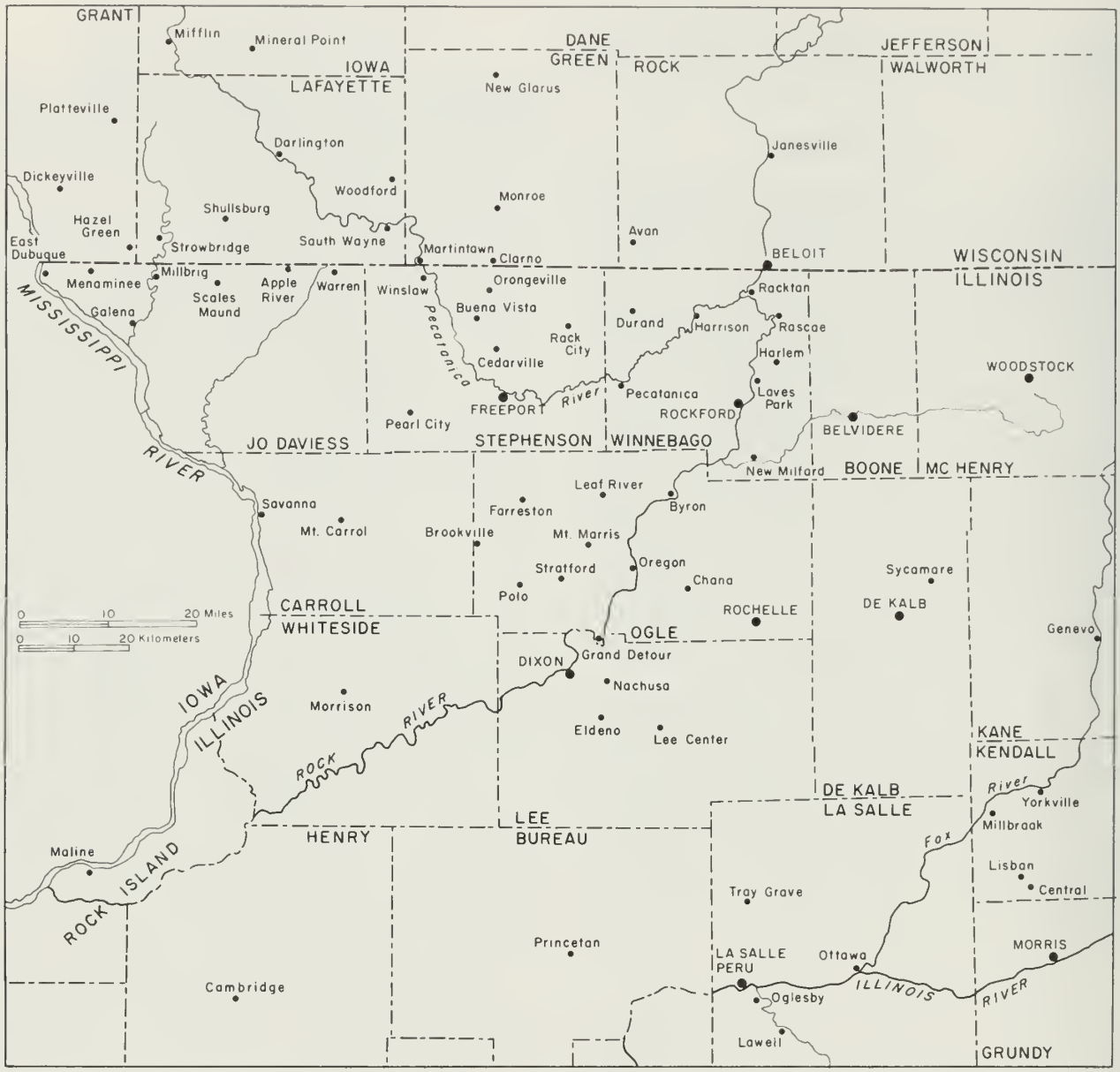

Figure 3A. Localities mentioned in the text.

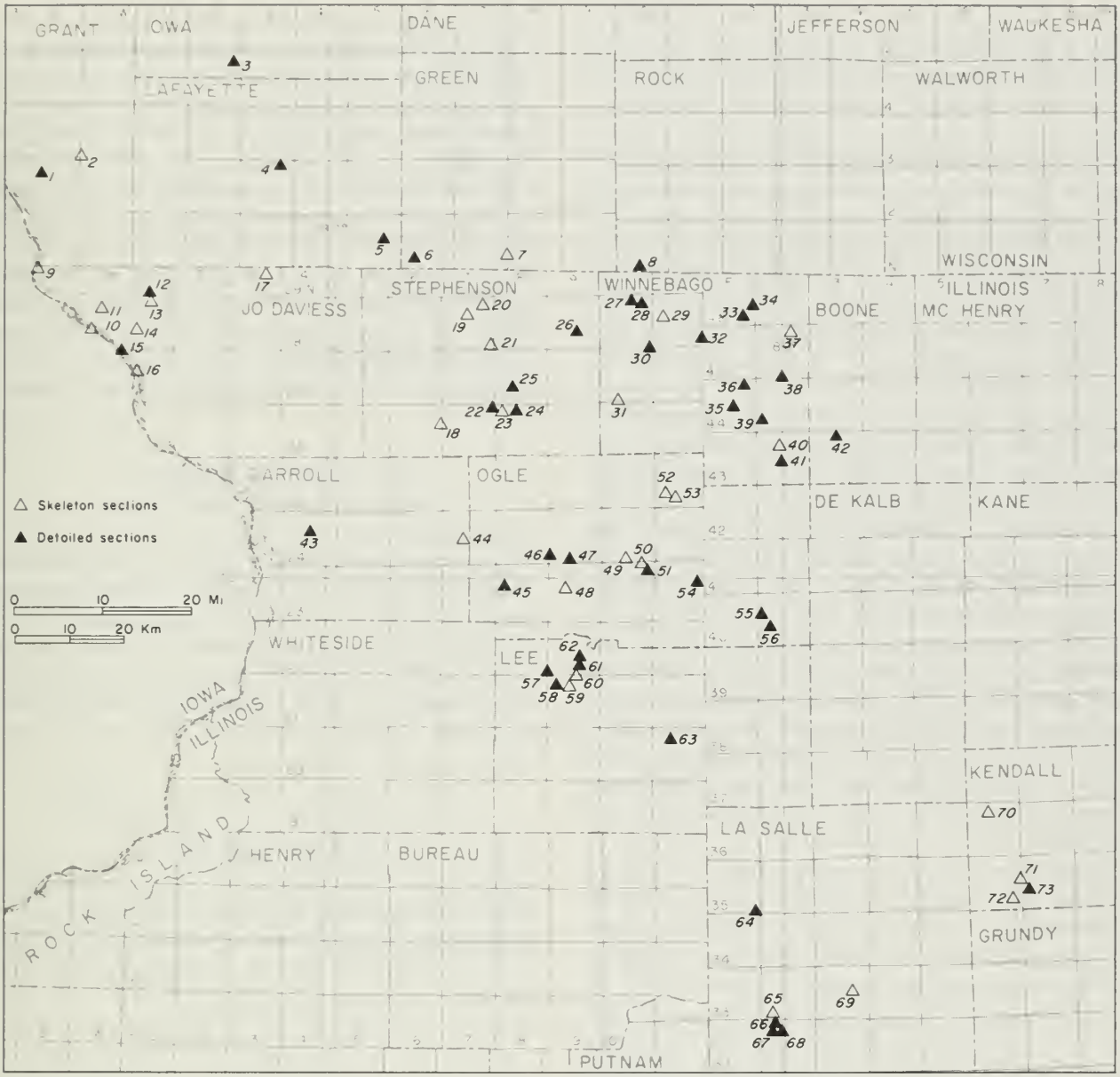

Figure 3B. Location of geologic sections in northern Illinois and southern Wisconsin. (Geologic section 74 is at Decorah, Iowa.)

In some formations the *members* are as distinctive as some of the formations, but are not thick enough to be formations. In others, the differentiation of members requires more detailed study and comparison with other sections before they become useful. Although helpful in confirming identification of formations and needed in identifications of the units in limited exposures, members are differentiated only where needed. In some areas the identifying characters become very weak, and only a few or none of the members of a formation are recognizable. Several members previously recognized in northern Illinois are very difficult to recognize; therefore, they are abandoned for use in that area in order to make the classification more practical.

The only units formally named as *beds* are certain bentonites that have wide distribution. The bentonites have previously been referred to by approximate position in a named unit, such as "the bentonite at the top of the Rivoli Member," or have been designated by a number, such as I-4 for bentonite No. 4 in Iowa (Mossler and Hayes, 1966). The first name is too long and clumsy, whereas the second lacks provision for including several bentonites not recognized by Mossler and Hayes, and probably others to be found. A few widespread bentonites have been given geographic names, following the standard practice for naming stratigraphic units. Nine bentonites in Illinois known to have wide distribution in the Upper Mississippi Valley are given formal geographic names. Those known only from one or two exposures are not named.

Groups and *subgroups* recognize similarities in the lithology of adjacent formations. They also serve to retain in the classification some long-established and valid names of larger units—names that are still used in other areas and that have meaning to many stratigraphers.

The *megagroup* recognizes the dominant carbonate character of the strata between the Ancell Group and the Maquoketa Shale Group—a unit commonly recognized, but not subdivided in drillers' logs of water wells and other borings. This unit is called the "Ottawa Megagroup" and is essentially equivalent to the combined Platteville and Galena Groups. As it is a broadly defined lithologic unit, its boundaries in places diverge from other rock-stratigraphic boundaries in order to include carbonate strata in the upper part of the underlying Ancell Group and similar strata in the lower part of the overlying Cincinnatian Series.

Biostratigraphic Classification

Units differentiated on the basis of their fossil content are called *zones* and are given fossil names. In the Platteville and Galena Groups, the zones named are primarily zones of exceptional abundance of a particular fossil. None of the zones represent the entire range of the named fossil, and several of the fossils have recurring zones of considerable abundance. Many of these zones extend widely and are useful for correlation. However, the fossils are facies controlled, and their wide extent reflects the uniformity in lithology of the units over wide areas. Most of the zones terminate sharply at significant changes in facies. Only a few persist from very argillaceous or shaly facies into relatively pure facies. Still fewer zones terminate without notable change in facies. The Platteville-Galena contact marks the principal vertical change in the fauna; many species terminate and others begin at that contact.

Classification of Unconformity-Bounded Units

The unconformities that have broad regional extent are used to bound rock units, called *sequences*. Sequences were deposited during intervals of relative structural stability, and they have generally uniform sources of the sediments. The Platteville and Galena Groups are in the Tippecanoe Sequence, which in this region includes all the strata from the sub-St. Peter unconformity to the sub-Middle Devonian unconformity.

Facies Classification

Rock units that are dominantly of one lithologic type, or that are characterized by one or more distinctive properties and therefore are believed to represent a uniform environment of deposition, are recognized as facies. Because an almost unlimited number of facies can be recognized (most units of the rock-stratigraphic classification have several facies), no formal facies classification is recognized. Some of the prominent lateral variations recognized as facies are identified by a lithologic name, such as the "shaly limestone facies" of a particular rock-stratigraphic unit.

Time-Stratigraphic Classification

Time-stratigraphic units, which serve as the basis for classification of geologic time, are bounded by time planes established in a type section and are independent of other stratigraphic boundaries. They are based largely on identification of characteristic fossils, particularly on the beginning or the ending of the range of certain fossils or assemblages of fossils. The Platteville and Galena strata belong

to the Champlainian Series. The Platteville strata comprise the younger part of the Blackriveran Stage; the Galena Group includes all strata of the Trentonian Stage in northern Illinois. Although time planes seldom follow precisely the contacts of rock-stratigraphic units, in most exposures the information is not adequate to establish a precise location, and for practical reasons, the boundary is placed at the nearest rock-stratigraphic boundary. It is apparent from the continuity and uniformity in position of the bentonites, which represent a single volcanic eruption, that the boundaries of most rock stratigraphic units, except at vertical cutoffs and facies changes, are at least close approximations of time planes and in fact permit a much finer local time classification than can at present be based on fossils.

Geologic Time Classification

As time is continuous, the geologic time classification includes not only the time represented by the rock units of the time-stratigraphic classification, but fills the intervals represented by hiatuses in deposition and the unconformities in the rock sequence. It uses the same terms except for the addition of a time unit term—the Champlainian Series of rocks was deposited during the Champlainian Epoch of time.

CHARACTER AND TERMINOLOGY

The Galena and Platteville Groups average about 90 percent carbonates—mostly dolomite and calcite. The remaining 10 percent consists of disseminated siliceous detrital minerals, beds of shale, nodules of chert, and relatively thin beds of bentonite and sandstone.

Limestone and Dolomite

Composition

The Platteville Group is about 80 percent dolomite in northern Illinois; 90 percent of the Galena Group is dolomite. Much of the Wise Lake Formation is high purity dolomite containing over 97 percent carbonates; parts of the Dunleith and Nachusa Formations are almost equally pure. The Stewartville Member of the Wise Lake is probably the purest unit, containing over 98 percent carbonates.

In the limestone facies some beds are high purity limestone, but much of the limestone is mottled with varied amounts of dolomite. In the Dixon area some of the moderately argillaceous and shaly beds in the Mifflin and Grand Detour Formations are low in dolomite and are used in the manufacture of portland cement.

Chemical analyses of several units are given by Bleininger et al. (1912), Krey and Lamar (1925), Willman (1943), and Lamar (1957). In Willman (1943) the units sampled are as follows: Samples 30, 38, 41, 135, and 140 are lower Dunleith; sample 55 is middle Dunleith; samples 36, 37, and 43 are Wise Lake; samples 40, 56, and L4 are Wise Lake (Sinsinawa Member); and samples 31, 33, 39, 44, and MC are Wise Lake (Stewartville Member).

Siliceous detrital minerals. The siliceous detrital (terrigenous) minerals, commonly called impurities, are finely distributed in the limestone and dolomite and consist largely of quartz in silt and sand-size grains and a variety of silicates, mostly clay minerals, feldspar, and heavy minerals. Much of the descriptive nomenclature of the carbonate rocks is based on the relative abundance of the detrital minerals. As shown by insoluble residues, the detrital minerals are generally less than 1.5 percent in the rocks described as *pure*. Most of the dolomite described as pure is highly vesicular and vuggy. The *slightly argillaceous* rocks commonly contain 1.5 to 3 percent insoluble residue, and the dolomite is generally slightly vesicular. Rocks with more than 3 percent of insoluble residue have an earthy or powdery weathered surface and are described as *argillaceous*, or *moderately argillaceous*. The dolomite is dense, like the limestone. The *very argillaceous* rocks have a tendency to weather shaly, and the residues are generally more than 10 percent. The term *shaly* limestone or dolomite is restricted to those beds that have a shaly appearance, even in fresh exposures. Most of the insoluble residues of the carbonates, like the shales, contain some silt. When the amount of silt is relatively high, generally enough to show on weathered surfaces, the limestone or dolomite is described as *silty*. Very few units average over 10 percent insoluble residue, except where interbedded shale is included as in the Mifflin Formation, the Forreston Member of the Grand Detour Formation, the Guttenberg Formation, the Buckhorn Member of the Dunleith Formation, and the Dubuque Formation.

Quartz is abundant in the siliceous detrital minerals, generally dominating in the insoluble residues that have a high content of silt. It occurs in angular grains, except in the few intervals that have "floating" sand grains such as the Chana Member of the Pecatonica Formation and, in extreme northwestern Illinois, the Buckhorn Member of the Dunleith Formation. The sand is largely medium grained and well rounded like the sand in the St. Peter Sandstone.

The clay minerals in the limestone and dolomite are the same as those in the interbedded shale and consist dominantly of illite. Clay minerals form the greater part of the less-than-2 micrometer (micron) fraction of the insoluble residues.

A relatively small amount of feldspar occurs in the detrital minerals, mostly as potash feldspar in the clay- and silt-size grains.

Heavy minerals are present in very small amounts in the insoluble residues, but are mostly of clay or very fine silt size and have not been studied.

Mottling. The term *mottled* is used primarily to describe the distinctive appearance of patchy areas of dolomite and limestone. On fresh surfaces, the dolomite is darker gray and coarser grained than the limestone. On weathered surfaces, the dolomite is rusty brown and the limestone is gray or light tan. In three dimensions, the dolomite areas consist of (1) small (1/8 to 1/2 inch) lenses or tubes fairly uniform in size and cross section and generally several inches long, and (2) bulbous, branching, interconnected bodies of various sizes, shapes, and abundance, most commonly 1/2 to 2 inches wide in cross section, and with no preferred orientation.

The contacts of both types of mottling show small crystals of dolomite invading the limestone, which indicates replacement of the limestone by dolomite after consolidation of the limestone matrix. The first type of mottling consists of dolomite replacement of the material filling animal burrows. The second type may have had a similar beginning, or it may have started in some slightly more porous area, but dolomitization has progressed to such a point that its initial shape can no longer be determined. Some beds, now entirely dolomite, have ghosts of an earlier stage of dolomitization—the older mottling being coarser grained because of repeated recrystallization.

Texture

The texture of the carbonate rocks is described in terms of present grain size and visible porosity. Diagenetic alteration of the primary texture ranges from mere compaction and cementation, which is accompanied by good preservation of the original constituents and depositional textures, to recrystallization and obliteration of all primary constituents.

Grain size. The grain size descriptions are estimates made in the field, commonly by the use of a hand lens, according to the Udden-Wentworth-NRC classification of clastic sediments, modified for carbonate rocks as shown in figure 4. Depositional grain size is given in the detailed descriptions when the primary constituents are well preserved.

The Platteville Group limestones and the northern limestone facies of the Galena Group consist largely of calcisiltite and calcilutite containing fossil debris that ranges from finely comminuted to whole, unabraded, often articulated shelly invertebrates. Thin lenses of calcarenite and calcirudite with sparry calcite cement occur but are a relatively small proportion of the limestones. Calcarenites, however, are common in the lower part of the southern limestone facies of the Galena Group. The upper part of the sequence in the southern limestone facies is fine grained but contains abundant comminuted shelly debris suspended in a fine-grained matrix.

Most of the dolomite rocks are fine or medium grained and have undergone various degrees of recrystallization. The dolomite rocks in the Platteville Group are generally fairly uniform in grain size, but those in the Galena have a characteristically abrupt variation from fine to medium in small, irregular patches within beds. The coarser-grained dolomite is more vesicular, which gives the rock a distinctively mottled texture. On weathering the coarser-grained mottled areas have a tendency to lose their cementing bonds, and the loosened grains fall out, or "sand out," to produce deeply pitted surfaces. Although some dolomitic rocks are extensively recrystallized, relict depositional textures are often preserved in the associated chert nodules.

Porosity. The porosity of the carbonates is described as dense, vesicular, or vuggy. The dense rocks have no visible porosity; the vesicular rocks have small openings; the rocks with openings larger than 1/4 inch are referred to as vuggy. Both vesicular and vuggy rocks are described in terms of relative abundance of the openings—slightly, moderately, or highly vesicular or vuggy. There is little correlation between visible porosity and total porosity. Some of the dense rocks, particularly those that are argillaceous, have a higher total porosity than those described as highly vesicular.

The limestones in the Galena and Platteville Groups are all dense rocks. The dolomites show the whole range of visible porosity. In general, the pure dolomites are the most vesicular and vuggy and the argillaceous dolomites are generally dense—the relative porosity showing a good correlation with the percentage of argillaceous impurities.

Bedding

Bedding planes in the Galena or Platteville range from very tight with almost no physical break and no recognizable change in composition to well defined bedding surfaces that are separated by a thin film of argillaceous material and commonly form prominent reentrants on weathered surfaces.

The thickness of beds is described as follows:

Size (mm)	Fraction name	Fragment	Aggregates[a]		Carbonates[a]	
			Unconsolidated	Consolidated	Depositional	Authigenic
256		Boulder	Boulder gravel	Conglomerate or breccia	Calcirudite	Conglomerate or breccia
128	Large					
	Small	Cobble	Cobble gravel			
64						
32	Very coarse	Pebble	Gravel			
	Coarse					
16	Medium					
8	Fine					
4	Very fine					
2						
1	Very coarse	Sand grain	Sand	Sandstone	Calcarenite	Coarse grained
	Coarse					
50	Medium					Medium grained
.25	Fine					
.125	Very fine					Fine grained
.0625						
.0313	Coarse	Silt grain	Silt	Shale: Siltstone	Calcisiltite	Very fine grained
	Medium					
0156	Fine					
.0078	Very fine					
0039						
.00195	Coarse	Clay particle	Clay[b]	Shale: Claystone	Calcilutite	Lithographic
	Medium					
.00098	Fine					
.00049	Very fine					

[a] Nomenclature is based on dominant size fraction

[b] Clay mineral analyses are made on the less than .002 mm fraction

Figure 4. Grain size of sedimentary rocks.

Very thin bedded - less than 1 inch
Thin bedded - 1 to 3 inches
Medium bedded - 3 to 12 inches
Thick bedded - 1 to 3 feet
Very thick bedded - more than 3 feet

The term *massive* is applied to any lithologic unit, regardless of thickness, that has no internal bedding planes. Very inconspicuous, discontinuous traces of bedding, commonly called incipient bedding, may be present in massive beds.

Laminations are units that are generally less than 1/4 inch thick, are uniformly parallel, and are marked by a change in color, texture, or composition. They may or may not be separated by a bedding plane.

Many of the bedding surfaces are stylolitic and vary from a faint roughness produced by solution interpenetration of the surfaces under pressure to conspicuous stylolites with an inch or two of interpenetration of adjacent beds. Stylolites are more abundant and show greater relief in some areas than in others; they are not diagnostic of any unit. Although generally more common in the pure units, especially the Wise Lake Formation, stylolites are particularly abundant in parts of extreme northwestern Illinois where they appear to be related to the corrosive effect of solutions that formed the lead-zinc ore bodies.

Some thin-bedded shaly units, like the Mifflin and Guttenberg Formations, are characterized by wavy, lenticular beds (figs. 8D and 16D) that closely resemble structures in recent sediments that are attributed to churning by burrowing organisms (Moore and Scruton, 1957).

Rarely, a wavy bedding surface with as much as 4 inches of relief truncates the underlying beds, which

indicates erosion probably caused by surge currents from storm-induced waves, or tsunamis. Such corrasion surfaces are entirely different from the flat, smooth, but pitted corrosion surfaces produced by solution of the sea floor.

Most units have a characteristic bedding both as to thickness of beds and the character of the bedding surfaces. Although far from uniform, particularly in thickness, the bedding in many units gives the impression of rhythmic sedimentation. This may have resulted from stable intervals of carbonate accumulation that alternated either with intervals of nondeposition of carbonates and only the continuing, slow accumulation of the fine terrigenous sediment, or from an abrupt and brief influx of terrigenous material and no decrease in carbonate sedimentation. The bedding planes may represent an interval as long as the interval of carbonate deposition. The cyclic nature of the sediments appears to be related to widespread events in the history of the basin; some bedding planes consequently have great continuity.

Corrosion surfaces

The Galena and Platteville Groups contain numerous distinctive bedding surfaces that have been called "corrosion zones" (Weiss, 1958), "corrosion surfaces" (T and W, 1952, 1963), and "discontinuity zones" (Levorson and Gerk, 1972). These surfaces are generally very flat and smooth, cutting across irregularities in the underlying bed and, in places, truncating one or more thin beds. The smooth surface is broken by steep-sided irregular pits as much as 4 inches deep but more commonly 1/4 to 1/2 inch deep. Most of the pits are filled with material like that in the overlying bed, but some are filled with gray or green, rarely red, clay. In some places the corrosion surfaces have a black rim and stand out prominently, but in other places close examination is required to find them. In a part of the section they occur in clusters, as many as 5 or 6 within a foot. A few of the most prominent surfaces, such as the upper contacts of the Pecatonica and Quimbys Mill Formations, are highly pyritic and are strongly stained with limonite. Corrosion surfaces are more abundant in the Galena than in the Platteville, and they are particularly common in the Dunleith Formation.

Although the stylolitic surfaces, with which corrosion surfaces can be confused, are the result of interpenetration of beds by solution under pressure, the corrosion surfaces were formed before the overlying bed was deposited. They are believed to indicate solution on the sea floor during an interval when a change in the chemistry of the water favored the solution rather than the deposition of carbonates.

Many of the corrosion surfaces have great continuity. For example, the corrosion surface on top of the Pecatonica Formation has been traced from Oglesby, in La Salle County, to Minneapolis, Minnesota. The widespread continuity of the corrosion surfaces and their usefulness in the identification of certain units, particularly in the Galena Group, has been demonstrated recently in Iowa (Levorson and Gerk, 1972).

Shale

Thin beds of shale, mostly calcareous or dolomitic, are characteristic of some units; most commonly, the beds separate thin to medium, generally wavy beds of limestone or dolomite. The shale beds are generally less than 1/8 inch thick, but in places they are as much as 1/4 to 1/2 inch thick. In some units, clay forms thin films on the bedding surfaces or occurs in thin lenticular streaks in the beds; these are referred to as clay partings. The clay minerals in the shales are dominantly illite. Small amounts of montmorillonite and kaolinite occur in some samples (nos. 2, 89, and 124, table 1).

In most units the shale has a sharp contact with the limestone or dolomite, but in the Dubuque Formation the contacts are gradational. The shales are green, red, brown, gray, and black. The color commonly is an important clue to identification of the unit. Green shale characterizes the Mifflin and Spechts Ferry Formations and the Buckhorn and St. James Members of the Dunleith Formation. Dark reddish brown shale characterizes the Guttenberg Formation and the Forreston Member of the Grand Detour Formation, as well as thin intervals in the Wall Member of the Dunleith Formation and the Dubuque Formation. Medium to dark bluish gray shale characterizes the Grand Detour Formation in fresh exposures, but it weathers readily to brown. A thin chocolate-brown shale bed marks the base of the Spechts Ferry Formation in most localities.

The red-brown color of the shale in the Guttenberg Formation appears to be related largely to the abundance of minute resinlike bodies, which are believed to be algal in origin. In the other reddish shales, the color appears to be due to the iron oxides that impregnate the clay. The color of the other shales may be related to differences in source areas, but the origin of the different colors has not been investigated.

Some beds of shale, commonly interbedded with shaly limestone or dolomite, are persistent marker beds and characterize the contacts between units.

Chert

Chert is abundant, highly persistent, and characteristic in some units but is absent or is a very minor constituent in others. The amount of free silica, mostly chert but including quartz in the siliceous detrital materials, probably

averages 5 to 6 percent in both the Platteville and Galena Groups. However, it is less than 0.5 percent in much of the Wise Lake Formation and in the relatively pure beds in other formations. Chert exceeds 10 percent only locally in a few relatively thin members.

The chert is dense, microcrystalline, and, in some cases, fossiliferous. It is mostly light gray, but in some units it is white, red-brown, or dark gray. It occurs mostly in smooth-surfaced, flattened nodules from 1 to 3 inches in vertical thickness. Irregular shapes occur, but there is very little intricate branching and interlocking. The nodules are 5 to 6 inches thick in a few beds, and locally they are welded forming an almost continuous bed of chert. The nodules are distributed mostly in bands in the middle parts of beds, rarely, if ever, crossing the major bedding planes. In some units, especially where the chert is not abundant, the nodules are more scattered.

Bentonite

The term bentonite is applied to distinctive beds of clay formed from the alteration of volcanic ash that was wind blown and was deposited over the sea bottoms. The volcanic ash devitrified in situ and was altered to montmorillonite. At this stage of alteration the clay beds were similar mineralogically to the type bentonite of Wyoming. Owing to compaction and metamorphism after burial, the expandable layers of the montmorillonite partially collapsed and the potassium content increased producing the present mixed-layer illite-montmorillonite structure (Grim, 1968, p. 567). In a few places, this material has recrystallized to monoclinic potash feldspar, thus changing from a clay to thin, hard, fine-grained beds that are generally pink. As the Paleozoic ash beds no longer have the montmorillonite composition of the type bentonite, they have been referred to by various authors as metabentonite, Ordovician bentonite, potash bentonite, and K-bentonite. Because the term bentonite commonly has been used stratigraphically as a general name for altered volcanic ash regardless of mineral composition, it is used in that meaning in this report.

Several beds of bentonite occur in the Galena Group, but only one is known in the Platteville Group. The bentonites are thin beds of nearly white clay with a "greasy" or smooth feeling when dry and very plastic when damp. The bentonites in northern Illinois are generally less than an inch thick and mostly less than 1/4 inch thick. The bentonites differ so much from the associated shales that they are readily identified even when as thin as 1/16 inch. In many localities the bentonite and bordering shale or limestone is strongly ferruginous.

Some samples of the bentonite contain an appreciable mixture of illite and kaolinite, probably largely because thinness of the beds makes it difficult to exclude shale from the samples. The Deicke Bentonite near the base of the Spechts Ferry Formation and the Dygerts Bentonite in the Wise Lake Formation are altered to feldspar in many places north of Illinois (Weiss, 1954; T and W, 1963) (geol. sec. 1), as also are two bentonites that occur in the Dubuque Formation, but have not been found in Illinois.

Because of its plastic character, the bentonite in many old exposures has been squeezed and washed out; its former presence is indicated only by an exceptionally sharp reentrant along a bedding surface that commonly is smooth surfaced. As a result, the bentonites are most commonly found in relatively fresh quarry faces and roadcuts.

Most of the bentonites previously identified by Templeton and Willman (1963) have been confirmed by more extensive sampling, and an additional bentonite locally present in the upper part of the Guttenberg Formation has been added. Bentonite found at several other horizons in the Galena Group elsewhere in the Upper Mississippi Valley probably will be found in Illinois. Also additional bentonites likely will be found in both the Platteville and Galena.

The bentonites seldom occur at the contacts between stratigraphic units. As they have a volcanic and wind-transported origin, they represent an interruption in the normal marine sedimentation—a brief interval in which the volcanic ash accumulated much more rapidly than the carbonate sediment. The bentonites, therefore, are excellent time markers. Because they have a consistent stratigraphic position throughout a wide area, the boundary surfaces of the stratigraphic units are also essentially time planes, or at least practical time planes.

Sandstone

Thin beds of sandstone occur in the Hennepin Member at the base of the Pecatonica Formation but are known at only one locality in Illinois (T and W, 1963). The sandstone is well sorted like that in the St. Peter Sandstone and is probably reworked from the St. Peter, rather than from the immediately underlying Glenwood Formation, which has a bimodal texture. Very thin lenses of sandstone also occur at or just above the base of the Spechts Ferry, as at the Dickeyville Northwest Section (geol. sec. 1), but they are not known in Illinois.

FOSSILS

The Platteville and Galena faunas are large and diverse; nearly every major invertebrate group known to occur in

the Ordovician shelly facies is represented. The general character of the faunas is described under each group.

Despite the abundance of well-preserved fossils, few taxa have been studied in detail; many existing collections have been gathered with insufficient stratigraphic information. As a result, many faunal relationships of these strata remain to be worked out.

A relatively sharp faunal break has long been recognized at the Platteville-Galena boundary and has been supported by recent studies of the trilobite (DeMott, 1963, fig. 6) and echinoderm (Kolata, 1975, fig. 4) faunas. These faunal differences are significant, mainly at the generic and specific levels. However, the higher taxonomic categories, relative abundances, and dispersals are quite similar in the two groups. Many Platteville species were largely replaced by other species in the interim represented by the unconformity between Platteville and Galena sedimentation. Both faunas were controlled by similar ecologic factors.

In addition to the shelly invertebrate fauna (body fossils), the Platteville and Galena rocks contain an abundance of intrastratal and bedding-surface trace fossils ("fucoids"). These features, which include mainly tracks, trails, and burrows, have resulted from the activity of organisms moving on or in the sediment at the time of its accumulation. Some trace fossils are abundant and distinct enough to be useful stratigraphic markers in parts of the Platteville and Galena section.

The most common trace fossils in the Champlainian rocks consist of the burrows and burrow systems commonly referred to as *Chondrites* (fig. 8C). These structures are branching, plantlike, cylindrical, tunnel systems ranging from 1/16 to 3/4 inch in diameter and may either be oblique or parallel to the plane of stratification. They occur in concave and convex forms partly in relief on bedding surfaces and in full relief within beds. Differences in composition between the burrow filling and host rock are often reflected in color and texture, thus producing a mottled appearance in sections transverse to bedding. Differential weathering of the burrows produces a vuggy or vesicular texture in some outcrops. In others, the burrow filling is completely dissolved away to produce a "worm eaten" texture. Many structures previously described as fucoids are interpreted herein as burrow structures.

Other common trace fossils in the Platteville and Galena rocks include forms such as *Phycodes*, *Planolites*, *Palaeophycus*, and *Palaeosynapta*.

Some elements of the Platteville and Galena faunas have been described by Meek and Worthen (1865, 1868), Ulrich and Everett (1890), Cooper (1956), Perry (1962), and Bork and Perry (1967, 1968a, 1968b).

ENVIRONMENT OF DEPOSITION

The abundant, diverse, well-preserved and poorly sorted fauna indicates that the Galena and Platteville rocks of northern Illinois were largely deposited in a stable, normal marine environment characterized by relatively low depositional energy. The currents were sufficient to supply food and oxygen to the large fauna of suspension feeders, but they were generally too weak to abrade and sort the abundant skeletal debris.

Thin lenses (up to 6 inches thick) of bioclastic debris indicating relatively high depositional energy, however, do occur in the Galena and Platteville. These lenses generally compose less than 5 percent of the vertical section at any given outcrop and consist of calcarenite and rarely calcirudite. Some lenses show graded bedding with coarse bioclastic debris in a sparry calcite cement grading upward to calcisiltite (fig. 8E). Most of these beds were very likely produced by surge currents resulting from storm-generated waves, or tsunamis. The currents were strong enough to scour the sea floor and temporarily suspend the fine calcareous mud and shelly debris. As the currents diminished, the larger shelly debris settled out first, followed by accumulation of finer and finer sediment, which resulted in graded beds.

Near Lowell, La Salle County (geol. sec. 68), and Central, Kendall County (geol. sec. 73), the lower part of the Galena consists predominantly of calcarenite. These calcarenites can be traced southward in the subsurface of central Illinois to the southern outcrop area, where they are equivalent to similar strata in the Kimmswick Subgroup. La Salle and Kendall Counties appear to be the northernmost extent of the southern calcarenite facies. These clastic rocks were deposited in a normal marine environment with relatively high depositional energy.

The calcarenite and slide breccia of the Oglesby Member of the Pecatonica Formation near Oglesby, La Salle County, Illinois, were probably deposited in a locally shallow area characterized by relatively high relief on the sea floor and by turbulent water, perhaps resulting from minor uplift along the La Salle Anticlinal Belt.

SOURCE OF THE SEDIMENTS

The carbonates are largely locally derived and are of organic origin. Much of the sediment was probably precipitated by the life processes of algae and other organisms, but finely comminuted shell debris contributes to the matrix in which shell fragments show little, if any, evidence of abrasion. There is no evidence that any of the carbonate is a direct inorganic precipitate.

Champlainian sediments covered the entire region eastward from Illinois to land areas along the eastern margin of the continent, northward at least to the Transcontinental Arch and the Hudson Bay Region, and westward to the Rocky Mountain Region. Consequently, the terrigenous sediments in the Platteville and Galena Groups in northern Illinois had to come from distant sources. There is slight change in the purity of the Platteville Group sediments throughout much of the Upper Mississippi Valley. However, the increase in argillaceous content in the northernmost exposures indicates that terrigenous sediments were coming from northern and northwestern sources. During Galena time, terrigenous sediments also came from a northerly direction. The relatively pure to slightly argillaceous sediments in central northern Illinois become more argillaceous in a north to northwest direction and become strongly shaly in Minnesota. In northeastern Illinois, east of the outcrop region, the Galena Group is of exceptional purity; the area apparently was in a part of the seas where only slight amounts of sediment were carried from either eastern or northern sources.

The source of the Platteville and Galena bentonites appears to have been from volcanic centers in the Appalachian mobile belt. This is suggested by the general thickening of most Champlainian bentonites toward the area of Virginia and North Carolina. Bentonites that are common in the Platteville Group in southwestern Illinois and eastern Missouri are not present, with one exception, in the same beds in northern Illinois. On the other hand, only one of the several bentonites in the Dunleith Formation of the Galena Group in northwestern Illinois and the Upper Mississippi Valley has been found in equivalent strata in southwestern Illinois and adjacent parts of Missouri. The differences in distribution of bentonites between the Platteville and the Galena could be due to changes in wind direction and/or marine currents, or to less favorable conditions for preservation of bentonites in some parts of the basin. For example, the calcarenitic character of the southern limestone facies of the Dunleith Formation suggests a high-energy environment in which the bentonites were not preserved.

TIME STRATIGRAPHY

Ordovician System

The Ordovician System (Lapworth, 1879), named for the type area in Wales, in Illinois is divided into three series—the Canadian (oldest), Champlainian, and Cincinnatian. The Platteville and Galena Groups described in this report are rock-stratigraphic units forming the upper part of the Champlainian Series.

Champlainian Series

The Champlainian Series (Schuchert and Barrell, 1914; Twenhofel et al., 1954) is named for exposures in the Lake Champlain region in New York state, but the term Middle Ordovician Series is currently used for these strata in New York (Fisher, 1962). In northern Illinois, the Champlainian Series includes the Ancell (at the base), Platteville, and Galena Groups. The series is subdivided into the Blackriveran and Trentonian Stages. The Platteville Group is the upper part of the Blackriveran Stage; the Galena Group includes all of the Trentonian Stage in Illinois.

The top of the Galena Group in Illinois can be traced to the top of the Trentonian rocks in the type region in New York (T and W, 1963), a correlation long accepted by many stratigraphers. However, others believe that the base of the type Cincinnatian is well below the top of the Galena; some place it as low as the base of the Stewartville Member of the Wise Lake Formation. This correlation was suggested by Foerste (1936) on studies of the cephalopods and has been supported by more recent studies of conodonts (Sweet et al., 1959; Schopf, 1966). If the latter correlations are correct, the Champlainian and Cincinnatian type sections overlap. In places the basal, dark colored Cincinnatian (Edenian) shale truncates the upper half of the Galena Group, but generally in New York, Ontario, Ohio, and Illinois, the distinctive upper Galena stratigraphic units are overlain by the basal Cincinnatian shales. Consequently, the terms Champlainian and Cincinnatian are retained pending more definitive paleontologic studies.

The base of the Champlainian Series was formerly placed at the base of the Platteville Group, and the Platteville was considered equivalent to Blackriveran. But tracing to the New York type region suggested that the Ancell Group in Illinois, below the Platteville, is also Blackriveran, which lowered the base of the Blackriveran to the base of the St. Peter Sandstone (T and W, 1963).

BLACKRIVERAN STAGE

The Blackriveran Stage (Vanuxem, 1842; Moore, 1949; Kay, 1960) is based on exposures along the Black River in western New York, where it is called the Black River Group. The time plane separating the Blackriveran Stage from the overlying Trentonian Stage is at the contact of the Platteville and Galena Groups in Illinois, a correlation long established (T and W, 1963) and supported by recent studies of the trilobites (DeMott, 1963) and echinoderms (Kolata, 1975). However, the tracing of lithologic units to the New York type section indicated that the Quimbys Mill Formation, which forms the top of the Platteville

Group in Illinois, thins out in southern Ontario and is not present in the New York section. The fauna of the Quimbys Mill associates it with the lower strata, so the Quimbys Mill Formation is included in the Blackriveran Stage. Also, the major physical break in the Platteville-Galena strata, as described later, is at the top of the Quimbys Mill Formation.

TRENTONIAN STAGE

The Trentonian Stage (Vanuxem, 1838; Kay, 1948, 1960) is named for Trenton Falls in New York, the type locality for the Trenton Group. The correlation of the Galena Group with the Trenton of New York was recognized early in the nineteenth century, but for many years the strata now called Platteville were also included in the Trenton. Later the term Trenton was restricted, inappropriately, to the Platteville. However, Bain (1905) corrected this usage by introducing the name Platteville for the strata then called Trenton.

The tracing of the lithologic units to the type Trentonian area in New York (T and W, 1963) indicated a close matching of lithologic units, general accordance with the faunas described at that time, and equivalence of many of the bentonites.

ROCK STRATIGRAPHY

Platteville Group

The Platteville Group (Bain, 1905, p. 18-21; Calvin, 1906, p. 60-61; T and W, 1963, p. 63) is named for Platteville, Wisconsin, which is 4 miles east of the type locality along the Little Platte River. A more accessible and complete exposure in a roadcut 5 miles southwest of Platteville (SE SW SE 1, 2N-2W), where the group is 53 feet thick, was suggested as an alternate (T and W, 1963) (geol. sec. 2).

Distribution and thickness. The Platteville Group (fig. 5) is widely exposed in central northern Illinois (fig. 1), in a small area along the Galena River in northwestern Illinois, in a few exposures in La Salle County, and in shallow exposures near Lisbon in Kendall County in northeastern Illinois. It is about 45 feet thick in Jo Daviess County, northwestern Illinois, but it thickens eastward to 115 feet at Rockford and 135 feet at Dixon (figs. 6 and 7).

Lithology. The Platteville Group consists of five dolomite and limestone formations differentiated largely on differences in argillaceousness and shaliness; members are differentiated on similar but less conspicuous differences (fig. 5). The amount of argillaceous material in the individual unit changes only slightly throughout the region. In general, the Platteville formations are finer grained and thinner bedded than the Galena formations and are gray rather than brown (fig. 8). However, the Pecatonica and Nachusa Formations are exceptions. Both of them resemble and occasionally are mistaken for the Galena. The Platteville formations are dominantly dolomite in the northern Illinois outcrop area, but they are limestone and dolomite-mottled limestone in the Dixon and Oglesby areas and in extreme northwestern Illinois. The Pecatonica Formation is more consistently dolomite than the younger formations. The younger formations are equivalent to the type Plattin in Missouri. Because of the general differences in lithology from the Pecatonica, they are recognized in Illinois as the Plattin Subgroup.

Fauna. The Platteville Group contains a discrete and homogenous fauna with no apparent evolutionary gradations. Few species are known to be confined to a particular Platteville unit, but the relative abundance of some species is useful in identifying stratigraphic units (fig. 9).

The Platteville contains a diverse, abundant, and locally well-preserved fauna that includes sponges, solitary and colonial corals, conularids, cornulitids, conodonts, graptolites, bryozoans, brachiopods, bivalves, gastropods, cephalopods, trilobites, ostracodes, and echinoderms. The brachiopods and bryozoans are the most conspicuous elements of the fauna. Among the brachiopods, the strophomenid *Öpikina minnesotensis* (N. H. Winchell) (figs. 9, T and U) is probably the single most abundant and widespread species, but in total numbers the orthids, represented mainly by *Hesperorthis concava* Cooper (fig. 9P), *Doleroides pervetus* (Conrad), *Campylorthis deflecta* (Conrad) (fig. 9S), and *Pionodema conradi* (N. H. Winchell) are more abundant. The bryozoans are represented by a number of small trepostomes and cryptostomes.

The most abundant and best preserved fossils occur in the argillaceous units, particularly in the Dane Member of the Pecatonica Formation, the Mifflin Formation, and the Forreston Member of the Grand Detour Formation. Fossils are most conspicuous on exposed bedding surfaces.

No faunal differences were observed between the dolomite and limestone facies. Species appear to occur with the same frequency in both facies.

Stratigraphic relations. The Platteville Group rests unconformably on the Ancell Group, evidenced by the common occurrence of phosphatic pellets and nodules and also fragments of the underlying Glenwood Formation in the basal Platteville strata—the Hennepin Member of the Pecatonica Formation. In addition, the top of the Ancell is locally a wavy, scoured surface. The Hennepin is erratic in

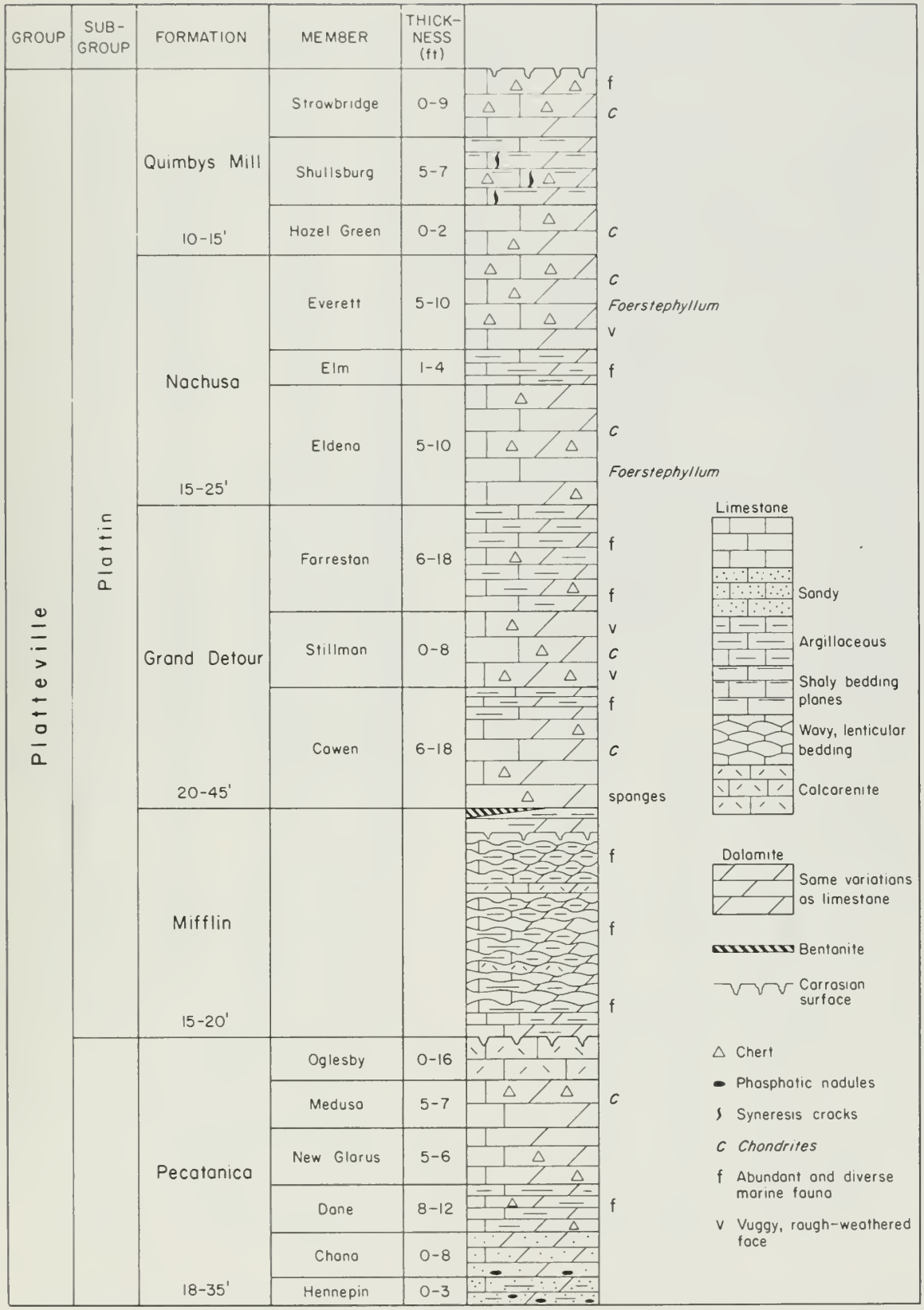

Figure 5. Columnar section of the Platteville Group

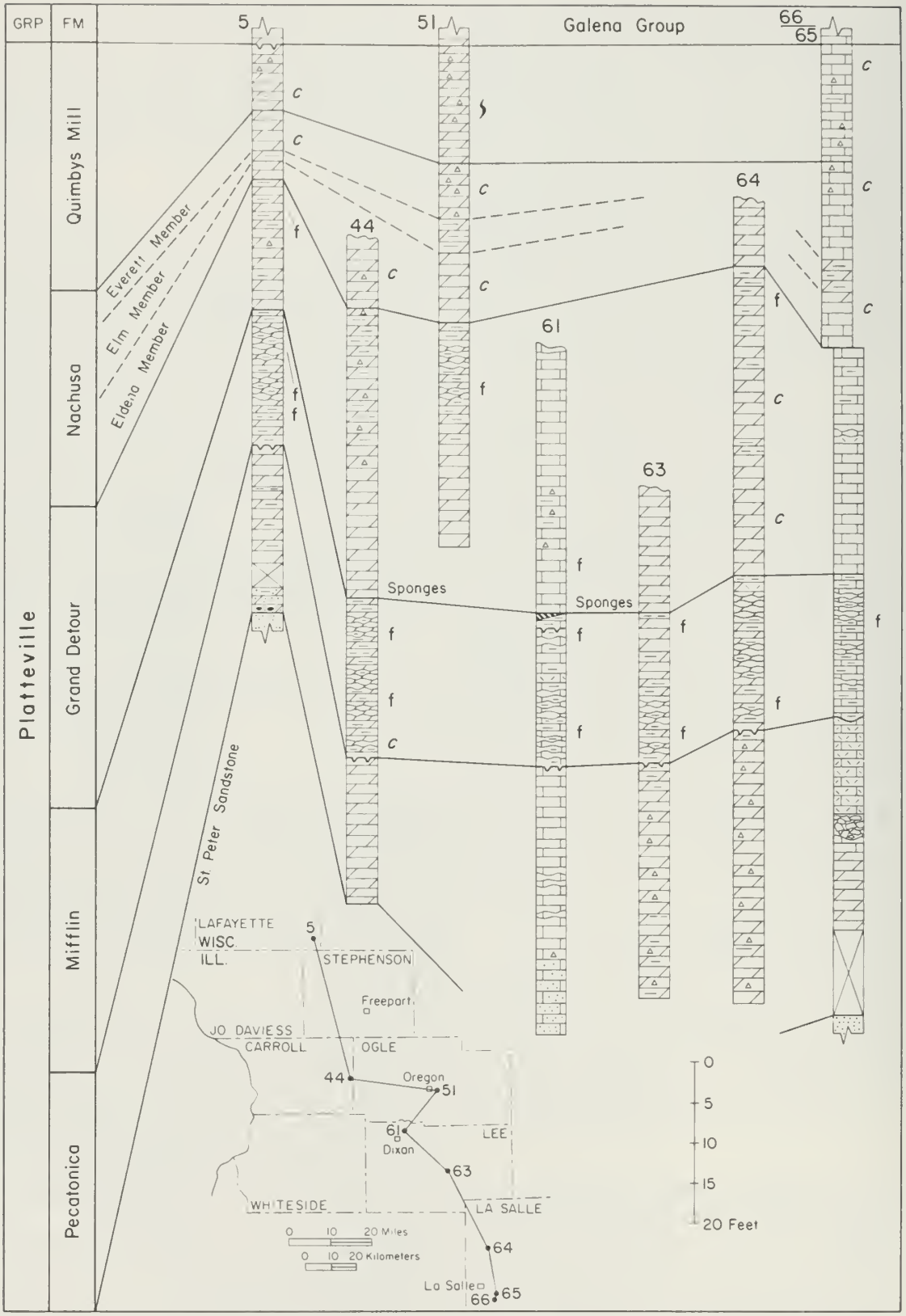

Figure 6. Correlation of Platteville Group sections from South Wayne, Wisconsin, to near Oglesby, Illinois. Column numbers refer to Geologic Sections, p. 57. See figure 5 for symbols.

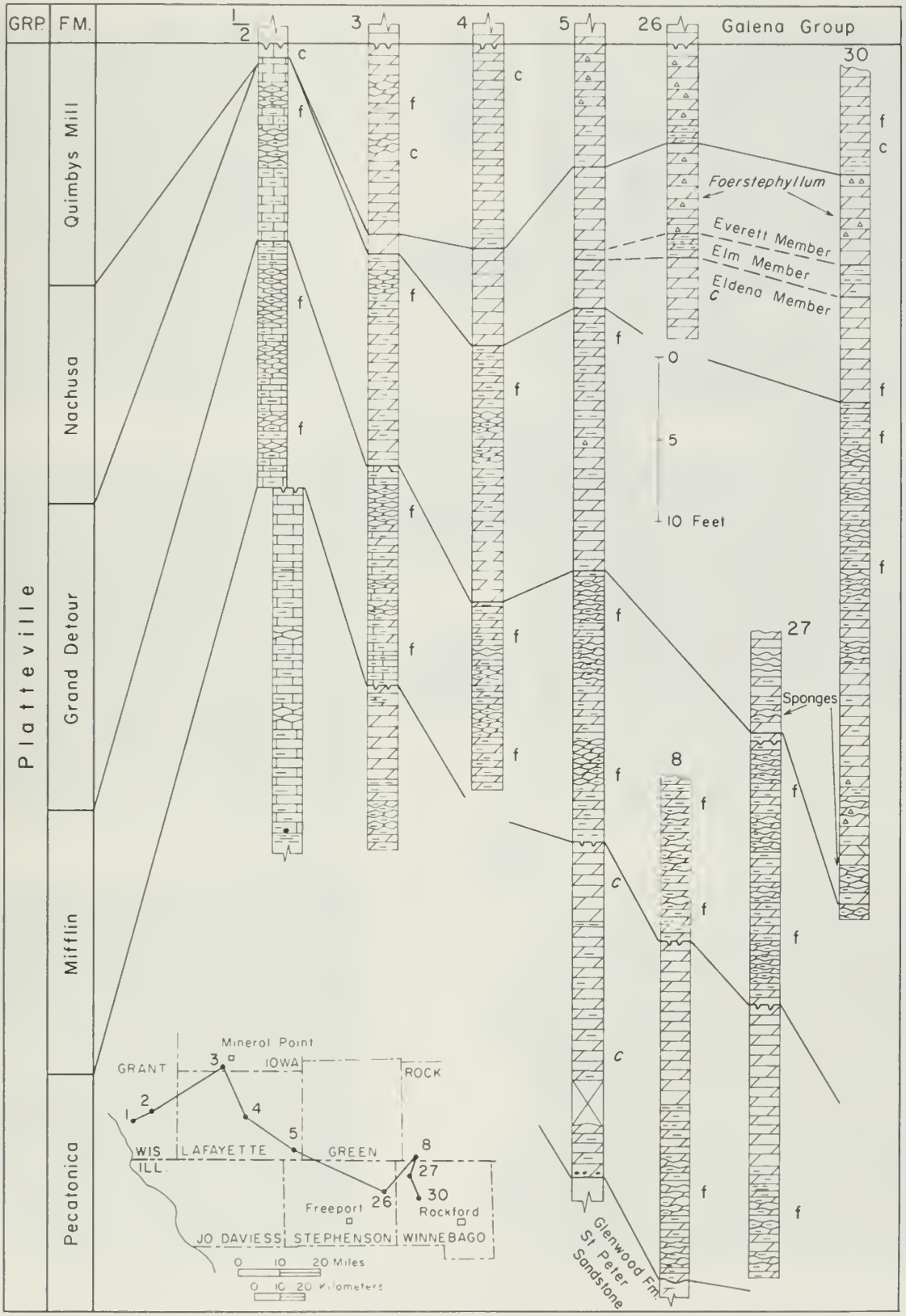

Figure 7. Correlation of Platteville Group sections from near Dickeyville, Wisconsin, to near Durand, Illinois. Column numbers refer to Geologic Sections, p. 57. See figure 5 for symbols.

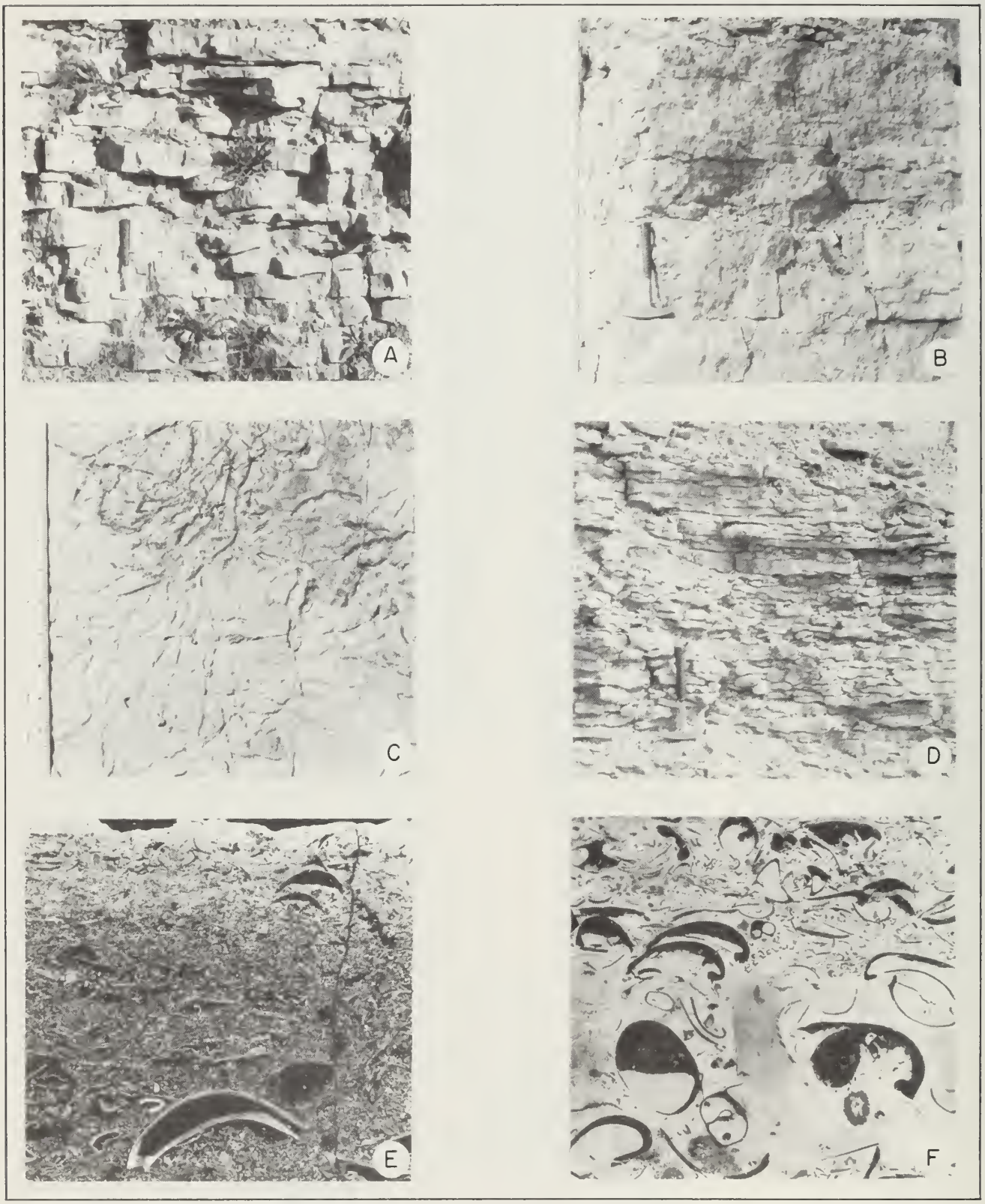

Figure 8. Bedding and textures of Platteville strata. A - Quimbys Mill Formation (geol. sec. 56), B - Nachusa Formation (geol. sec. 56), C - *Chondrites* on bedding surface in Cowen Member of Grand Detour Formation (geol. sec. 64), D - Mifflin Formation (geol. sec. 61), E - graded bed of fossil debris from the Mifflin Formation (geol. sec. 61), F - shelly invertebrates suspended in fine-grained matrix, Mifflin Formation (geol. sec. 61), E and F are X 1.

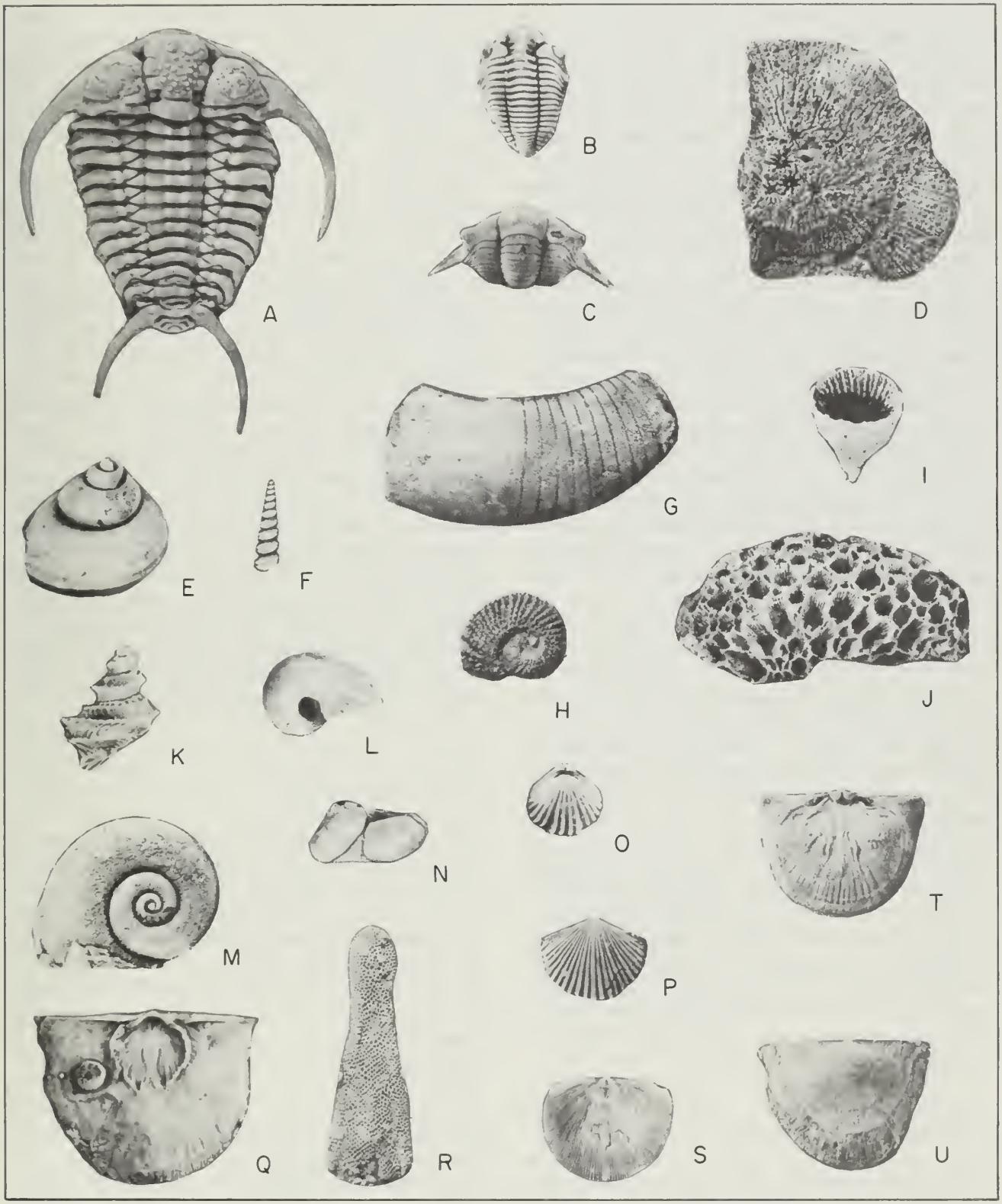

Figure 9. Characteristic fossils of the Platteville Group. A - *Ceraurus* sp., B - *Encrinurus* sp., C - *Thaleops ovata* Conrad, D - *Anthaspidella* sp., E - *Clathrospira* sp., F - *Ectomaria* sp., G - *Richardsondoceras* sp., H - *Phragmolites* sp., I - *Streptelasma* sp., J - *Foerstephyllum* sp., K - *Lophospira* sp., L - *Tetranota* sp., M - *Maclurites* sp., N - *Eoleperditia fabulites* (Conrad), O - brachial valve exterior of *Rostricellula minnesotensis* (Sardeson), P - pedicle valve exterior of *Hesperorthis concava* Cooper, Q - pedicle valve interior of *Strophomena plattinensis* Fenton, R - *Leptotrypa hexagonalis* Ulrich encrusting *Hyolithes baconi* Whitfield, S - brachial valve exterior of *Campylorthis deflecta* (Conrad), T and U - brachial valve interior and pedicle valve exterior of *Öpikina minnesotensis* (N. H. Winchell), all X 1.

occurrence, and in places higher Pecatonica strata, generally the Chana Member, rest directly on various members of the Glenwood Formation. Not uncommonly, the Glenwood, which has a maximum thickness of about 25 feet in most of northern Illinois, is entirely absent, and the Pecatonica rests directly on the St. Peter Sandstone, locally filling distinct channels in the sandstone, as in the Covel Creek area near Ottawa (geol. sec. 69). However, the persistence of the Glenwood Formation suggests that the unconformity resulted from a slight, regional movement without significant local warping.

The Platteville Group is separated from the overlying Galena Group by a minor unconformity, which is indicated by a prominent, widespread corrosion surface on the top of the Platteville, by the westward thinning and disappearance of the Quimbys Mill Formation at the top of the Platteville, by the eastward thinning and disappearance of the Spechts Ferry Formation at the base of the Galena Group, and by the regionally significant change in the fauna at the contact. The eastward thinning of the Spechts Ferry suggests a slight uplift of the Wisconsin Arch, which may be related to the tectonic event that resulted in uplift and consequent unconformity at this stratigraphic position on the northern flank of the Ozark Dome.

The contacts between the Platteville formations are generally sharp but conformable; they indicate a change but not an interruption in sedimentation. However, the top of the Pecatonica Formation is an exception as it has a prominent, limonitic corrosion surface that indicates at least an interruption in sedimentation. Although the Platteville formations overlying the Pecatonica Formation tend to be similar in character, the Pecatonica is independent from them, differing in area and extent of dolomitization and direction of thinning. The two uppermost formations in the group thin out northward and are absent in much of the Upper Mississippi Valley, but the Pecatonica continues to the northern limit in the Minneapolis region. On the flanks of the Ozark Dome in the St. Louis region, the Pecatonica thins out and is overlapped by the younger Platteville formations. Despite these differences, the Pecatonica is more allied to the overlying formations than to the Ancell Group below and, therefore, is included in the Platteville Group.

Correlation. The name Platteville is used only in the Upper Mississippi Valley, where some authors still classify it as a formation. The Glenwood Formation, which we assign to the underlying Ancell Group, is included in the Platteville by some authors. The Platteville is equivalent to most of the Black River in Indiana and Michigan, to the upper part of the High Bridge in Kentucky, to the upper Stones River in Tennessee, and to the part of the Black River above the Pamelia in New York. It is also equivalent to part of the Simpson in Oklahoma and to the Winnepeg in Manitoba, both of which include strata younger and older than the Platteville (T and W, 1963).

Plattin Subgroup

The Plattin Subgroup (Ulrich, 1904, p. 111; Weller and St. Clair, 1928, p. 109-110; Martin, Knight, and Hayes, 1961, p. 27; T and W, 1963, p. 70) is named for exposures along the lower part of Plattin Creek, Jefferson County, Missouri. The Plattin Subgroup consists of all the Platteville formations above the Pecatonica Formation, including the Mifflin, Grand Detour, Nachusa, and Quimbys Mill Formations. It ranges from 50 to 100 feet thick. The Pecatonica Formation is absent along Plattin Creek, and the type section, therefore, conforms to the usage in Illinois. The Plattin Subgroup is separated from the Pecatonica Formation below by a widespread corrosion surface. In some areas, the base of the Plattin marks a prominent lithologic change from dolomite below to lithographic limestone above. The top of the Plattin is also a widespread corrosion surface that marks the top of the Platteville Group. In Missouri the Plattin is classified as a formation, and it includes strata from the top of the Castlewood Member of the Spechts Ferry Formation downward to a prominent oolite in the Brickeys Member of the Mifflin Formation. The oolite is not present in northern Illinois.

PECATONICA FORMATION

The Pecatonica Formation (Hershey, 1894, p. 175; 1897), the basal formation of the Platteville Group, consists of about 20 feet of relatively pure dolomite or limestone. The formation is named for the Pecatonica River in southwestern Wisconsin where it is well exposed. Hershey did not select a type section, but Templeton and Willman (1963, geol. sec. 12) designated as the type section the exposures in a quarry just north of Woodford, Lafayette County, Wisconsin (W ½ NW NE 14, 2N-5E), where it is 22 feet thick.

Distribution. The Pecatonica Formation is present throughout the area of the Platteville Group in northern Illinois (fig. 1), except on a few local anticlinal areas in northwestern Ogle County, where it is overlapped by the Mifflin Formation. It is deeply buried beneath younger formations in much of the area. The principal exposures are near Durand (geol. secs. 8, 27) in Winnebago County, near Oregon and Forreston in Ogle County, near Dixon

(geol. sec. 61, 62) and Lee Center (geol. sec. 63) in Lee County, and at Troy Grove (geol. sec. 64), Oglesby (geol. sec. 65), and Ottawa (geol. sec. 69) in La Salle County. The uppermost part is exposed near Orangeville in Stephenson County. The formation is not exposed, however, in most of Stephenson County and in Jo Daviess County.

Thickness. The Pecatonica commonly is 20 to 25 feet thick, but it varies from 18 to 35 feet, generally thickening from north to south (fig. 6).

Lithology. In the region north and west of Dixon, the Pecatonica Formation consists largely of brown, fine- to medium-grained, relatively pure, medium-bedded, locally cherty dolomite that has a mixed dense and finely vesicular texture that gives a mottled appearance. At Dixon, Oglesby, and Ottawa, the Pecatonica consists of gray, fine-grained to lithographic limestone, mostly strongly mottled with dolomite. Cross-bedded calcarenite occurs at the top in the southernmost part of the outcrop area, near Oglesby.

The Pecatonica Formation is differentiated into six members. The Oglesby Member, at the top, is calcarenite. The Medusa Member is prominently mottled, burrowed dolomite or limestone with thin argillaceous laminations. The New Glarus Member is relatively pure, thick-bedded, locally cherty dolomite or limestone. The Dane Member is slightly argillaceous, thin- to medium-bedded dolomite or limestone with shale partings. The Chana Member is generally similar to the New Glarus Member but contains an abundance of sand grains. The Hennepin Member, at the base, is a variable unit consisting of dolomitic sandstone, laminated dolomitic siltstone, or silty, sandy dolomite.

The Pecatonica members are based mostly on slight but persistent differences in argillaceousness, porosity, and bedding, and in content of chert and fossils. The contacts are sharp, but only the contact at the top of the Dane Member is moderately prominent. The change from the pure New Glarus to the argillaceous Dane Member is the most readily recognized contact in the formation; generally it is marked by a 6- to 8-inch shaly zone at the top of the Dane.

Each of the members is distinctive in some areas, but not infrequently the members are indistinct. In many localities, strata believed to be equivalent to the Medusa Member lack the distinctive dolomite mottling and weak argillaceous laminations that characterize the member in the type locality; thus, in those areas probable Medusa, strata are included in the underlying New Glarus Member. At some localities, it appears that the Medusa strata have been truncated by the corrosion surface that consistently marks the top of the formation. In places, strata equivalent to the Chana Member lack the characteristic sand grains; therefore, these strata are included in the overlying Dane Member. Consequently, in some areas the Pecatonica is subdivided into only two members—the New Glarus and Dane Members. These can nearly always be recognized. The basal Hennepin Member and the Oglesby Member at the top are distinctive units but are present in only a few exposures.

The Pecatonica differs from the underlying Glenwood Formation of the Ancell Group in consisting of relatively pure limestone and dolomite, whereas the uppermost Glenwood strata are noncalcareous sandstone with a strong bimodal texture (Loughridge or Nokomis Members) or green shale (Harmony Hill Member). The underlying dolomite (Daysville Member) of the Glenwood is very argillaceous or silty and is highly variable in lithology. The Glenwood Formation is absent in some localities; in these areas the Pecatonica rests with a sharp contact on the St. Peter Sandstone. Lenses of silty dolomite, calcareous siltstone, and sandstone (Hennepin Member) at the base of the Pecatonica, probably reworked from St. Peter and Glenwood sediments, are included in the Pecatonica because they contain phosphatic pellets, St. Peter-type (rather than Glenwood-type) sand, and are calcareous (T and W, 1963). Because of the high content of clastic materials, the Hennepin is included in the Glenwood Formation in Wisconsin (Ostrom, 1967).

Fauna. The Pecatonica Formation is generally less fossiliferous than other Platteville formations. There are some areas, however, in Ogle and Winnebago Counties where the Dane Member is locally fossiliferous (geol. sec. 27). Although less diverse, the Pecatonica fauna appears to be the same as that in the other Platteville formations.

Stratigraphic relations. The Pecatonica Formation appears to be separated from the underlying Glenwood by an erosional surface that may mark a brief withdrawal of the sea or at least a notable shallowing of the sea. The Glenwood thins in places, but the distinctive and widespread green shale of the Harmony Hill Member at the top of the formation indicates that most of the thinning is depositional rather than erosional.

The Pecatonica is separated from the Mifflin Formation above by a prominent, widespread, deeply pitted corrosion surface. The pits are generally filled with clay, limonite, or pyrite. The surface is very flat, and there is no evidence of erosional scour. Although a withdrawal of the sea is not indicated, the surface appears to represent a major interruption in sedimentation. The surface is widely traced throughout the Mississippi Valley and eastward (T and W, 1963).

Correlation. The Pecatonica Formation appears to be absent on the northeast flank of the Ozark Dome in western Illinois. It is present in subsurface in central and southern Illinois and has been widely correlated with formations in other states (T and W, 1963).

Hennepin Member

The Hennepin Member (T and W, 1963, p. 75, geol. sec. 5) is the basal member of the Pecatonica Formation and is named for Hennepin County in eastern Minnesota, where the type section is in a bluff on the west side of the Mississippi River at Lock and Dam No. 1 in Minneapolis (NE SW NW 17, 28N-23W). The Hennepin Member consists of local lenses of argillaceous and silty limestone or dolomite, calcareous siltstone, and sandstone, and commonly contains phosphatic nodules in the lower part. The member is exposed in Illinois only in a few places north of Grand Detour, where it is 1 to 3 feet thick (T and W, 1963, geol. secs. 4, 6). It appears to be generally missing in most of the northern Illinois outcrop area.

Chana Member

The Chana Member (T and W, 1963, p. 76, geol. sec. 6) is the basal member of the Pecatonica Formation in the large part of the outcrop area where the Hennepin Member is absent. It is named for Chana, Ogle County, and the type section is in the Harmony Hill School Section, 9 miles west of Chana (N ½ NW NE NE 25, 23N-9E), where it is 6 feet 4 inches thick. The Chana Member consists of relatively pure dolomite, or limestone, except for the presence of floating grains of St. Peter-type sand, the abundance of which is highly variable. It is thick bedded and in many places contains phosphatic pellets in the basal few inches. The Chana is thicker bedded and less argillaceous than the Dane above.

Dane Member

The Dane Member of the Pecatonica Formation (T and W, 1963, p. 76, geol. sec. 13) overlies the Chana Member and is named for Dane County, Wisconsin. The type section is in a quarry and roadcut 4 miles north of New Glarus (SW NW NE 34, 5N-7E), where the member is 8 feet 2 inches thick. The Dane Member is generally 8 to 12 feet thick in northern Illinois. It consists of slightly argillaceous dolomite or limestone in thin to medium wavy beds separated by shale partings, which are prominent in some areas but relatively thin in others. In some areas the Dane contains scattered chert nodules. A shaly zone 2 to 8 inches thick is widely present at or as much as a foot below the top of the Dane Member. The Dane is the most fossiliferous of the Pecatonica members.

New Glarus Member

The New Glarus Member of the Pecatonica Formation (T and W, 1963, p. 77, geol. sec. 13), which overlies the Dane Member, is named for New Glarus, Green County, Wisconsin. The type section is 4 miles north of New Glarus in the same section as the type of the Dane Member, where the New Glarus is 5 feet 8 inches thick. In the exposures in northern Illinois where the Medusa is recognized, the New Glarus is commonly about 5 feet thick. It generally consists of relatively pure, brown, vesicular to vuggy, medium- and thick-bedded dolomite, but locally it is dolomite-mottled, dense, lithographic limestone. The New Glarus is locally cherty, containing scattered large chert nodules. It is generally more cherty than the Dane, and it is sparsely fossiliferous.

Medusa Member

The Medusa Member (T and W, 1963, p. 77) is the uppermost member of the Pecatonica Formation in most of northern Illinois. It is named for the Medusa Cement Company plant, 1 mile northeast of Dixon in Lee County. The Medusa Member is well exposed in the quarry at the plant (geol. sec. 61), but a more accessible exposure, the Dixon North section, 1 mile farther north (T and W, 1963, geol. sec. 14) was designated the type section. Unfortunately, the latter section was miscorrelated, and the Medusa Member, although present, was misidentified as the Hazelwood Member of the Mifflin Formation (fig. 10). The correct position of the Medusa type section is shown in the revised description of the Dixon North Section in this report (geol. sec. 62). The Medusa Member consists of thick-bedded limestone or dolomite containing thin, argillaceous laminations. It commonly is 5 to 7 feet thick. In the Dixon area, where the member is most prominent, the Medusa is gray, fine-grained limestone heavily mottled with dolomite. Much of the mottling appears to be due to selective dolomitization of burrows. This type of mottling is preserved less prominently in areas where the member is all dolomite.

Oglesby Member

The Oglesby Member (T and W, 1963, p. 77, geol. sec. 15), the uppermost member of the Pecatonica Formation, is named for Oglesby, La Salle County, which is just east of the type section, the Deer Park Section in Matthiessen State Park (NE NE NE 31, 33N-3E), where the member is 16 feet 2 inches thick. This is the only known exposure of the Oglesby Member in Illinois. It is absent farther north, but it is present in samples from borings in central Illinois,

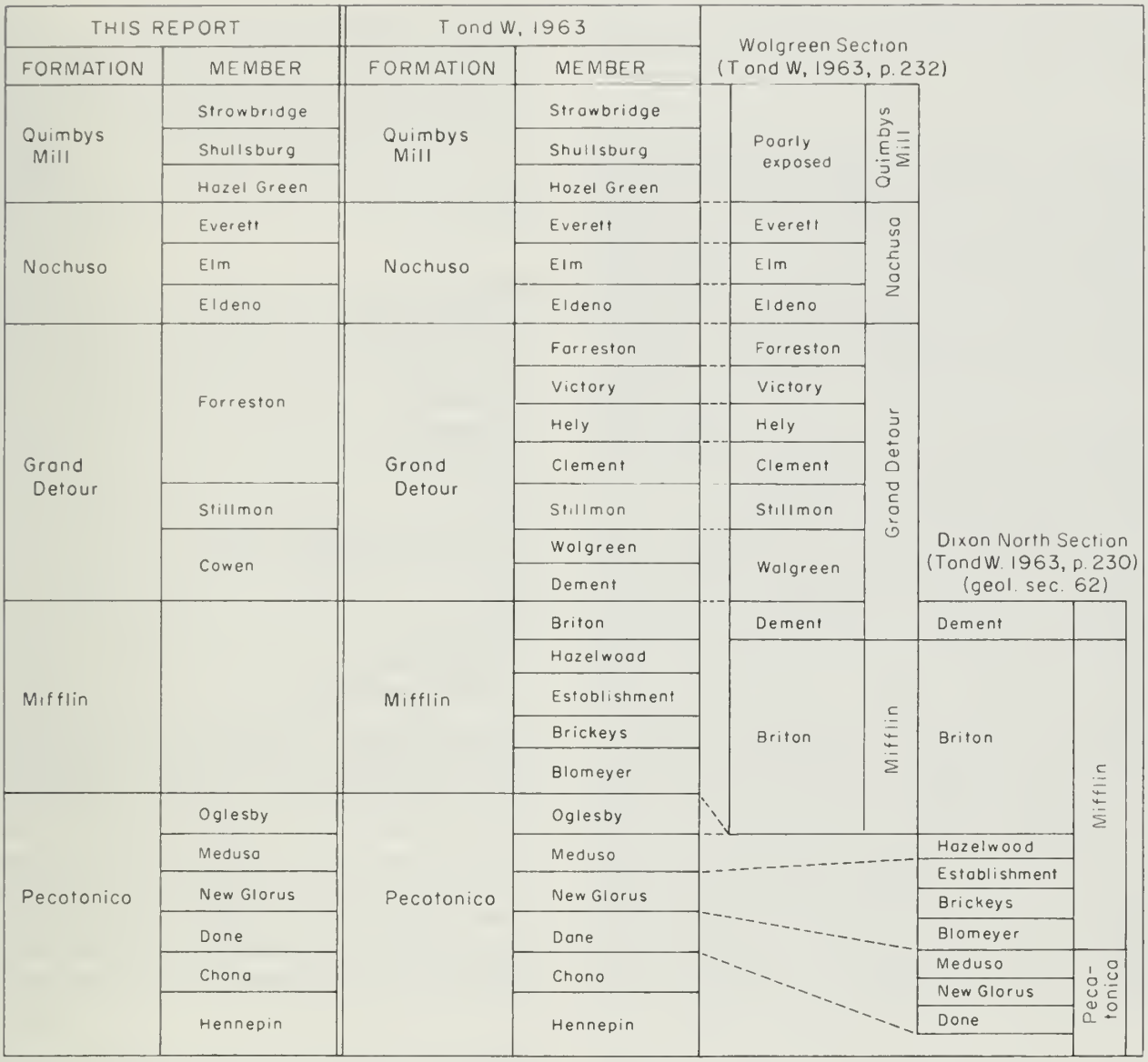

Figure 10. Recorrelation of the Walgreen and Dixon North Geologic Sections of Templeton and Willman, 1963.

and it is also exposed just east of Illinois at Kentland, Indiana. It consists of gray, medium- to coarse-grained, slightly cherty calcarenite and varies from thin to thick bedded. Locally, it is cross bedded. A few beds are fractured and contorted, suggesting a slide breccia.

MIFFLIN FORMATION

The Mifflin Formation (Bays, 1938, p. 269) consists of 15 to 20 feet of thin-bedded shaly dolomite or limestone overlying the Pecatonica Formation and underlying the Grand Detour Formation. It is named for Mifflin, Iowa County, Wisconsin, just west of the type section—a roadcut and bluff on the east side of the Pecatonica River (NE NE NE 34, 5N-1E) where the formation is 17 feet 10 inches thick.

Distribution. The Mifflin Formation crops out at many places in an area extending eastward from Orangeville in Stephenson County, to Rockton in Winnebago County (geol. secs. 27, 28, 29), and southward along Rock River Valley to Dixon, Lee County (geol. secs. 61, 62). It is also exposed on the Forreston and Brookville Domes and the Leaf River Anticline in western Ogle County (geol. sec. 44) and near Chana in eastern Ogle County (geol. sec. 54). Southeast of Dixon it is exposed on the west flank of the

La Salle Anticline near Lee Center, Lee County (geol. sec. 63), and near Troy Grove and Oglesby, La Salle County (geol. secs. 64, 65).

Lithology. The Mifflin Formation consists of gray to light tan, very fine grained to lithographic limestone or fine-grained dolomite in thin wavy beds separated by beds of shale (fig. 8D) that are generally green or in places, gray. The shale beds generally comprise less than 10 percent of the formation. In some areas they are very thin and are not prominent on fresh quarry surfaces. However, the green shale beds usually readily differentiate the formation from the thicker bedded, relatively pure formations above and below. The Mifflin generally contains several thin beds of calcarenite. It is dolomite in most of the Illinois outcrop area, but it is limestone at Dixon, Oglesby, and in southern Wisconsin west of Darlington.

Templeton and Willman (1963) recognized a somewhat thicker bedded, less shaly zone within the Mifflin and used this as the basis for differentiation of three members including the Establishment (lower, shaly member), Hazelwood (middle, thick-bedded member) and Briton (upper, thin-bedded member). The threefold differentiation has been found to be unrecognizable in many exposures and generally too indistinct to be useful. In addition, some confusion has resulted from miscorrelation of the Hazelwood Member at the type section. The possible equivalence of thin units in the basal part of the Mifflin in northern Illinois with thicker, more prominent members in southwestern Illinois and Missouri (Blomeyer and Brickeys Members) was suggested (T and W, 1952, 1963), but these units, if present, are also not sufficiently distinct to merit differentiation in northern Illinois. No Mifflin members are differentiated in this report.

Fauna. The Mifflin Formation is the most fossiliferous unit in the Platteville Group. Bedding planes are typically crowded with well-preserved bryozoans, brachiopods, ostracodes, and trilobite fragments. An abundant and diverse molluscan fauna is often contained within the beds. The most conspicuous fossils include the following:

Bryozoans
- *Eridotrypa* sp.
- *Hemiphragma* sp.
- *Leptotrypa hexagonalis* Ulrich encrusting *Hyolithes baconi* Whitfield
- *Stictopora* sp.

Brachiopods
- *Campylorthis deflecta* (Conrad)
- *Doleroides pervetus* (Conrad)
- *Hesperorthis concava* Cooper
- *Öpikina minnesotensis* (N. H. Winchell)
- *Pionodema conradi* (N. H. Winchell)
- *Protozyga nicolleti* (Winchell and Schuchert)
- *Rostricellula minnesotensis* (Sardeson)
- *Strophomena plattinensis* Fenton

Bivalves
- *Vanuxemia* sp.

Gastropods
- *Clathrospira* sp.
- *Lophospira* sp.
- *Phragmolites fimbriatus* (Ulrich and Scofield)
- *Sinuites* sp.
- *Subulites* sp.
- *Tetranota* sp.

Ostracodes
- *Eoleperditia fabulites* (Conrad)

Trilobites
- *Ceraurus* sp.
- *Encrinurus* sp.
- *Thaleops ovata* Conrad

Stratigraphic relations. The Mifflin rests with a sharp contact on the corrosion surface at the top of the Pecatonica Formation. The contact with the thicker bedded, less shaly Grand Detour above is usually marked by a 3- to 6-inch bed of dolomitic shale, which at one locality (geol. sec. 61) contains a bentonite (sample 110). In addition, at a number of places the upper part of the Mifflin contains a strong corrosion surface, a bed of calcarenite 3 to 5 inches thick, and a 6- to 8-inch bed of limestone nodules closely spaced in green shale.

Correlation. The Mifflin Formation is widely recognized in the Upper Mississippi Valley, but in some areas it is called the lower shaly part of the McGregor Formation.

GRAND DETOUR FORMATION

The Grand Detour Formation (T and W, 1963, p. 83, geol. sec. 19), which overlies the Mifflin Formation and underlies the Nachusa Formation, consists of 25 to 45 feet of medium-bedded dolomite or limestone. It is named for the village of Grand Detour, Ogle County. The type section is on the Walgreen estate, 3 miles west of Grand Detour in a quarry in the west bluff of the Rock River (NE 20, 22N-9E), where the formation is 44 feet 3 inches thick. In the type section, the base of the Grand Detour Formation is poorly exposed and was projected from a

nearby section. It was placed 8 feet lower than elsewhere (fig. 10). Because the type section of the Grand Detour Formation is now partly slumped and is not readily accessible, a section in a quarry near Brookville (geol. sec. 44) is proposed as an alternate reference section. The base is here placed at the prominent 4- to 6-inch shaly bed that is widely recognized at the top of the Mifflin throughout northern Illinois.

Distribution. The Grand Detour is exposed at many places in the outcrop area of the Platteville Group in northern Illinois (fig. 1), but because of the low relief of the surface, the entire section is present in only a few exposures, such as at the type section at Dixon, on the flank of the Forreston Dome near Brookville (T and W, 1963, geol. sec. 22), on the Oregon Anticline at Rochelle (geol. sec. 56), and on the La Salle Anticline at Troy Grove (geol. sec. 64) and Oglesby (T and W, 1963, geol. sec. 15). Complete sections are more common in southern Wisconsin, where the formation is much thinner, as at Woodford (T and W, 1963, geol. sec. 12), South Wayne (geol. sec. 5), Darlington (geol. sec. 4), Mineral Point (geol. sec. 3), Platteville (T and W, 1963, p. 63), and Dickeyville (geol. sec. 1). Typical but only partial exposures occur near Winslow (geol. sec. 6), Orangeville (Doyle, 1965, geol. sec. 1), Rock City, Durand (geol. secs. 27, 28, 30), Shirland, Byron (geol. secs. 52, 53), and Lee Center (geol. sec. 63).

Thickness. The Grand Detour generally thickens southward, from as little as 20 feet near the Wisconsin state line to nearly 45 feet near Dixon. It thins south of there to about 38 feet at Troy Grove and 25 feet at Oglesby, but because of deformation the thickness at Oglesby may not be accurate.

Lithology. The Grand Detour Formation is more variable in lithology than the other formations in the Platteville Group. Although similar to them in varying laterally from fine- and medium-grained dolomite to lithographic limestone, the Grand Detour varies vertically from thick to thin bedded and from pure to argillaceous and shaly. In general, however, in bedding and argillaceousness, it is relatively intermediate between the thin-bedded and shaly Mifflin below and the massive pure Nachusa above. It is partly cherty and has red-brown shale partings, which are most common in the upper part but in places occur throughout. In other places the Grand Detour Formation contains some dark gray, nearly black, shale partings. In most exposures the limestone is largely gray, and the dolomite is light brown. However, the upper part, and in places all of the formation, is a distinctive dark blue-gray on unoxidized fresh surfaces. Lenses of medium-grained calcarenite 1 to 3 inches thick are especially common in the upper part.

The Grand Detour is differentiated into three members differing principally in argillaceous content and bedding. The upper thin- to medium-bedded member contains red-brown shale partings (Forreston Member). It overlies a thick-bedded to massive, generally cherty, pure member (Stillman Member). Below the Stillman is a new member (Cowen Member) that is a medium-bedded, moderately pure unit which is generally cherty and argillaceous to shaly at the top. The three members can generally be differentiated in Ogle, Lee, and La Salle Counties, but they are difficult to differentiate northwest of there, where the formation thins.

The Grand Detour previously has been differentiated into seven members (T and W, 1963), three of which are based on type sections in southeastern Missouri, where they are thick and distinctive. Although these three (the Clement, Hely, and Victory Members) have been tentatively identified in northern Illinois, they are not considered sufficiently distinctive to be identified with confidence, thus they are not used in this study. At present, they are included in the lower part of the Forreston Member.

Two members that underlie the Stillman Member were based on exposures in northern Illinois—the Walgreen, an upper argillaceous or shaly member; and the Dement, a lower relatively pure member (T and W, 1963). Although the boundary between them is sharply defined at some localities, in many others it is difficult to place, and the thickness variations suggest that the boundary has not been consistently drawn. Further, the Walgreen and Dement Members are poorly exposed and not correctly differentiated in the type section (fig. 10). Thus it has seemed desirable to combine them as the Cowen Member.

Fauna. The Grand Detour Formation contains an abundant and diverse fauna, particularly in the more argillaceous beds. Well-preserved fossils are especially conspicuous in the Forreston Member where, in addition to the abundant brachiopod remains, the solitary rugose coral *Streptelasma* is very common in places. Thecal plates of the rhombiferan cystoids *Coronocystis durandensis* Kolata and an unidentified *Cheirocrinus*-like form are relatively abundant on some bedding planes in the Stillman Member and lower in the Grand Detour.

Lithistid sponges including *Anthaspidella* (fig. 9D) and *Zittelella* occur in the lower 1 to 2 feet of the Grand Detour and in the shaly bed at the top of the Mifflin near Pecatonica (geol. sec. 30), Shirland, Durand (geol. sec. 28), Byron (geol. sec. 52), Brookville (geol. sec. 44), and Dixon (geol. sec. 61). The sponges are not known to occur

in any other part of the Platteville, and they are a significant marker for this part of the Platteville Group. The abundant and diverse sponges described by Ulrich and Everett (1890, p. 255) from Dixon, Illinois, were probably collected from this unit. Ulrich and Everett gave a very general description of the sponge locality stating only that the sponges were found in "a quarry situated 3 miles northwest of his home (Dr. Everett's) in Dixon, Illinois, . . . in a shaly layer of Trenton limestone, . . . about 25 feet above the top of the St. Peter Sandstone." Both the quarry location and stratigraphic position appear to be in error. Their description of the associated trace fossils, *Palaeophycus* and *Buthotrephis (Chondrites)*, as well as the lithologic characteristics of the sponges and matrix, suggest that the sponges were found in the 6-inch shaly bed at the top of the Mifflin Formation, somewhere near the Medusa Cement Company quarry (geol. sec. 61). *Coronocystis durandensis* Kolata is found commonly in association with the sponges.

Stratigraphic relations. The Grand Detour is conformable with the underlying Mifflin Formation and the overlying Nachusa Formation. Commonly an interval 1 to 2 feet thick at the top of the Grand Detour is transitional to the Nachusa.

Correlation. The McGregor Formation of the Upper Mississippi Valley consists of the Mifflin and Grand Detour Formations, except in part of southwestern Wisconsin where it also includes the thinned margin of the Nachusa Formation. The greater part of the McGregor is Grand Detour. The Grand Detour and Nachusa Formations combined were formerly called the Magnolia Member of the Platteville Formation in southern Wisconsin and northern Illinois. The Grand Detour is equivalent to strata in the High Bridge in Kentucky, the Lebanon in Tennessee, and the Lowville in New York (T and W, 1963).

Cowen Member (new)

The Cowen Member, the basal member of the Grand Detour Formation, underlies the Stillman Member and is named herein for the Cowen School, 2 miles southwest of the type section, which is in the Brookville Section (geol. sec. 44) in Carroll County (NE SE NW 21, 24N-7E), 1 mile northwest of Brookville in Ogle County. The Cowen Member is 7 feet 9 inches thick in the type section. It combines strata previously differentiated as the Walgreen and Dement Members. It varies from 6 to 18 feet thick and is well exposed in Ogle and Lee Counties (geol. secs. 52, 56, 61, 63). In many exposures, the member consists of an upper thin-bedded, argillaceous to shaly dolomite 1 to 2 feet thick. It is sharply differentiated from the lower part, which is medium-bedded, moderately pure dolomite containing a few thin calcarenite layers and scattered chert nodules. In other places the upper 5 to 8 feet is only slightly argillaceous and medium bedded, and it is not readily separable from the lower part.

Stillman Member

The Stillman Member (T and W, 1963, p. 85, geol. sec. 20) is a massive dolomite or limestone near the middle of the Grand Detour Formation. It is named for Stillman Run, a small stream 1½ miles east of the type section. The type section is in a quarry north of Byron, Ogle County (NE NE SE 30, 25N-11E), where the member is 5 feet 4 inches thick. The Stillman Member consists of relatively pure, massive- to thick-bedded, partly cherty dolomite or limestone. Where it is dolomite, the member is vuggy. It is commonly 5 to 8 feet thick in the Dixon-Oregon area, but locally it is as much as 14 feet thick. The Stillman Member is absent in places in the northern part of the area where the formation is thin. Where massive it is readily separated from the more shaly members above and below, but in some localities it is well bedded and is differentiated largely on being less argillaceous than the adjoining members.

Forreston Member

The Forreston Member (T and W, 1963, p. 87, geol. sec. 22) is the uppermost member of the Grand Detour Formation. It is named for Forreston, Ogle County, and the type section is in a quarry 7 miles southwest of Forreston, 1 mile northwest of Brookville (NE SE NW 21, 24N-7E), where the Forreston is 17 feet 10 inches thick. The Forreston varies in thickness from 6 to 18 feet. It consists of thin- to medium-bedded dolomite or limestone; the beds are separated by thin partings of red-brown shale. In detail, the member commonly consists of three argillaceous, thin-bedded units separated by about equal thicknesses of relatively pure, medium-bedded strata. These units are not prominent and can be differentiated only by close comparisons with other sections. They are not generally useful in field mapping and are not differentiated in this study. The Forreston contains several beds of calcarenite. A bed of calcarenite at or near the base has been correlated with the Clement Member in southwestern Illinois (T and W, 1963). A few feet above the calcarenite, a generally massive, lithographic, white-weathering bed about a foot thick has been correlated with the distinctive Victory Member in southern Illinois. The name Hely has been used for the shaly strata between the Clement and the Victory. The

identification of these units is difficult in northern Illinois; therefore their use in that area is discontinued.

NACHUSA FORMATION

The Nachusa Formation (T and W, 1963, p. 87, geol. sec. 23), which overlies the Grand Detour Formation, consists of 15 to 25 feet of thick-bedded to massive, relatively pure dolomite or limestone. It is named for the village of Nachusa in Lee County, and the type section is in a quarry on the east side of Illinois Highway 2 at the east edge of Dixon (SE SE SW 33, 22N-9E), where the formation is 17 feet 10 inches thick.

Distribution. The Nachusa Formation is widely exposed throughout northern Illinois, particularly in the area north of the Pecatonica River from Winslow to Rockton (geol. secs. 26, 30, 32) and along the Rock River Valley from Rockton to Dixon (geol. secs. 34, 35, 51, 52, 53, 58, 60). It is also exposed on the domes and anticlines at Brookville (geol. sec. 44), Forreston, and Leaf River, and on the La Salle Anticline at Troy Grove (geol. sec. 64) and Oglesby (geol. sec. 65). It is also exposed in a small area near Lisbon (geol. sec. 72).

Thickness. Although consistently 15 to 25 feet thick in the northern Illinois outcrop area, in the subsurface westward from Winslow the Nachusa thins rapidly and is absent in Jo Daviess County. The westward and northward thinning is best observed in the outcrop area in southern Wisconsin, where the formation thins from 13 feet at Martintown to 8½ feet at South Wayne, 6 feet at Darlington, and 2 feet at Mineral Point (fig. 7). West of there the Nachusa Formation appears to be generally absent.

Lithology. The Nachusa Formation consists largely of pure dolomite or limestone, generally massive appearing but broken into thick, tight beds where weathered (fig. 8B). It is largely medium-grained, vuggy dolomite north of Dixon but is partly dolomite-mottled, light gray, lithographic limestone at Dixon and Oglesby. Chert is highly variable with none at all in some exposures. In a few places the entire formation is cherty with many bands of white to gray chert nodules mostly 2 to 3 inches in diameter. More commonly, the upper and middle parts are moderately cherty and the lower part is slightly or not cherty. A persistent band of relatively large, white chert nodules occurs just below the top in many exposures.

The Nachusa is differentiated into three members, because of a persistent, well-bedded, argillaceous unit near the middle—the Elm Member. The overlying Everett Member and the underlying Eldena Member are both massive units, but the lower part of the Eldena is slightly argillaceous and has thin argillaceous partings, which are scarce in the Everett. West of South Wayne, Wisconsin (geol. sec. 5), where the Nachusa thins, the Elm Member is not recognized, and the formation is not differentiated into members (fig. 7).

Fauna. The Nachusa Formation is a moderately fossiliferous unit. In most places the rocks have been extensively recrystallized, thus masking or obliterating the original fossil content. Most fossils consist of interior and exterior molds and occasionally, poorly preserved silicified remains. The lower part of the Eldena Member appears to be the most fossiliferous part of the Nachusa.

Large colonies of the tabulate coral *Foerstephyllum* as much as 15 inches in diameter are common at many localities and provide a good marker for the Nachusa. Probably the most conspicuous elements of the fauna in the Nachusa are the abundant trace fossils represented mainly by *Palaeophycus* and *Chondrites*. These fossils are particularly common on exposed bedding planes in the Everett and Eldena Members.

Stratigraphic relations. The Nachusa has conformable relations with the Grand Detour below and the Quimbys Mill above. The contact with the Grand Detour varies from transitional to sharp, but the contact with the Quimbys Mill is sharp.

Correlation. The Nachusa Formation thins out westward and is not recognized in the Upper Mississippi Valley. All three members are persistent regionally. The formation is equivalent to the Chaumont Formation of New York, and it is a distinctive part of the Tyrone in Kentucky and the Carters in Tennessee (T and W, 1963).

Eldena Member

The Eldena Member (T and W, 1963, p. 89, geol. sec. 23), the basal member of the Nachusa Formation, is named for the village of Eldena in Lee County. The type section, 6 miles south of Eldena, is part of the Nachusa type section, where the Eldena is 7 feet 6 inches thick. The Eldena varies from 5 to 10 feet thick in the northern Illinois outcrop area. It is thick bedded to massive, slightly fossiliferous dolomite. It is mostly pure, but the lower part is slightly argillaceous and has thin shaly partings that are commonly brown or gray but in places are dark blue-gray.

Elm Member

The Elm Member (T and W, 1963, p. 89, geol. sec. 23), the middle member of the Nachusa Formation, is named

for Elm Street in Dixon, just southwest of the type section, which is part of the Nachusa type section, where the Elm is 2 feet 10 inches thick. The Elm is commonly 2 to 3 feet thick but varies from 1 to 4 feet. It consists of gray to light buff, argillaceous, laminated, dense, commonly cherty, thin- to medium-bedded dolomite. Its weathered surface is light colored and smooth, which differentiates it from the darker, rough surface of the members above and below.

Everett Member

The Everett Member (T and W, 1963, p. 90, geol. sec. 23), the uppermost member of the Nachusa Formation, is named for Everett Street in Dixon near the type section, which is part of the Nachusa type section where the Everett is 7 feet 6 inches thick. The Everett Member is commonly 5 to 10 feet thick in northern Illinois. It consists largely of gray, pure, vuggy, cherty, thick-bedded to massive, medium-grained dolomite.

QUIMBYS MILL FORMATION

The Quimbys Mill Formation (Agnew and Heyl, 1946, p. 1585), the uppermost formation of the Platteville Group, consists of 10 to 15 feet of medium- to thin-bedded, argillaceous to shaly limestone or dolomite, which is generally readily differentiated from the pure, massive Nachusa below and the more shaly basal strata of the Galena Group above. The formation is named for Quimbys Mill near the village of Etna, 5 miles west of Shullsburg, in Lafayette County, Wisconsin (SE SE 11, 11N-1E). Quimbys Mill Formation is 12 feet thick at the type section, which is in a quarry at the mill (T and W, 1963, geol. sec. 24).

Distribution. The Quimbys Mill Formation is present throughout northern Illinois, except in the extreme northwest corner of Illinois and in the areas where older formations are at the surface. The upper 4 to 6 feet is exposed in a few outcrops along the Galena River north of Galena in Jo Daviess County (geol. sec. 12), but it is buried beneath younger formations between there and Winslow in Stephenson County. The Quimbys Mill Formation is exposed at many places in the Pecatonica Valley in Stephenson and Winnebago Counties, particularly at Orangeville (Doyle, 1965, geol. sec. 2), Rock City (geol. sec. 26), Harrison (geol. sec. 32), and Rockton (geol. sec. 34). It is exposed along the Rock Valley at Byron (geol. sec. 53), Oregon (geol. secs. 49, 50, 51), and Dixon (geol. secs. 58, 60). It is also exposed at Lisbon in Kendall County (geol. sec. 71) and along the flank of the La Salle Anticline near Oglesby (geol. sec. 65).

Thickness. The Quimbys Mill Formation is thickest, about 17 feet, near Rochelle. It is commonly 10 to 15 feet thick in the outcrop area in Rock Valley, in the lower Pecatonica Valley, and along the La Salle Anticline. Farther west, near the crest of the Wisconsin Arch between Rock City and Winslow in Stephenson County, the formation is 3 to 5 feet thick, but it thickens again to 12 feet in Jo Daviess County. In southern Wisconsin the Quimbys Mill thins rapidly from 12 to 13 feet at the type section and also at Darlington, to 2 feet 6 inches at Platteville, and to only 7 to 9 inches at Dickeyville. It is generally absent west and north of there.

Lithology. In the type area in southern Wisconsin and along the Galena River north of Galena (geol. sec. 12), the Quimbys Mill is largely medium to dark brown, lithographic limestone in well-defined beds (fig. 8A) separated by dark brown shale partings. The limestone fractures with smooth, curved surfaces and is called "the glassrock" in the zinc-lead mining district. In the vicinity of Shullsburg in Wisconsin and Scales Mound in Illinois, the Quimbys Mill changes eastward to a very fine-grained, pure to argillaceous, dense, well-bedded dolomite. The dolomite facies is characterized throughout the northern Illinois outcrop area by its light tan color, by smooth bedding surfaces, and by thin shaly partings. In the area along the Oregon Anticline from near Rochelle to Mt. Morris, where the Quimbys Mill is relatively thick, the formation is more dense, lighter in color, has greenish gray bedding surfaces, and lacks the diverse marine fossils seen at other localities. Like the Nachusa below, the Quimbys Mill is very cherty in some areas, noncherty in others. It is subdivided into three members. The Strawbridge Member at the top is a relatively pure unit that has only thin shale partings and in places is massive, pure, and vuggy. The underlying Shullsburg Member is more argillaceous and contains the major shale partings. The basal Hazel Green Member contains fewer shale partings and is massive to thick bedded. In Winnebago and Stephenson Counties, a shaly zone as much as a foot thick marks the base of the formation. Where the formation is thinner than 5 feet, it generally resembles the Shullsburg Member, but members are not differentiated.

Fauna. The Quimbys Mill contains a diverse but not a conspicuously abundant fauna. Patches of fossil debris occur locally on shaly bedding planes, particularly in the Shullsburg Member. Fossil preservation is similar to that in the Nachusa Formation consisting mainly of exterior and interior molds. The most common fossils appear to be *Öpikina* and *Streptelasma*. Relatively small trace fossils referable to *Chondrites* are common in the Strawbridge Member.

Stratigraphic relations. The contact of the Quimbys Mill with the Nachusa Formation below is sharply defined, but there is no evidence of truncation of the Nachusa. The top of the Quimbys Mill, however, is a prominent corrosion surface with deep pits that in places are filled with clay. The top and the upper few inches of the Quimbys Mill are strongly ferruginous. In many places phosphatic pellets are abundant on the surface. Both the Nachusa and Quimbys Mill thin westerly and terminate in approximately the same area, although the Quimbys Mill extends a little farther west. However, the thickness variations are gradual, and the westward disappearance appears to be depositional rather than erosional.

Correlation. The Quimbys Mill is not present in the Upper Mississippi Valley west and north of a line from near Platteville, Wisconsin, to Dubuque, Iowa. Equivalent strata are widely present, however, in other regions (T and W, 1963).

Hazel Green Member

The Hazel Green Member (T and W, 1963, p. 91, geol. sec. 24), the basal member of the Quimbys Mill Formation, is named for Hazel Green, which is 6 miles southwest of the type section. The type section is part of the Quimbys Mill type section where the Hazel Green is 1 foot 8 inches thick. The member is commonly 1 to 2 feet thick, rarely, 3 or 4. It consists of relatively thick-bedded, nonshaly, fine-grained dolomite in its outcrop area in northern Illinois, but it is not always sufficiently distinctive to be definitely identified. In these places, it is included in the Shullsburg Member.

Shullsburg Member

The Shullsburg Member of the Quimbys Mill Formation (T and W, 1963, p. 92, geol. sec. 24) is named for Shullsburg, Wisconsin, which is 5 miles east of the type section. The type section is part of the Quimbys Mill type section, where the Shullsburg is 2 feet 6 inches thick. It is about 3 feet thick in northwestern Illinois west of Rock City in Stephenson County, but it is commonly 5 to 7 feet thick in most of the outcrop area. In the limestone facies west of Scales Mound, the Shullsburg consists of brown lithographic limestone in thin to medium beds separated by beds of dark brown shale as much as half an inch thick. In the dolomite facies it is slightly argillaceous, brown to buff, slightly cherty, dense, and thin to medium bedded with smooth bedding surfaces. Lenticular cavities (possible syneresis cracks) ½ to 1 inch long oriented vertically are characteristic of the dolomite facies.

Strawbridge Member

The Strawbridge Member (T and W, 1963, p. 92, geol. sec. 24), the uppermost member of the Quimbys Mill Formation, is named for Strawbridge, Wisconsin, a small village 3 miles southwest of the type section. The type section is part of the Quimbys Mill type section, where the Strawbridge is 7 feet 10 inches thick. The Strawbridge is at least 6 feet thick along the Galena River about 2 miles south of the Wisconsin state line, but the base is not exposed. The member thins eastward to only 2 feet in the vicinity of Rock City, but it thickens east of there to about 9 feet near Rockton, 4 to 5 feet at Dixon, and 8 to 9 feet near Lowell. The Strawbridge differs from the Shullsburg below in being less argillaceous, more cherty, and thicker bedded in both limestone and dolomite facies.

Galena Group

The Galena Group (Hall, 1851; Kay, 1935; T and W, 1963), which is named for Galena in Jo Daviess County, is the uppermost part of the Ottawa Megagroup in northern Illinois and includes the youngest strata of the Champlainian Series (fig. 11). The Galena is generally classified as a formation elsewhere in the Upper Mississippi Valley, but the need to differentiate it into 6 major units with 18 subdivisions resulted in designation of the Galena as a group subdivided into formations and members. Five of the formations and 17 of the members (including a newly-named member) occur in northern Illinois. Nine beds are named in this report. Six overlapping sections within six miles of Galena were designated as typical of the group in the type locality (T and W, 1963, p. 93).

Distribution and thickness. The Galena Group is widely distributed in northern Illinois (figs. 12 to 15); it crops out in many river and stream cutbanks, roadcuts, and quarries. It is 250 to 275 feet thick where overlain by the Maquoketa Shale Group.

Lithology. The Galena Group is dominantly carbonate, largely dolomite in northern Illinois (fig. 16). At the extreme northwest corner of the state, the lower part grades to fine-grained and lithographic limestone. At the southeastern outcrops at Central in Kendall County and Oglesby and Lowell in La Salle County, it is fine- to coarse-grained limestone. Much of the limestone is strongly mottled with dolomite.

The most argillaceous and shaly parts of the group are at the base (the Decorah Subgroup) and at the top (the Dubuque Formation); the intervening strata are relatively pure (Kimmswick Subgroup). Vertical variation in

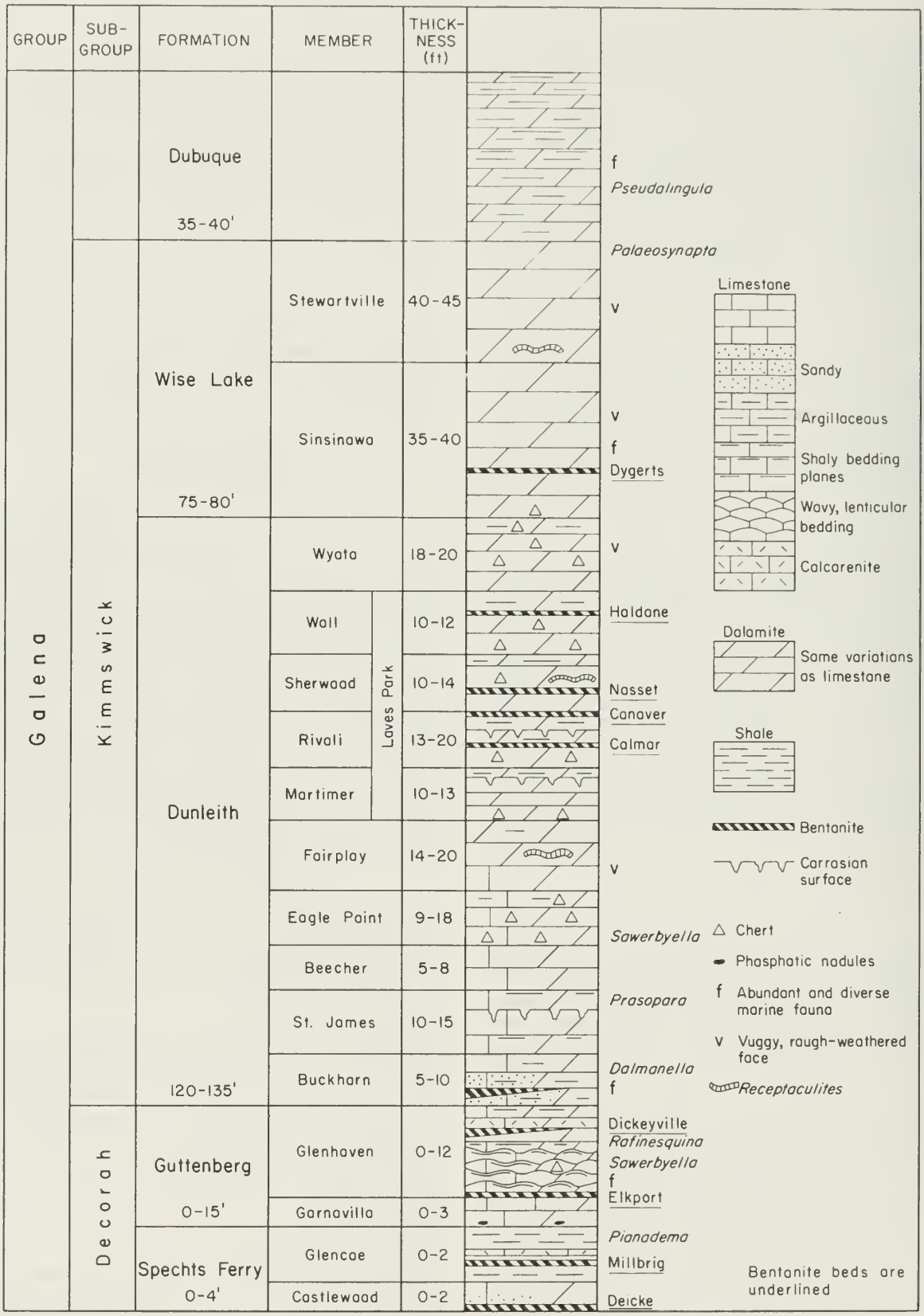

Figure 11. Columnar section of the Galena Group.

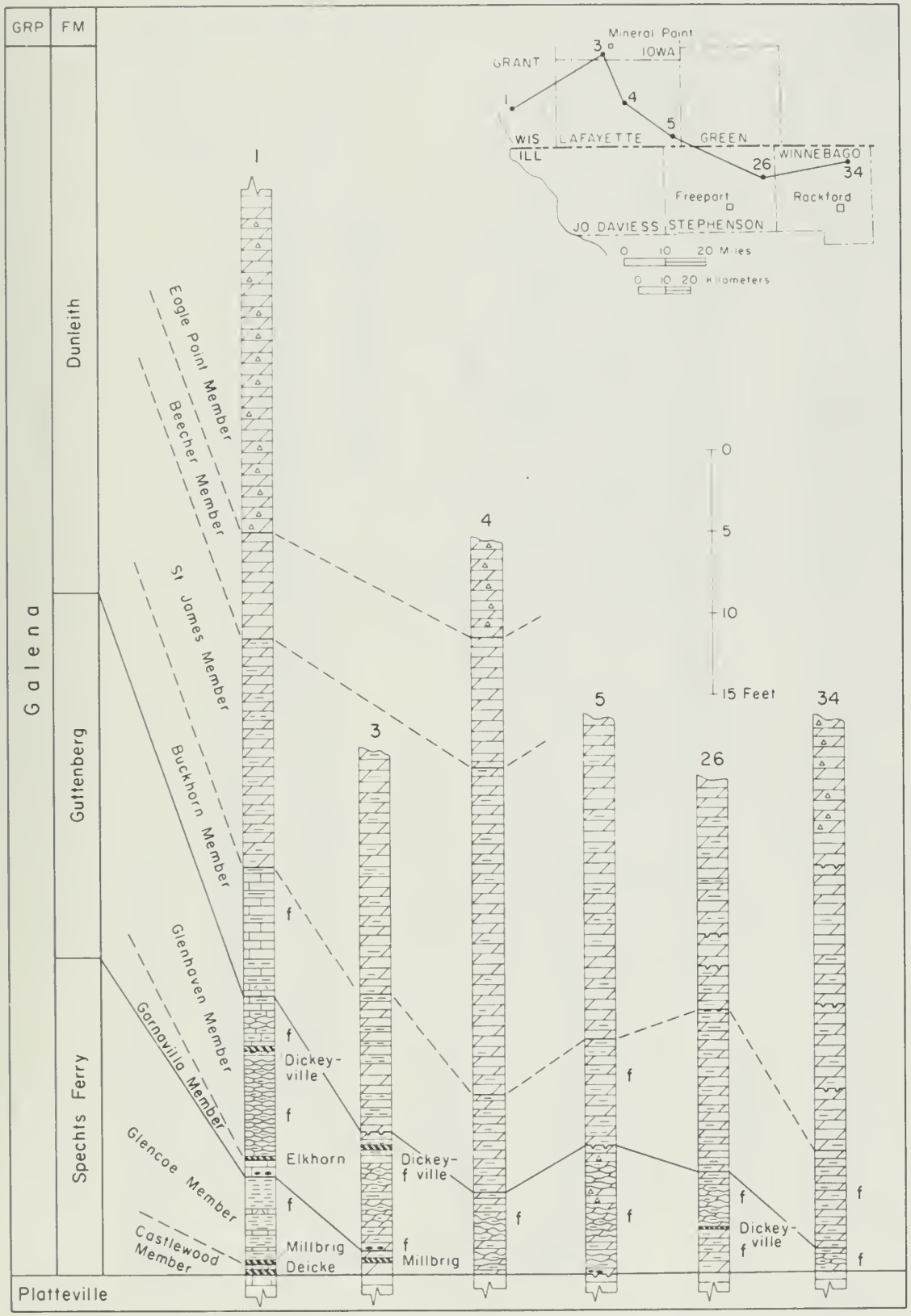

Figure 12. Correlation of Galena Group sections from near Dickeyville, Wisconsin, to near Rockton, Illinois. Column numbers refer to Geologic Sections, p. 57. See figure 11 for symbols.

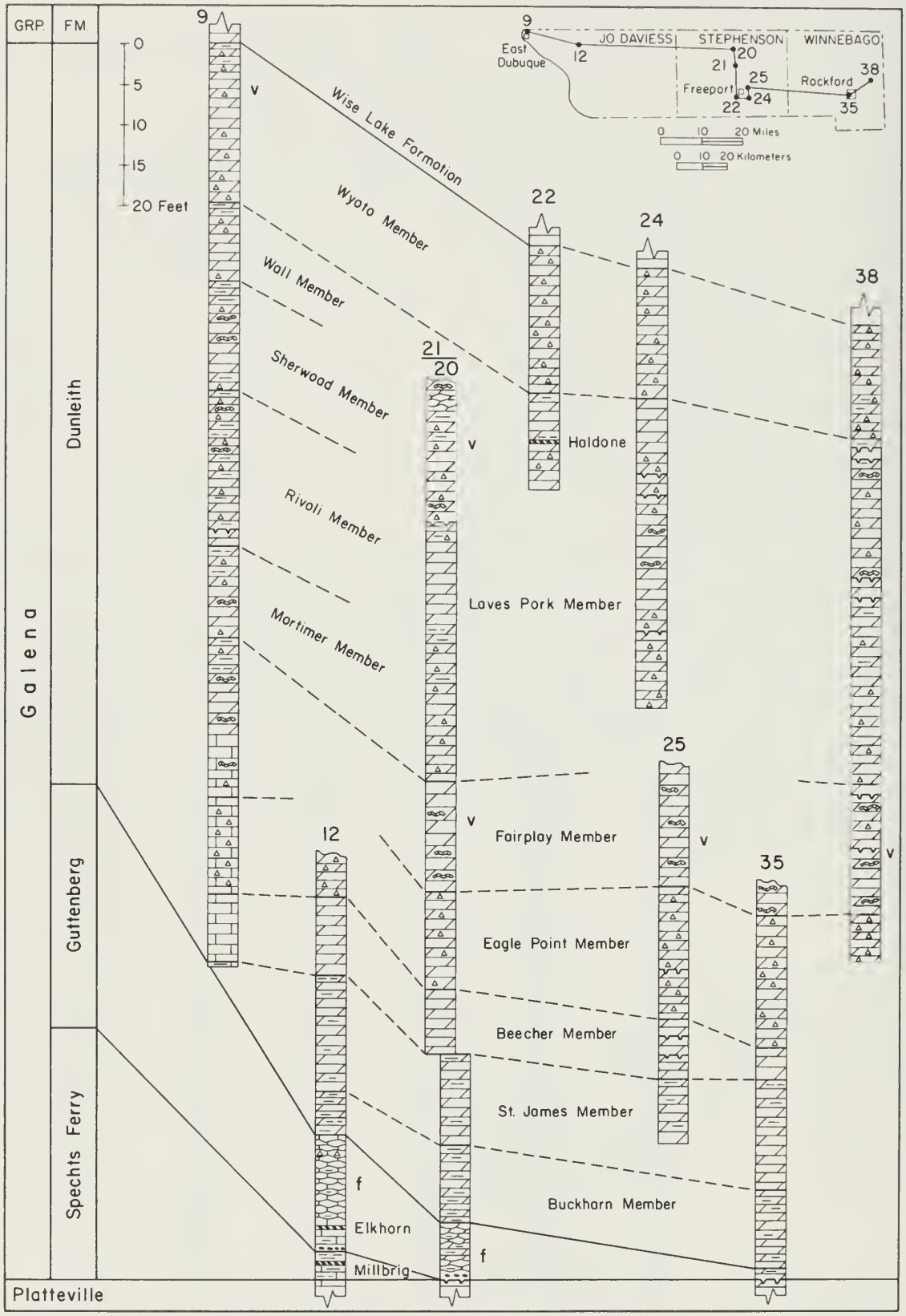

Figure 13. Correlation of Galena Group sections from East Dubuque to near Rockford. Column numbers refer to Geologic Sections, p. 57. See figure 11 for symbols.

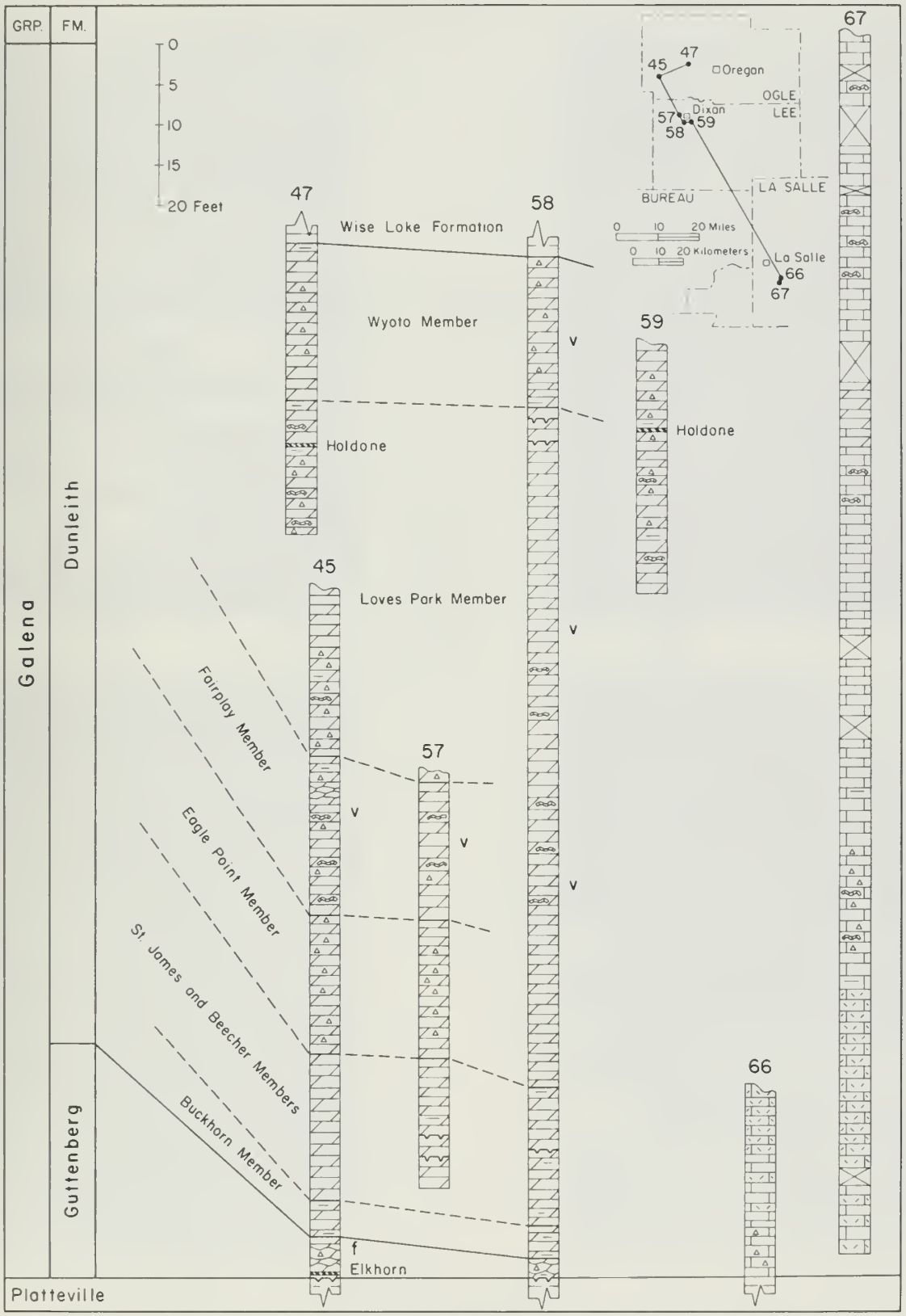

Figure 14 Correlation of Galena Group sections from near Oregon to near La Salle. Column numbers refer to Geologic Sections, p. 57. See figure 11 for symbols.

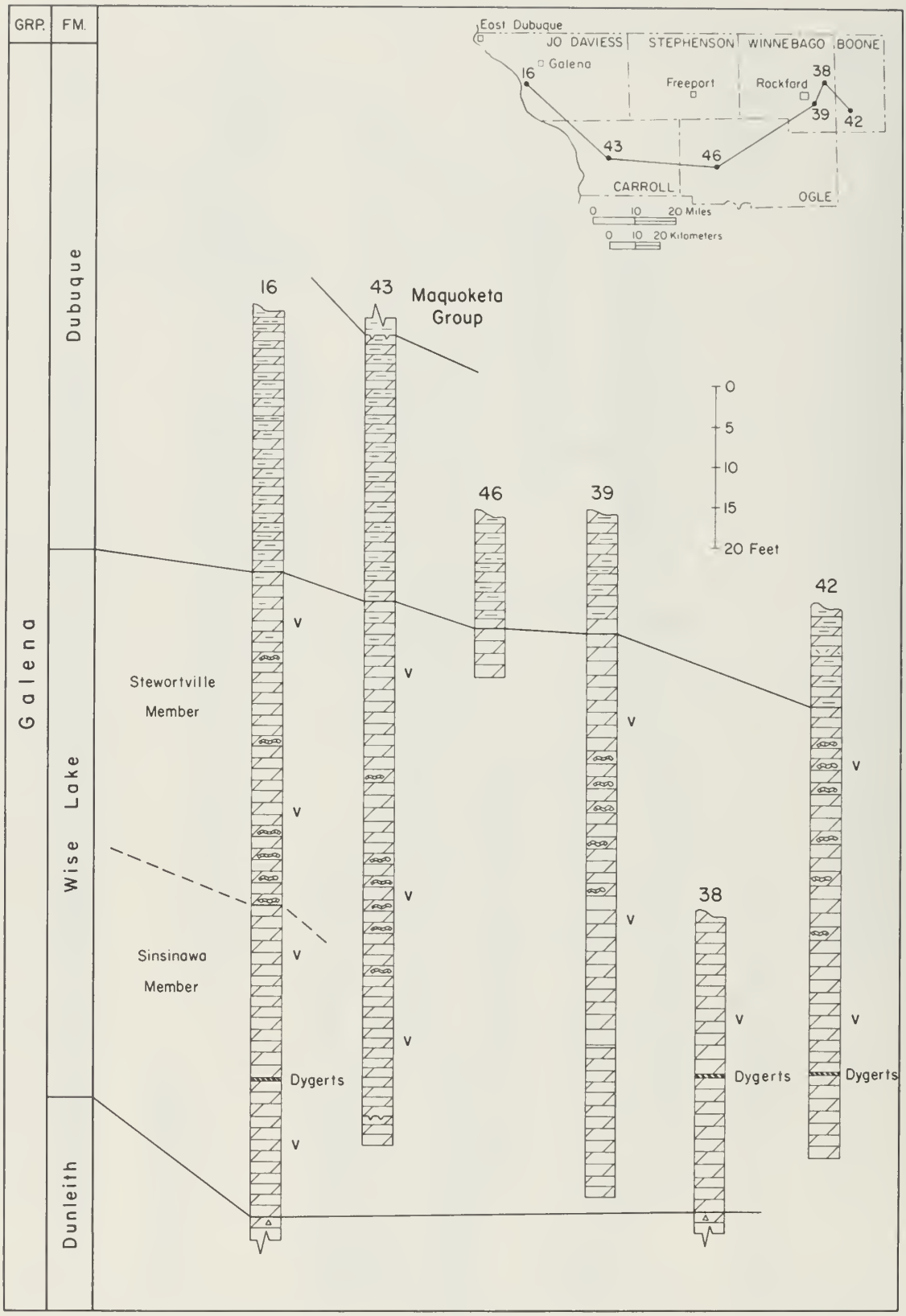

Figure 15. Correlation of Galena Group sections from near Galena to near Belvidere. Column numbers refer to Geologic Sections, p. 57. See figure 11 for symbols.

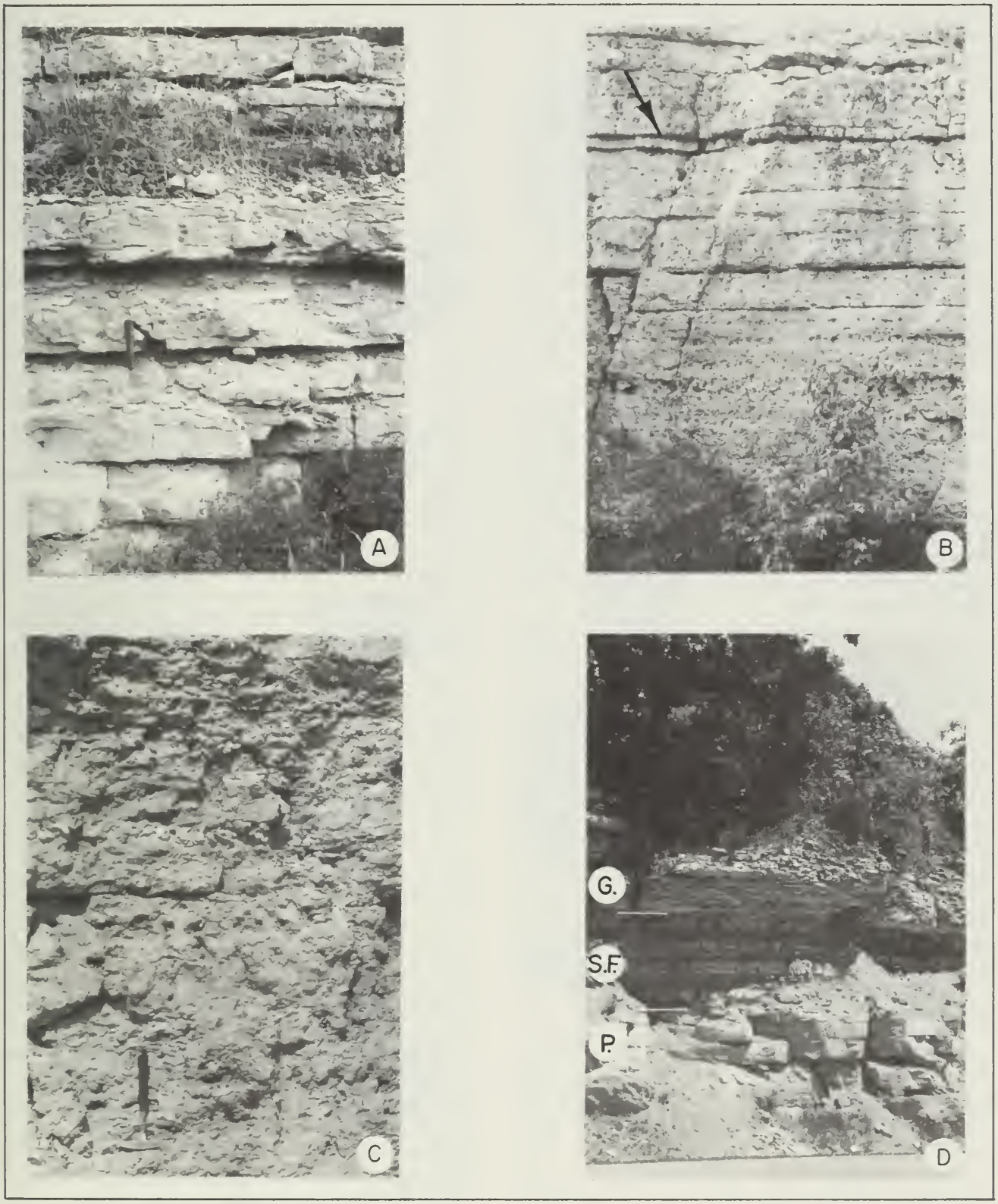

Figure 16. Characteristic bedding in the Galena Group. A - Dubuque Formation in roadcut of U.S. Highway 20 northwest of Galena, Illinois (SE SW SE 32, 29N-1W), B - Wise Lake and Dubuque Formations (geol. sec. 11), arrow points to 4" to 6" bed at top of Wise Lake Formation, C - cherty, vuggy, rough-weathered face in Dunleith Formation (geol. sec. 38), D - Guttenberg (G.) and Spechts Ferry (S.F.) Formations overlying Platteville Group (P.) (geol. sec. 1).

the content of terrigenous material, like in the Platteville Group, is the principal basis on which the formations and members are differentiated, but the presence or absence of chert, the color of the shales, or the abundance of a particular fossil, are contributing and locally dominant factors in the differentiation (fig. 11). Usually, the units are relatively uniform bodies separated by well-defined contacts or narrow transition zones. In the Dunleith Formation, however, the vertical variations in the amount of disseminated clay are more frequent, and the resulting alternations are too numerous and many are too thin to justify differentiation as separate members. Consequently, pairs of units, a pure and an argillaceous unit, were recognized as members, even though the units are not significantly gradational.

Fauna. The precise vertical and horizontal distribution for most described species in the Galena Group is not well known. It is suspected that the fauna changes gradually from the bottom to the top of the sequence, with species appearing and disappearing at various horizons. This is supported in part by the detailed studies of the trilobites (DeMott, 1963) and echinoderms (Kolata, 1975). In addition, significant differences exist between contemporary faunas of different areas.

Like the underlying Platteville Group, the Galena contains a diverse fauna dominated mainly by brachiopods and bryozoans (fig. 17). Some stratigraphic units, particularly those in the lower part of the Galena, are characterized by an abundance of a particular assemblage of brachiopods. For example, the orthids *Pionodema* and *Doleroides* are very abundant in the Spechts Ferry Formation; in the superjacent Guttenberg Formation, the strophomenids *Sowerbyella* and *Rafinesquina* dominate; in the St. James and Buckhorn Members, the orthids *Dalmanella* and *Glyptorthis* are abundant; and in the Eagle Point Member, *Sowerbyella* is once again relatively abundant. These faunal changes seem to reflect periodic cycling of benthic marine conditions that favored one faunal assemblage, then another. Cyclic environmental effects are probably also the cause of widespread "blooms" of *Receptaculites* during Dunleith and Wise Lake time.

Owing to extensive recrystallization, fossil preservation is relatively poor in the Beecher Member of the Dunleith Formation and in the younger Galena units in northern Illinois. Most fossils are preserved as composite internal and external molds.

Stratigraphic relations. The Galena Group is separated from the Platteville below by a widespread but relatively minor unconformity, as discussed under Platteville. Near the northwest corner of Illinois, the basal Galena strata successively overlap the Quimbys Mill and Nachusa Formations, perhaps as a result of the gentle warping that caused the interruption in sedimentation. However, the contact is very flat, lacks conglomeratic material, and is a strong corrosion surface; thus it is more likely that the westward termination of the Quimbys Mill and Nachusa Formations marks the limit of their deposition. There is no evidence of lateral gradation of the Quimbys Mill and Nachusa to the underlying and more persistent Grand Detour Formation. The basal Galena strata, on the other hand, thin easterly from extreme northwestern Illinois—the Spechts Ferry extending only to the vicinity of Scales Mound in Jo Daviess County, and the Guttenberg Formation thinning to only a third of its maximum thickness in the same area. The overlying Dunleith Formation and its members are relatively uniform in thickness throughout northern Illinois and show no thickness variations that can be related to the Platteville-Galena contact. The eastward thinning of the basal Galena strata appears to be depositional; probably it resulted from slight uplift along the Wisconsin Arch. The area in which the Spechts Ferry, Quimbys Mill, and Nachusa Formations are absent is at least a diastem and probably is a minor unconformity. The considerable change in the faunas at this contact support the evidence for a significant time gap.

The contact of the Galena Group with the overlying Maquoketa Shale Group is described under Dubuque Formation.

Correlation. The Galena Group is equivalent to the Trenton Group in New York, the Lexington Group and probably the lower part of the Cynthiana Limestone in Kentucky, the Nashville Group in Tennessee, and the Decorah and Kimmswick Formations in Missouri.

DECORAH SUBGROUP

The Decorah Subgroup (Calvin, 1906) consists of the dominant shale and shaly limestone and dolomite at the base of the Galena Group, the basis on which it was originally differentiated as a formation in the type locality at Decorah, Iowa. In northern Illinois the Decorah Subgroup (fig. 11) occurs only in the northwestern corner of the state, where it consists of the Spechts Ferry and Guttenberg Formations (T and W, 1963). In the type area the Decorah also includes strata, called the Ion Member, that are equivalent to the Buckhorn and St. James Members of the Dunleith Formation, but these strata grade southward to dolomite that is only slightly shaly and closely resembles the overlying Galena strata. Consequently, near the northwest corner of Illinois, the top of the Decorah is dropped, by vertical cut-off, to the top of the Guttenberg

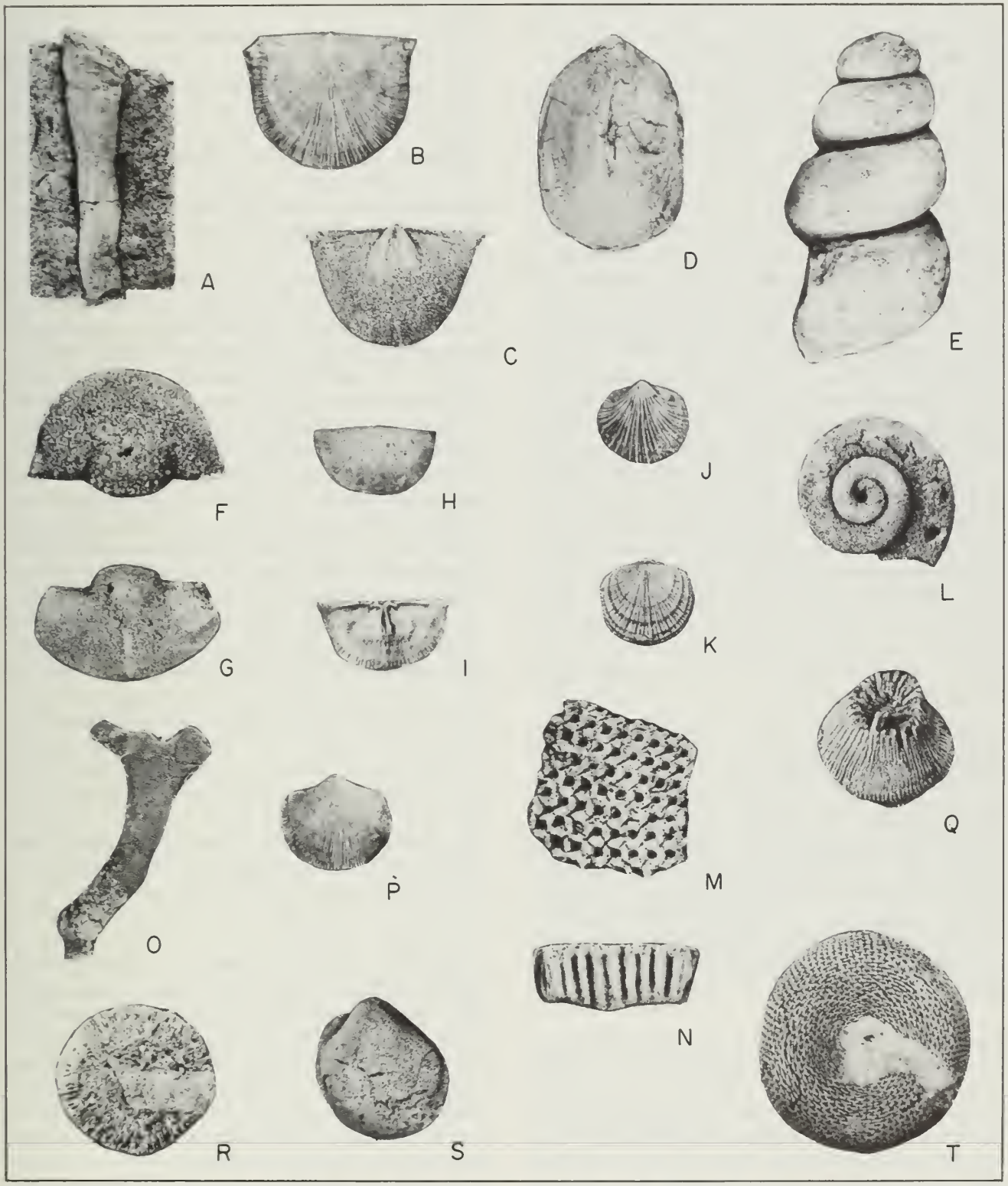

Figure 17. Characteristic fossils of the Galena Group. A - *Palaeosynapta flaccida* Weiss, B - pedicle valve exterior of *Rafinesquina trentonensis* (Conrad), C - interior mold of pedicle valve of *Rafinesquina* sp., D - *Pseudolingula iowensis* (Owen), E - *Hormotoma major* (Hall), F and G - cephalon and pygidium of *Illaenus* sp., H and I - pedicle valve exterior and brachial valve interior of *Sowerbyella punctostriata* (Mather), J and K - pedicle and brachial exterior of *Dalmanella* sp., L - *Liospira* sp., M and N - top and side views of *Receptaculites oweni* Hall, O - trepostome bryozoan, P - pedicle valve exterior of *Pionodema subaequata* (Conrad), Q - *Streptelasma* sp., R - basal view of *Prasopora* sp., S - *Vanuxemia* sp., T - *Ischadites iowensis* (Owen), all X 1.

Formation. In eastern Jo Daviess County the Spechts Ferry thins out, the Guttenberg thins greatly, and the Decorah Subgroup, represented only by the Guttenberg Formation, is only 1 to 4 feet thick and is locally absent. The Decorah Subgroup continues southward in western Illinois and is particularly well developed in the outcrop region in Calhoun County.

KIMMSWICK SUBGROUP

The Kimmswick Subgroup (Ulrich, 1904) consists of the dominantly pure carbonate strata that form by far the greater part of the Galena Group, excluding only the basal shaly Decorah Subgroup and the uppermost shaly Dubuque Formation. It, therefore, includes the Dunleith and Wise Lake Formations. It is equivalent to the Kimmswick Formation of Missouri in Ralls County, Missouri, north of St. Louis, where both the Dunleith and Wise Lake Formations are present. In the type area of the Kimmswick in Jefferson County, Missouri, south of St. Louis, the Wise Lake and the upper part of the Dunleith were truncated before deposition of the Maquoketa Shale Group (T and W, 1963). Because the Dunleith and Wise Lake Formations are distinctive units in the Kimmswick of eastern Iowa and western Illinois, the Kimmswick was designated as a subgroup in Illinois. It is a useful unit in Illinois, particularly in northeastern Illinois, where the Dunleith Formation becomes relatively pure and is not readily distinguished from the Wise Lake.

SPECHTS FERRY FORMATION

The Spechts Ferry Formation (Kay, 1928, p. 16; 1935, p. 287), the basal formation in the Galena Group, is dominantly shale containing thin beds of limestone and bentonite. It is named for Spechts Ferry, Iowa, north of Dubuque in Dubuque County, (SW NW 4, 40 N-2E), where it is exposed in a ravine and is 7 feet 9 inches thick (T and W, 1963, p. 106). It is called the "Clay bed" in the mining district.

Distribution and thickness. In northern Illinois, the Spechts Ferry Formation is restricted to the northwest corner of the state where it is exposed only in a limited area along the Galena River north of Galena. It is 3 feet 4 inches thick in the Millbrig Southeast Section (geol. sec. 12) and is as much as 5 feet thick in borings in the zinc-lead mining district in Illinois. However, it is absent in places, and it does not extend far east of the mining district, pinching out about the middle of Jo Daviess County. In southern Wisconsin, the eastern limit of the formation is along a north-south line between Mifflin and Mineral Point in Iowa County. Farther east, near Harrison (geol. sec. 32), a thin bed of bentonite and a thin lense of dark brown shale at the base of the Guttenberg and green clay in pits in the top surface of the Quimbys Mill may indicate that the Spechts Ferry formerly extended farther east than at present. However, the Spechts Ferry is entirely absent in exposures in Rock River Valley. Therefore, it probably was not deposited in that area but thinned out on the flank of the Wisconsin Arch.

Lithology. The Spechts Ferry is largely green calcareous shale containing thin beds of limestone, particularly in the lower part (fig. 16D). In comparison to other shales, the Spechts Ferry is high in clay and low in silt. The limestone beds are of considerable variety—argillaceous, nonfossiliferous, dense, fine-grained limestone; lithographic, slightly argillaceous limestone; dark purplish gray calcarenite; and coquina, the latter consisting largely of the shells of *Pionodema*. Some of the limestone beds have widespread continuity throughout the outcrop region in Iowa, Wisconsin, and Minnesota. The dominantly shaly upper part of the formation, the major part, is differentiated as the Glencoe Member, which contains the Millbrig Bentonite at its base or in its lower few inches. The Castlewood Member, beneath the Glencoe Member, consists of a thin but widespread bed of limestone underlain in places by the Deicke Bentonite Bed and a thin bed of dark brown shale.

Fauna. The Spechts Ferry Formation in northwestern Illinois and adjacent parts of Wisconsin and Iowa is locally very fossiliferous. Orthid brachiopods, including *Pionodema subaequata* (Conrad) and *Doleroides gibbosus* (Billings), are particularly conspicuous in some limestone beds. Ramose and bifoliate bryozoans are also locally abundant. Broken and abraded fossil debris is commonly concentrated in thin coquinoid limestone beds.

Stratigraphic relations. The Spechts Ferry Formation rests on the prominent corrosion surface on top of the Quimbys Mill Formation. It thins out easterly whereas the Quimbys Mill and the underlying Nachusa thin out to the west. However, the Spechts Ferry extends far enough eastward to overlap the Quimbys Mill in a north-south area about 20 miles wide extending eastward from the northwest corner of Illinois. The contact of the Spechts Ferry with the overlying Guttenberg is sharp, but there is no evidence of erosion of the Spechts Ferry. However, the basal Guttenberg strata commonly contain phosphatic nodules, and the Kings Lake Formation in western Illinois and northeastern Missouri is missing at that position.

Correlation. The Spechts Ferry Formation is a distinctive unit in Iowa and Wisconsin, where it commonly is classified as a member of the Decorah Formation. Farther north in Minnesota, the overlying Guttenberg grades into shale and the Spechts Ferry is not a useful rock-stratigraphic unit. In that area, the Castlewood Member of the Spechts Ferry is equivalent to the *Lingula elderi* bed of Minnesota reports (Stauffer and Thiel, 1941). It is the lower part of the Carimona Limestone Member (Weiss, 1955, 1957). Weiss correlated the Carimona with the Quimbys Mill Formation and assigned it to the Platteville Formation because of its dominant limestone lithology, but Templeton and Willman (1963) retained it in the Spechts Ferry because the widespread physical and faunal break of the Platteville-Galena is at the base. The Spechts Ferry was long considered to be the uppermost member of the Platteville Formation (Kay, 1954). However, its close association with the overlying Decorah was shown by Herbert (1949), and its Trentonian age was supported by faunal studies (Perry, 1962; DeMott, 1963).

The Spechts Ferry is present in western Illinois and in northwestern Missouri, but in the latter area the Glencoe Member is an undifferentiated part of the Decorah Formation and the Castlewood Member is included in the Plattin Formation. The Spechts Ferry is equivalent to the Curdsville Limestone in Kentucky and Tennessee and to the Selby Member, the basal member of the Rockland Formation in New York and Ontario (T and W, 1963). In all these areas, strata equivalent to the Spechts Ferry are the basal strata in the Trentonian Series.

Castlewood Member

The Castlewood Member, the basal, dominantly limestone member of the Spechts Ferry Formation (T and W, 1963, p. 107, geol. sec. 25), is named for Castlewood, St. Louis County, Missouri, 1½ miles northeast of the type section in the Mincke Section (cen. E ½ SE SE 21, 44N-4E). In the type section, the member is 6 feet 11 inches thick. Where exposed north of Galena (geol. sec. 12) in northwestern Illinois, it is 1 foot 6 inches thick. It is 6 inches thick in the Spechts Ferry type section and is thin and locally absent in the Wisconsin and Iowa outcrop area, but northward it thickens to 2 feet at Decorah and to 4 feet in southern Minnesota. The limestone is slightly argillaceous, gray, dense, very fine grained, and medium bedded to massive. It contains *Pionodema* in places but is generally unfossiliferous. The limestone commonly overlies an inch or two of green shale and a widely persistent bed of dark brown shale half an inch or less thick. The Deicke Bentonite Bed occurs either in the green shale or on top of the basal brown shale.

Deicke Bentonite Bed (new)

The Deicke Bentonite Bed, which occurs near or at the base of the Castlewood Member, is named herein for Deicke, in St. Louis County, Missouri, which is 2 miles southwest of the type section. The type section is part of the Castlewood type section in the Mincke Section (T and W, 1963, geol. sec. 25), where the bentonite is 5 inches thick. It is 3 inches thick in the Kings Lake Section near Foley in Lincoln County, Missouri, just across the Mississippi River from Calhoun County, Illinois (T and W, 1963, geol. sec. 26). The Deicke Bentonite Bed is present in many localities in the Upper Mississippi Valley outcrop region (T and W, 1963, figs. 22-24) but is less continuous than the Millbrig Bentonite Bed above the Castlewood. It is commonly a light gray plastic clay as much as 2 inches thick (samples 23, 26, and 95, table 1). In several areas in southwestern Wisconsin and northeastern Iowa, the Deicke Bentonite is altered to a hard pink bed consisting of monoclinic potash feldspar. The bentonite has not been found in the few exposures of the Castlewood Member in northwestern Illinois, but it probably is present elsewhere in the subsurface in that area, as well as in Calhoun County, Illinois. It is correlated with the prominent bentonite at the base of the Curdsville in Kentucky and Tennessee (T and W, 1963).

Glencoe Member

The Glencoe Member, the upper member of the Spechts Ferry Formation (T and W, 1963, p. 16, geol. sec. 25) is named for Glencoe, St. Louis County, Missouri, 3 miles west of the type section, which is in the same section as the Castlewood Member. The Glencoe is 5 feet 3 inches thick in the type section. In northern Illinois, the Glencoe is exposed along the Galena River north of Galena (Millbrig Southeast Section, geol. sec. 12), where it is 1 foot 6 inches thick. It is largely green shale with thin beds of limestone, and it contains *Pionodema* in great abundance. The Millbrig Bentonite Bed occurs at the base of the Glencoe.

Millbrig Bentonite Bed (new)

The Millbrig Bentonite Bed, which occurs at the base of the Glencoe Member of the Spechts Ferry Formation, is named herein for Millbrig in Jo Daviess County. The type section is in the Millbrig Southeast Section (geol. sec. 12), where the bentonite is as much as 4 inches thick. In the region where the Spechts Ferry Formation is present, the Millbrig Bentonite Bed is the most consistently present and the thickest Champlainian bentonite. It is a light gray

plastic clay, stained orange by limonite in many places, and its mineral composition is typical of Ordovician bentonites (samples 1, 24, 27, 35, 86, 120, table 1). The Millbrig Bentonite correlates with the Hounsfield Bentonite in the Selby Member of the Rockland Formation in New York and with a bentonite on top of the Curdsville Limestone in Kentucky and Tennessee (T and W, 1963).

GUTTENBERG FORMATION

The Guttenberg Formation (Kay, 1928, p. 16; 1935, p. 289) is a widely distributed dolomite or limestone characterized by red-brown shale partings. It is named for Guttenberg, Iowa, where the type section is in a ravine north of the town. However, it is better exposed in a nearby roadcut, the Guttenberg North Section (T and W, 1963, geol. sec. 27), (SW SW 5, 92N-2W), where it is 16 feet 6 inches thick. The Guttenberg Formation is the basal formation of the Galena Group throughout northern Illinois, east of central Jo Daviess County. West of there, it overlies the Spechts Ferry Formation.

Distribution and thickness. The Guttenberg Formation is 15 to 20 feet thick in the limestone facies, which occurs in northwestern Illinois west of Scales Mound in Jo Daviess County. In local areas, particularly the mineralized areas, it is thinned to 2 to 4 feet by solution of the limestone beds, leaving a residuum of red-brown shale, which is called the "Oilrock" in the mining district. In the dolomite facies east of Scales Mound, the formation is not exposed in Illinois to near Winslow where it is 5 to 6 feet thick (geol. secs. 5, 6). In the area where it changes to dolomite, both in subsurface and in the outcrop area in southern Wisconsin, it appears to thin rapidly eastward to about one-half its maximum thickness. It is only 6 to 7 feet thick in the Orangeville and Rock City areas (geol. secs. 7, 20, 26). It continues to thin eastward to only 1 foot to 1 foot 6 inches in the Rockton and Rockford areas (geol. secs. 32, 34, 35, 36) and to about 3 feet in the Dixon and Polo areas (geol. secs. 45, 58, 60). It is missing or is represented by only a foot or two of brown, vesicular, fossiliferous dolomite lacking red shale partings in the exposures along the Oregon Anticline from Rochelle to Mt. Morris, along the La Salle Anticline near Oglesby and Lowell, and locally in subsurface elsewhere. Although not exposed in northeastern Illinois, it is widely recognized in borings as an important key bed (Buschbach, 1964).

Lithology. In the limestone facies the Guttenberg Formation is largely a very fine-grained to lithographic, dense, light pinkish tan limestone in 2- to 4-inch wavy beds that are separated by thin beds of dark red-brown shale as much as half an inch thick but mostly less than ¼ inch. Thin beds of calcarenite and fossil debris are common. Chert nodules and lenses are generally present in a single bed at a position 3 to 4 feet below the top. The formation is differentiated into two members—the lower, more grayish and slightly argillaceous, is the Garnavillo Member; and the upper and major part of the formation is the Glenhaven Member. A thin but persistent bed of bentonite, the Elkport Bentonite Bed, occurs at the base of the Glenhaven Member. Another bentonite that is 3 to 4 feet below the top of the Glenhaven has been found in southern Wisconsin and northern Illinois and is named the Dickeyville Bentonite Bed.

In the dolomite facies, the red-brown shale partings vary from prominent, as at Orangeville (geol. sec. 20) and Dixon Southwest (geol. sec. 58), to very thin and inconspicuous in other places. The dolomite is relatively pure, brown, thin bedded, and strongly vesicular. Molds and casts of fossils are abundant. A prominent megarippled bed of calcarenite occurs in the Guttenberg near Rockton in Winnebago County.

Fauna. The Guttenberg Formation of northern Illinois contains an abundant, diverse, and locally well-preserved fauna represented primarily by strophomenid brachiopods. The most conspicuous and ubiquitous element of the fauna is *Sowerbyella punctostriata* (Mather) and to a lesser extent *Rafinesquina trentonensis* (Conrad). Cephala and pygidia of the trilobite *Eomonorachus intermedius* (Walcott) are locally abundant on bedding planes, particularly in the limestone facies in northwestern Illinois and southwestern Wisconsin.

Guttenberg strata south and east of Winslow appear to contain a greater abundance of molluscan fossils than equivalent strata in northwestern Illinois and southwestern Wisconsin. At some localities (geol. secs. 20, 34, 58) the beds contain a large and diverse assemblage of archaeogastropods, nuculoid bivalves, and small nautiloid cephalopods.

Stratigraphic relations. The base of the Guttenberg is marked by abundant phosphatic nodules, but there is no evidence of significant erosion of either the Spechts Ferry or the Quimbys Mill Formations. The Guttenberg is overlain conformably by the Dunleith Formation. Commonly there is a transition zone about a foot thick with characteristics of both formations; the interval may be included in the Guttenberg in some places, in the Dunleith in others.

Correlation. The Guttenberg Formation in Illinois is equivalent to the Guttenberg Member of the Decorah Formation in the Upper Mississippi Valley, except some have included the strata here called Garnavillo in the Spechts

Ferry (Agnew et al., 1956). The Guttenberg is equivalent to the upper part of the Decorah Formation in eastern Missouri, to part of the Logana in Kentucky and the Hermitage in Tennessee, and the Napanee Member of the Rockland Formation in New York and Ontario (T and W, 1963).

Garnavillo Member

The Garnavillo Member, the basal member of the Guttenberg Formation (T and W, 1963, p. 113, geol. sec. 27), is named for Garnavillo, Clayton County, Iowa, 7½ miles northwest of the type section in the Guttenberg North Section (SW SW 5, 92N-2W), where the member is 1 foot 8 inches thick. The Garnavillo Member is 2 to 3 feet thick in the limestone facies in Illinois but generally is less than a foot thick in the dolomite facies and is missing in places. The Garnavillo is gray, slightly argillaceous, very fine-grained, dense limestone. It is thicker bedded and has thinner, lighter colored, brown shale partings than the Glenhaven Member above. In many places it occurs in 2 or 3 beds separated by 1 to 2 inches of calcareous greenish gray shale. Small phosphatic pellets are common in the basal bed. In the dolomite facies, it is also more grayish, more argillaceous, and less vesicular than the Glenhaven.

Glenhaven Member

The Glenhaven Member of the Guttenberg Formation (T and W, 1963, p. 113, geol. sec. 27) is named for Glenhaven, Grant County, Wisconsin, 2½ miles northeast of the type section in the Guttenberg North Section, where the member is 14 feet 10 inches thick. The Glenhaven Member is the greater part of the formation in all areas and is all of it in a few areas where the Garnavillo Member is missing. The limestone and dolomite beds in the Glenhaven are purer and browner than those in the Garnavillo Member, and the dark red-brown shale partings are more prominent. In the limestone facies, the upper 5 to 6 feet of the Glenhaven has thinner shale partings, is thicker bedded, and contains more calcarenite beds than the lower part. The only chert bed in the Guttenberg occurs 3 to 5 feet below the top. The Elkport Bentonite Bed occurs widely at the base of the Glenhaven Member, and the Dickeyville Bentonite Bed occurs 3 to 4 feet below the top. Above the upper bentonite the strata are thicker bedded, coarser grained, contain few red shale partings, and are transitional in character to the Buckhorn Member above. In places a corrosion surface occurs at or close to the top of the Guttenberg. In the dolomite facies in northwestern Illinois and southwestern Wisconsin (geol. secs. 5, 7, 20, 26) this transitional zone is sharply differentiated from both the more typical Glenhaven below and the Buckhorn above and is a distinctive medium-bedded vesicular, coarse-grained, highly fossiliferous brown dolomite.

Elkport Bentonite Bed (new)

The Elkport Bentonite Bed is the basal unit of the Glenhaven Member. It is named herein for Elkport in Clayton County, Iowa, which is 9 miles southwest of the type section in the Guttenberg North Section (T and W, 1963, geol. sec. 27). It is part of the type section of the Glenhaven Member in which it is ½ to 1½ inches thick. The bentonite is present in numerous exposures in northern Illinois (geol. secs. 32, 45). It is as much as an inch thick. In places the bentonite occurs as several very thin layers of gray clay interbedded with dark red-brown shale, the entire unit 1½ inches thick. It has the physical character and mineral composition typical of other bentonites (samples 15, 34, 37, 39, 46, 79, table 1).

Dickeyville Bentonite Bed (new)

The Dickeyville Bentonite Bed, which occurs in the Glenhaven Member of the Guttenberg Formation, is named for Dickeyville in Grant County, Wisconsin, which is located 4 miles southeast of the type section in the Dickeyville Northwest Section (geol. sec. 1), where it was first reported and called bentonite I-4 by Mossler and Hayes (1966). It is ½ to 2 inches thick in the type section, where it occurs 3 feet 6 inches below the top of the Glenhaven Member and has a typical bentonite composition (sample 98, 112, table 1). It has also been found in the Mineral Point Southwest Section in Wisconsin (geol. sec. 3), where it is ½ inch thick. In Illinois a bentonite occurs at this position at Rock City (geol. sec. 26, sample 40, table 1). It may be present elsewhere in northern Illinois where the Guttenberg is thin—a bentonite at the base might be the Dickeyville Bentonite rather than the Elkport Bentonite.

DUNLEITH FORMATION

The Dunleith Formation (T and W, 1963, p. 114, geol. sec. 28) is variable but is intermediate in purity between the underlying shaly Guttenberg Formation and the overlying purer Wise Lake Formation. It is named for Dunleith Township, Jo Daviess County, where the type section is in the Mississippi River bluffs on the north side of East Dubuque (SE 19, 29N-2W). The formation is about 132 feet thick in the type section, the lower 15 to 20 feet of which is not exposed.

Distribution and thickness. The Dunleith Formation is present throughout the area of the Galena Group in northern Illinois (fig. 1) and is fairly uniform in thickness

ranging from 120 to 135 feet, most commonly close to 125 feet. It is partially exposed at numerous outcrops in northern Illinois. Some of the more complete sections occur at East Dubuque (geol. sec. 9), Galena Junction (geol. sec. 10), Cedarville (geol. sec. 21), Freeport (geol. secs. 22, 23, 24, 25), Rockford (geol. secs. 35, 36, 37, 38, 40, 41), Polo (geol. sec. 45), Dixon (geol. secs. 57, 58, 59), and Lowell (geol. secs. 67, 68).

Lithology. The Dunleith Formation is largely slightly argillaceous, mostly cherty dolomite in the northern Illinois outcrop area. At the northwest corner of the state, the lower 25 to 40 feet is lithographic limestone, which is part of the northern limestone facies. In the southernmost outcrops, near Oglesby and Morris, the Dunleith is in the southern calcarenite facies. The northern limestone facies is more shaly and argillaceous than the dolomite facies, which in turn is more shaly than the southern limestone facies. But the change is progressive and is not related to the limestone-dolomite contacts.

The predominant dolomite is characteristically gray to light brown, described as the "Drab" in the mining district. It is pure to slightly argillaceous and unevenly vesicular, which gives it a distinctive, mottled appearance and a rough weathered face. It is thin to medium bedded and cherty. It contains beds of dense, argillaceous, fine-grained dolomite a few inches to several feet thick, several beds of bentonite generally less than an inch thick, thin beds with shaly partings, and rarely, beds of dolomitic shale or very shaly dolomite an inch or two thick.

The chert is commonly gray to light gray, locally white. It occurs largely as roughly spherical 2- to 4-inch concretions, but locally it is in flat slabs or lenses and in larger, more irregular masses. In some members the chert concretions are irregularly scattered, but in others they form well-defined layers. Some cherty intervals that are separated by noncherty strata are widely persistent. In northern Illinois the amount of chert is variable but generally is less than 5 percent, except for a few beds 5 to 10 feet thick, which in places are as much as 25 percent chert. The amount of chert generally decreases eastward, and it is almost entirely absent in subsurface east of Rockford.

Corrosion surfaces occur persistently at several horizons, most abundantly about the middle of the formation. Mostly they are parallel to bedding surfaces, but some truncate an inch or two of the underlying beds.

Many bedding surfaces are stylolitic, much more so in some areas than in others. Interpenetrations of more than an inch are not common.

In the northern limestone facies in Illinois, the Dunleith is characteristically gray lithographic limestone with a few argillaceous and shaly beds. In the southern limestone facies the Dunleith is largely light tan, fine- to coarse-grained limestone. It contains a small amount of chert and a few thin shaly partings. The lower part consists of thick-bedded and partly cross-bedded calcarenite. Some beds are strongly dolomite mottled.

Differentiation of the Dunleith Formation into members is difficult and requires detailed study to become familiar with minor lithologic features that seem very subtle on preliminary observation. Although detailed matching of closely spaced sections has demonstrated the lateral continuity of the minor variations on which member differentiation is based, the recognition of members is scarcely worth undertaking unless the identification of precise position in the section is needed for determining depth to other units such as cherty or argillaceous zones and for detailed studies of geologic structures. Because the formation is about 125 feet thick in a region where the relief exceeds 50 feet only along major valleys, the Dunleith is the only formation exposed in large areas. Consequently, the need to recognize stratigraphic position within the formation justifies the differentiation of members that are usually less readily recognized than members in the other formations.

In the type locality and in the general vicinity of Galena, Illinois, the Dunleith is subdivided into 10 members (fig. 11), most of which are distinguished by a lower, relatively pure unit overlain by an argillaceous unit. The argillaceous unit forms only about 10 percent, or even less, of the member. These members are traceable from the Galena area northwestward to northern Iowa, but the increase in shaliness north of there reduces their usefulness. East of Galena the upper parts of the members decrease in argillaceousness and thickness; the four members below the uppermost member (Wyota Member) become so much alike that they are not useful units and are combined in a single member, the Loves Park Member. Two of the members lack the upper argillaceous zone—the Beecher Member, which is entirely pure dolomite, and the overlying Eagle Point Member, which is a persistent cherty zone.

Because of the cyclic nature of the members, their differentiation and correlation depend in part on the recognition of many minor characteristics, such as corrosion surfaces, mottling, exceptionally large chert nodules, bentonites, shaly beds, and characteristic fossils. Four of the bentonites are widely persistent and are named as beds (fig. 11).

Fauna. Fossils occur throughout the Dunleith Formation, but they are better preserved and more conspicuous in the lower shaly beds, which include the Buckhorn and St.

James Members. The Buckhorn, St. James, and Beecher Members are characterized by an abundance of the orthid brachiopod *Dalmanella rogata* (Sardeson). The orthid *Glyptorthis bellarugosa* (Conrad) is locally abundant in the Buckhorn. Abundant trepostome bryozoans are often present in the green shale partings on bedding planes. The trepostome *Prasopora* (fig. 17R) is particularly abundant near the top of the St. James Member in northwestern Illinois and southwestern Wisconsin but is rarely present in the relatively purer equivalents to the south and east. Bedding planes in the St. James Member and overlying Dunleith units are often covered with large stemlike trace fossils referable to *Palaeophycus*.

Sowerbyella punctorstriata (Mather) and to a lesser extent *Dalmanella rogata* (Sardeson) are common in the Eagle Point Member.

Receptaculites oweni (fig. 17M, N) Hall occurs sporadically throughout the Dunleith and overlying Wise Lake strata. Specimens are abundant in the Fairplay (Lower *Receptaculites* Zone), Rivoli and lower part of the Sherwood Members (Middle *Receptaculites* Zone), and the lower part of the Stewartville Member (Upper *Receptaculites* Zone) of the Wise Lake Formation. The receptaculitid *Ischadites iowensis* (Owen) (fig. 17T) is relatively common in the middle and upper part of the Dunleith in northwestern Illinois and farther up the Mississippi Valley but is uncommon in central northern Illinois.

Stratigraphic relations. The Dunleith Formation appears everywhere to be conformable to the Guttenberg Formation below and the Wise Lake Formation above. The many corrosion surfaces within the formation indicate thinning, but the amount is difficult to evaluate. Combining the effects of interbed solution, represented by the stylolitic surfaces, with the effects of corrosion surfaces, total thinning of several feet is likely in most localities, and it may be several times greater in some places.

Correlation. The Dunleith Formation is equivalent to the strata differentiated in early reports as the "thick-bedded dolomite" plus the overlying "thick- to thin-bedded cherty dolomite" (Bain, 1905). Later it was largely included in the Prosser Formation of Minnesota (Ulrich, 1911), although the latter extended upward from the top of the Decorah Formation (top of the St. James Member) to the base of the Stewartville Formation (Willman, Reynolds, and Herbert, 1946). The Dunleith Formation was introduced to establish greater lithologic unity by recognizing the regionally persistent top of the relatively impure and cherty dolomite as a formation boundary. This combined the upper noncherty pure dolomite of the Prosser with the similar Stewartville in a new formation—the Wise Lake Formation. The uppermost Decorah strata (Ion Member), which grade southward into relatively pure dolomite (Buckhorn and St. James Members), are included in the Dunleith.

The Dunleith Formation is equivalent to the Kimmswick Formation in Missouri south of the Missouri River. North of there the Kimmswick includes the Wise Lake Formation. Although the boundaries do not match precisely, the Dunleith is equivalent to Cummingsville and Prosser as currently used in Minnesota, to the middle part of the Viola in Oklahoma and Kansas, to the Lexington Limestone in Kentucky, and to the lower part of the Bigby-Cannon in Tennessee. It is equivalent to the Hull, Shoreham, and Denmark Formations and the Rust Member of the Cobourg Formation of the Trenton Group in New York (T and W, 1963).

Buckhorn Member

The Buckhorn Member of the Dunleith Formation (T and W, 1963, p. 119, geol. sec. 29), the basal member, consists of shaly dolomite named for Buckhorn Corners, 2 miles east of the type section, a quarry at Buena Vista, Stephenson County (NW SW NE 15, 28N-7E), where the member is 8 feet 4 inches thick. It is commonly 5 to 10 feet thick, consists of medium gray, dark gray speckled, medium-grained dolomite or limestone, and contains green shale partings (geol. secs. 19, 20, 26). It is limestone only in the La Salle area. It contains several very shaly beds, especially in the upper part. It grades from strongly shaly in the Galena region to only slightly shaly in the La Salle area. In the Galena region, well rounded, medium grains of sand, like St. Peter sand, occur sparsely, particularly near the top. Thin beds of bentonite occur locally in a quarry north of Oregon in Ogle County (SE NE SW 28, 24N-10E), but have not been found elsewhere. The Buckhorn Member is more shaly than the St. James Member above and generally is sharply differentiated from it. It lacks the red shale partings of the Guttenberg Formation below, but the contact is gradational. The Buckhorn Member is equivalent to the lower part of the Ion Member of the Decorah Formation in Iowa, but it is much less shaly than at Decorah. It has long been differentiated as the "Blue" in the lead-zinc district because of the dark bluish gray of the samples from test borings.

St. James Member

The St. James Member of the Dunleith Formation (T and W, 1963, p. 119, geol. sec. 29), which overlies the Buckhorn Member, consists of relatively pure dolomite containing green shaly partings. It is named for St. James

Cemetery, 3 miles northwest of the type section in the same quarry as the type section for the Buckhorn Member at Buena Vista in Stephenson County. The St. James is 13 feet 3 inches thick in the type section. The St. James Member is commonly 10 to 15 feet thick throughout the northern Illinois outcrop area (geol. secs. 5, 6, 7, 19, 20, 26). It consists of light brownish gray, medium-grained, thin- to medium-bedded, vuggy dolomite containing thin green shaly partings, except in the La Salle area where it is limestone. The lower part is thicker bedded and contains fewer shale partings. In the exposures in Jo Daviess County, the upper part is moderately shaly and the upper 1 to 2 inches is strongly shaly, but the abundance of green shale diminishes eastward and shale is inconspicuous, although present, in the Rock River Valley.

The St. James is purer and lighter in color than the Buckhorn Member below. The thinner bedding and the presence of green shale partings, particularly in the upper few feet, distinguishes it from the Beecher above. Because of its grayish color in samples from borings, it has long been differentiated as the "Gray" in the mining district. It is equivalent to the upper part of the Ion Member in Iowa but is much less shaly than the type Ion.

Beecher Member

The Beecher Member of the Dunleith Formation (T and W, 1963, p. 119, geol. sec. 28) is a relatively pure, massive dolomite or limestone overlying the St. James Member. It is named for Beecher Street in East Dubuque, near the type section, which is part of the type section of the Dunleith Formation, where the Beecher is 8 feet 3 inches thick. It is commonly 5 to 8 feet thick throughout the northern Illinois outcrop area (geol. secs. 9, 12, 19, 25, 33, 35, 36). The Beecher consists of thick-bedded to massive, pure, light gray-brown, lithographic limestone in the type section and in northwestern Jo Daviess County. Throughout most of northern Illinois the Beecher is medium-grained, vuggy, pure, gray-brown dolomite. In the La Salle area the Beecher equivalent consists of calcarenite and calcisiltite with abundant comminuted shelly debris. It varies from massive in the area north and west from Freeport, to medium and thin bedded farther east. It contains several widely persistent corrosion surfaces. The Beecher differs from the cherty and generally thinner bedded Eagle Point Member above, and it lacks the green shale partings characteristic of the St. James Member below. It and overlying members of the Dunleith Formation have been called the "Drab" in the lead-zinc district.

Eagle Point Member

The Eagle Point Member of the Dunleith Formation (T and W, 1963, p. 120, geol. sec. 28), which overlies the Beecher Member, consists of relatively pure but cherty dolomite or limestone. The member is named for Eagle Point, a prominent bluff on the west side of the Mississippi River 2 miles north of the type section. The type section is part of the Dunleith type section, where the Eagle Point is 11 feet 10 inches thick. It thickens eastward from the type locality to 17 feet at Rockford. The Eagle Point is readily recognized as the lowest cherty zone in the Galena Group (geol. secs. 9, 21, 25, 33, 34, 35, 45, 57, 58). The Eagle Point Member is dolomite-mottled limestone in the type locality but grades to dolomite a short distance to the east and is dolomite throughout most of northern Illinois. It is moderately pure, vesicular dolomite, only slightly less pure than the members above and below. The Eagle Point contains many gray to light gray chert nodules, mostly arranged in well-defined bands parallel to the bedding surfaces. It is thin to medium bedded, generally thinner bedded than the Beecher below and the Fairplay above. The contacts are not sharply defined. They are placed at the first prominent bedding plane below the lowest band of chert nodules and above the highest band of chert nodules. In one section, at Dixon Southwest (geol. sec. 58), the chert is not prominent and the Eagle Point cannot be separated from the members above and below.

Fairplay Member

The Fairplay Member of the Dunleith Formation (T and W, 1963, p. 121, geol. sec. 28), commonly recognized as the Lower *Receptaculites* Zone in the Galena Group, is named for Fairplay, Grant County, Wisconsin, 6 miles northeast of the type section, which is part of the Dunleith type section. The Fairplay is 19 feet 7 inches thick in the type section. It occurs throughout the area of the Dunleith Formation ranging from 14 to 20 feet thick (geol. secs. 9, 25, 33, 38, 45, 57). It consists of lithographic, dense, thick-bedded, gray limestone strongly mottled with dolomite in the type section and for a few miles to the east, but throughout much of northern Illinois it is medium-grained, brown, vuggy, pure dolomite. The member is largely chert-free, but chert nodules are common in the upper 2 to 4 feet in many localities, and in the Dixon region they are common in a 1- to 2-foot interval near the middle. An argillaceous dense bed 1 to 2 feet thick, bounded in places by prominent bedding planes or corrosion surfaces, occurs at the top of the member. A prominent, smooth bedding surface 4 to 8 feet below the top is probably the position of a bentonite found farther north in Minnesota. *Receptaculites* is abundant in this zone in the calcarenite, dolomite, limestone, and shale facies.

Mortimer Member

The Mortimer Member of the Dunleith Formation (T and W, 1963, p. 121, geol. sec. 28), which overlies the Fair-

play Member, consists of cherty dolomite. It is named for Mortimer Street in East Dubuque near the type section, which is part of the Dunleith type section. The Mortimer is 11 feet 3 inches thick in the type section. The Mortimer is distinguished by the presence of exceptionally large nodules of white chert. A well-defined argillaceous zone at the top extends from the type area (geol. sec. 9, 15) eastward to the Freeport area (geol. secs. 21, 24), but east of there the argillaceous zone is not generally recognizable and strata that are equivalent to the Mortimer are included in the Loves Park Member. The distinctive, large chert nodules are generally present in the lower part of the Loves Park Member (geol. sec. 38). In the type area the Mortimer is distinctly more argillaceous than the Fairplay below but less argillaceous than the Rivoli above. A prominent, smooth bedding surface is commonly present at the top of the Mortimer and is probably the position of a bentonite elsewhere.

Rivoli Member

The Rivoli Member of the Dunleith Formation (T and W, 1963, p. 122, geol. sec. 28), which overlies the Mortimer Member, consists of cherty argillaceous dolomite. It is named for Rivoli Street in East Dubuque near the type section, which is part of the Dunleith type section where the Rivoli is 19 feet thick. The Rivoli is a well-defined member in the East Dubuque to Galena area (geol. secs. 9, 10, 13, 15), but it thins and loses its distinctiveness eastward and is included in the Loves Park Member at Freeport and farther east. The equivalent interval in the Loves Park Member is only about 13 feet thick. In the type locality, the upper 5 to 6 feet of the Rivoli Member is very argillaceous and contains an abundance of dark gray chert nodules and lenses. The high chert content is a local feature, because the unit becomes noncherty in the outcrop regions both to the north and east. The relatively high argillaceous content is more persistent but becomes much less distinctive eastward. However, the Rivoli is the most argillaceous part of the Dunleith Formation in northern Illinois. The Rivoli is also characterized by many corrosion surfaces, locally as many as 6 to 8 to the foot, particularly in the upper part. Many of the corrosion surfaces continue eastward to the Freeport (geol. sec. 21) and Rockford (geol. sec. 38) areas where they serve as a useful marker for the lower part of the Loves Park Member. A prominent corrosion surface occurs 1 to 1 foot 6 inches above the base of the member in many exposures. One of the more widespread bentonites in the Dunleith Formation (the Calmar Bentonite Bed) occurs 4 to 5 feet below the top of the Rivoli Member. A less prominent but widespread bentonite (the Conover Bentonite Bed) occurs at the top of the Rivoli. It is well developed in the Guttenberg and Decorah areas in Iowa, but it is represented in Illinois only by strong, smooth-surfaced reentrants, as at East Dubuque and Galena Junction. Thin streaks of gray clay at the base of the upper shaly zone and in the lower part of the Rivoli in the local areas may also be bentonitic. A 1- to 3-inch bentonite occurs near the base of the section at Galena Junction (geol. sec. 15, sample 82, table 1), about 6 feet above the base of the Rivoli. The bentonite may be equivalent to the Calmar Bentonite, but it appears to be a little lower in the section.

Calmar Bentonite Bed (new)

The Calmar Bentonite Bed, which occurs in the Rivoli Member (T and W, 1963, p. 116, 122) has been informally called "K" (Levorson and Gerk, 1972). It is named herein for Calmar, Winneshiek County, Iowa, 9 miles south of the type section (geol. sec. 74), which is in an excavation for the diversion of a stream at Decorah (SE NE 18, 98N-8W). In the type section the bentonite is only locally present, but it is 1 to 2 inches thick and occurs as two layers in an 8-inch shaly zone (sample 63, table 1). It presently is more accessible in the Decorah South Quarry Section (T and W, 1963) (sample 138, table 1) and on the north side of Iowa Highway 9, about 2 miles southeast of Decorah (SE SE 23, 98N-8W) (sample 132, table 1). In Illinois its position is marked by a prominent, smooth-surfaced reentrant with thin patches of clay, ¼ inch or less thick, as at the Cedarville Section (geol. sec. 21) and the Pecatonica South Section (geol. sec. 31). Bentonite has been confirmed only in the Kishwaukee Forest Preserve Section (geol. sec. 41, sample 3). This bentonite is prominently developed in Iowa and Minnesota (Levorson and Gerk, 1975).

Conover Bentonite Bed (new)

The Conover Bentonite Bed occurs at the top of the Rivoli Member (T and W, 1963, p. 122). It is named herein for Conover, Winneshiek County, Iowa, 7 miles southeast of the type section, which is in the same section as the Calmar Bentonite Bed, where it is as much as 1 inch thick but is only locally present. It is more accessible in nearby quarries to the southeast (SW 17, 98N-8W) (sample 139, table 1) and in a roadcut of U.S. Highway 52 (SE 17, 98N-8W). It is widely present in Iowa (Levorson and Gerk, 1975), but in northwestern Illinois its position is marked by a prominent smooth-surfaced reentrant, as at Galena Junction (geol. sec. 15) and Pecatonica (geol. sec. 31).

Sherwood Member

The Sherwood Member of the Dunleith Formation (T and W, 1963, p. 123, geol. sec. 28) consists of slightly argillaceous cherty dolomite overlying the Rivoli Member. It is named for Sherwood Street in East Dubuque near the type section, which is part of the Dunleith type section, where the Sherwood is 13 feet 7 inches thick. It is commonly 10 to 14 feet thick in northern Illinois, where it is recognized only in the area west of Freeport (geol. secs. 9, 10, 13, 15, 21). Farther east, strata equivalent to the Sherwood are an undifferentiated part of the Loves Park Member. In the Galena and East Dubuque region, the lower part is relatively pure, vuggy dolomite that is only locally cherty, except for an almost continuous 2- to 6-inch bed of chert 6 inches to 1 foot above the base. The upper 3 to 5 feet is strongly argillaceous, relatively dense, cherty dolomite containing beds of calcarenite and locally red-brown chert nodules and shale partings. Corrosion surfaces are common to abundant. A widespread bed of bentonite, the Nasset Bentonite Bed, occurs near the base of the member.

Nasset Bentonite Bed (new)

The Nasset Bentonite Bed, which occurs 3 to 6 feet above the base of the Sherwood Member (T and W, 1963, p. 123), is one of the more widely distributed bentonites in the Upper Mississippi Valley. It is named herein for Nasset, Winneshiek County, Iowa, which is 8 miles east of the type section in the same section as the Calmar Bentonite Bed, where it is as much as 3 inches thick but presently is not well exposed. It is a prominent bentonite elsewhere in Winneshiek County (Levorson and Gerk, 1972, 1975). The Nasset is also present to the southeast in Clayton County, Iowa, in the Guttenberg North Section (T and W, 1963, p. 236) (sample 14, table 1). It is much thinner in northern Illinois where it is generally less than ¼ inch thick. The Nasset Bentonite Bed is present in the Kishwaukee Forest Preserve Section (geol. sec. 41, sample 4), and its position is marked by a prominent reentrant at East Dubuque (geol. sec. 9), Menominee Station (geol. sec. 10), and Galena Junction (geol. sec. 15), all in Jo Daviess County. It has been called "I-5" by Mossler and Hayes (1966).

Wall Member

The Wall Member of the Dunleith Formation (T and W, 1963, p. 123, geol. sec. 28), which overlies the Sherwood Member is named for Wall Street in East Dubuque. The type section is part of the Dunleith type section, where the Wall Member is 9 feet 8 inches thick. The Wall is differentiated in Illinois only in the Galena to East Dubuque region (geol. secs. 9, 10, 13, 15), where it is 10 to 12 feet thick. The lower part is relatively pure, vuggy, medium-bedded dolomite; the upper 1 to 3 feet is dense, slightly argillaceous dolomite and contains thin shale partings. The upper part is strongly cherty. Farther east, the amount of clay, silt, and chert decreases and strata equivalent to the Wall are the upper part of the Loves Park Member. The widely distributed Haldane Bentonite Bed occurs near the middle of the member.

Haldane Bentonite Bed (new)

The Haldane Bentonite Bed, which occurs in the middle part of the Wall Member in northwestern Illinois and farther east in the uppermost part of the Loves Park Member, is named for Haldane in Ogle County, 5 miles northwest of the type section. The type section is in the Victory School Section (geol. sec. 47, sample 32, table 1), where the bentonite is as much as 2 inches thick. It is 6 inches thick locally in the Dixon South Section, but the abnormal thickness perhaps is due partly to squeezing (geol. sec. 59, sample 33, table 1). It is well exposed also at Freeport (geol. sec. 22, sample 5, table 1); its position is marked by a strong reentrant in exposures at Menominee Station (geol. sec. 10), at Galena Junction (geol. sec. 15), northeast of Galena (geol. sec. 13), south of Pecatonica (geol. sec. 31), and elsewhere.

Loves Park Member (new)

The Loves Park Member of the Dunleith Formation is named herein for strata essentially equivalent to the Mortimer, Rivoli, Sherwood, and Wall Members of the type Dunleith section. It is named for the town of Loves Park, on the north side of Rockford, in Winnebago County, which is 1 mile southwest of the type section in the Harlem Southeast Section (geol. sec. 38). The Loves Park Member is recognized throughout the outcrop region from Freeport (geol. sec. 24) east to Rockford (geol. secs.31, 37, 38) and southwest of there to Dixon (geol. sec. 58). It is not differentiated in the calcarenite facies of the Dunleith in the La Salle area. It is commonly about 50 feet thick, which indicates a slight thinning of the interval from the equivalent strata in the East Dubuque area. The Loves Park Member consists of relatively pure, vuggy, slightly cherty dolomite which lacks the argillaceous zones that permit subdivision of this part of the Dunleith Formation into members farther west. Certain distinctive units continue into the Loves Park Member and are useful in determining the approximate position and correlation

with the type Dunleith section but do not permit practical identification of the member boundaries. The large chert nodules characteristic of the Mortimer Member, the abundance of corrosion surfaces in the Rivoli, and the bentonites in the Rivoli, Sherwood, and Wall persist into the Loves Park Member. The amount of chert in this part of the section decreases eastward from the Galena region. Chert is still present in the Rockford and Dixon areas but is absent in subsurface east of there and in the exposures at Central in Kendall County.

Wyota Member

The Wyota Member of the Dunleith Formation (T and W, 1963, p. 124, geol. sec. 28), the uppermost member, consists of relatively pure dolomite containing bands of chert nodules. It is named for Wyota Street in East Dubuque near the type section, which is part of the Dunleith type section, where the Wyota is 19 feet 9 inches thick. It is one of the more widely traced members of the Dunleith, extending eastward from the type region to the Rockford and Dixon areas and northward to southern Minnesota. It does not extend farther north, where the Dunleith becomes dominantly shale, nor farther east in northeastern Illinois, where the entire Dunleith becomes very pure and noncherty. The Wyota is relatively pure, vuggy, medium-grained, medium- to thick-bedded, cherty dolomite. The chert nodules are light gray, mostly 2 to 3 inches thick, and occur in well-defined bands. The upper 2 to 4 feet of the Wyota is slightly argillaceous and the uppermost 1 to 2 inches commonly is shaly, these two units producing a pronounced reentrant in many outcrops. The Wyota is characterized by the presence of 1- to 2-inch dense beds which contain small burrows. In some localities corrosion surfaces are common in the upper 5 to 10 feet of the Wyota. A bed of bentonite as much as 2 inches thick occurs just above the top of the Wyota Member southeast of Rockford in the New Milford East Section (geol. sec. 40, sample 70) and nearby in a roadcut just east of the Kishwaukee Forest Preserve. A 1-inch bed of bentonite 1 foot 10 inches below the top of the Wyota in southern Minnesota (T and W, 1963) could be the same, because the local presence of chert in the basal 2 or 3 feet of the overlying Wise Lake Formation makes precise location of the Wyota top uncertain in some localities.

WISE LAKE FORMATION

The Wise Lake Formation (T and W, 1963, p. 125, geol. secs. 32, 33; revised in this report) consists of about 75 feet of pure, massive dolomite or limestone overlying the cherty Dunleith Formation and is overlain by the shaly Dubuque Formation. The Wise Lake is named for Wise Lake, a lake on the Mississippi River floodplain, presently part of the larger lake formed by the navigational dam at Bellevue, Iowa. The type section is in a bluff of the Mississippi River bordering Wise Lake, 6 miles south of Galena, Jo Daviess County (cen. W. line NE SE 21, 27N-1E), where it is 79 feet thick. The lower 9 feet was exposed in a railroad culvert excavation that is now filled, but it can be seen in the type section of the Sinsinawa Member at Galena.

The change to the Dubuque above is a gradual transition through an interval of about 20 feet, and the contact between the formations has been placed at various positions in that interval. In defining Wise Lake, the contact was placed at the lowest strong shaly bed. However, a distinctive bed of dolomite (fig. 16B) 4 to 6 inches thick, bounded by strong shaly partings, occurs 8 feet above the base of the transition zone and is a widely traceable marker bed (T and W, 1963, p. 239). Because it is more easily recognized, the top of the Wise Lake Formation is raised to that position, as suggested by Levorsen and Gerk (1975). Although a few thin shaly partings occur in the 8-foot interval, the dolomite is only slightly argillaceous and as a whole more closely resembles the Wise Lake below, to which it now is assigned.

Distribution and thickness. The Wise Lake Formation is present throughout the northern outcrop area; its thickness is not known to vary by more than 5 feet from 75 to 80 feet thick. The entire Wise Lake Formation is well exposed in roadcuts of U.S. Highway 20 on the east side of Sinsinawa Creek, northwest of Galena (geol. sec. 11). Large parts of the formation are exposed near Freeport (geol. sec. 22), Rockford (geol. sec. 39, 40), Belvidere (geol. sec. 42), Mt. Carroll (geol. sec. 43), Dixon (geol. sec. 58), and near Millbrook (geol. sec. 70).

Lithology. The Wise Lake Formation consists almost entirely of pure, light brown, vesicular to vuggy dolomite. It is noncherty except for a few scattered chert nodules in the lower 2 to 3 feet. The lower part of the Wise Lake, differentiated as the Sinsinawa Member, is medium bedded and some beds are very slightly argillaceous. The upper part, the Stewartville Member, is thick bedded and is essentially free from siliceous impurities, except for a few thin, slightly shaly beds near the top, which are in the transition to the Dubuque Formation above. The Wise Lake contains two bentonites, one known only near Rockford at the base, as discussed under the Wyota Member of the Dunleith Formation, and the widespread Dygerts Bentonite Bed, which is 17 feet above the base of the Sinsinawa Member. The contact between the Sinsinawa and Stewartville Members is not a prominent change

in lithology and commonly is uncertain within an interval of 1 to 3 feet. In the Rockford area where the entire Wise Lake is essentially free from siliceous impurities, the members cannot be differentiated, although the presence of abundant *Receptaculites*, which characterizes the lower part of the Stewartville, indicates the approximate position of the Sinsinawa-Stewartville contact. In the outcrops along the Vermilion River at Lowell (geol. sec. 67), where about 150 feet of the Galena Group is exposed, approximately the upper 30 to 40 feet is dolomite-mottled limestone, which is probably equivalent to the lower part of the Wise Lake Formation. In this region and in the subsurface farther south and east, the chert at the top of the Dunleith is missing, and the Dunleith and Wise Lake Formations are not readily separable.

Fauna. The Wise Lake Formation contains a diverse and locally abundant fauna that consists mostly of internal and external molds. The mollusks are particularly common and include archaeogastropods, nuculoid bivalves and nautiloid cephalopods. The relatively large, high spiralled internal molds of *Hormotoma major* (Hall) (fig. 17E) are especially conspicuous. Other characteristic fossils include *Illaenus* (fig. 17F, G), *Streptelasma* (fig. 17Q) and *Rafinesquina* ? (fig. 17C).

The Upper *Receptaculites* Zone of the Galena Group occurs about 35 to 40 feet above the base of the Wise Lake Formation. Where the Wise Lake members can be differentiated, this zone occurs at the base of the Stewartville Member and at some localities *Receptaculites* is also abundant in the upper 5 to 6 feet of the Sinsinawa Member.

Palaeosynapta flaccida Weiss (fig. 17A) is locally common in the upper 10 to 15 feet of the Wise Lake Formation and in the lower 5 feet of the Dubuque Formation.

Although the gastropod *Maclurites* is locally common in the Stewartville Member of the Wise Lake Formation in northeastern Iowa and southeastern Minnesota, it is relatively uncommon in northern Illinois.

Stratigraphic relations. The contact of the Wise Lake with the Dunleith Formation is generally sharp but conformable. The change to the Dubuque above is a gradual transition through an interval of about 20 feet.

Correlation. The Wise Lake Formation represents the peak of purity in the Galena Group with an almost complete absence of siliceous terrigenous materials. A comparable degree of relative purity occurs in Trentonian strata from New York (Steuben Member of the Cobourg Formation) to Colorado (in the Fremont Formation) and from Manitoba (in the Selkirk Member of the Red River Formation) to Tennessee (in the Upper Cannon Member of the Bigby-Cannon Formation), and comparable relations exist even more widely (T and W, 1963). This indicates a long interval of stability throughout the interior of the continent, an interval during which clastic materials were not transported far westward from the tectonically active areas along the eastern margin of the continent.

Sinsinawa Member

The Sinsinawa Member of the Wise Lake Formation (T and W, 1963, p. 126, geol. sec. 33), the basal member, is named for Sinsinawa Creek, where the member is well exposed in roadcuts of U.S. Highway 20 on the east side of the creek. However, the section is dangerous to study because of heavy traffic, and a roadcut of the same highway on the east side of Galena River at Galena was designated the type section (SW SE NE 20, 28N-1E), except for the uppermost few feet, which is exposed in the Wise Lake type section. The Sinsinawa Member is continuously present and is uniformly 35 to 40 feet thick. It consists of thick-bedded, light brown, pure dolomite that is noncherty, except for a few scattered nodules in the lower two feet. Near the middle of the Sinsinawa Member is a widespread bentonite named the Dygerts Bentonite Bed.

Dygerts Bentonite Bed (new)

The Dygerts Bentonite Bed, which occurs about 17 feet above the base of the Sinsinawa Member, is named herein for Dygerts Mound in Jo Daviess County, 1½ miles southeast of the type section (geol. sec. 14), which is part of the type section of the Sinsinawa Member at Galena (T and W, 1963, geol. sec. 33). The bentonite is generally 1 to 2 inches thick in northern Illinois (samples 81, 88, 102, 125, table 1) but is absent in some localities. It extends northward from Illinois to southern Minnesota and has been informally called "I-7" in Iowa (Mossler and Hayes, 1966, Levorson and Gerk, 1972, 1975) and the "feldspathized shale" in Minnesota (Weiss, 1957).

Stewartville Member

The Stewartville Member of the Wise Lake Formation (Ulrich, 1911), the uppermost member, is named for Stewartville, Olmstead County, southeastern Minnesota, where the type section is a quarry on the north bank of Root River (Kay, 1935; T and W, 1963). The Stewartville Member is recognized throughout the outcrop area in northern Illinois, where it is 40 to 45 feet thick. It differs from the Sinsinawa Member below in being thicker bedded—some

beds are 5 to 10 feet thick. It is even purer than the Sinsinawa; those samples from the lower half in particular contain almost no insoluble residue. Large vugs mostly filled with white calcite are common in the uppermost 1 to 2 feet.

DUBUQUE FORMATION

The Dubuque Formation (Sardeson, 1907; T and W, 1963; Levorson and Gerk, 1975; revised in this report) which is the uppermost formation in the Galena Group, is named for Dubuque, Iowa, where the type section is an exposure in a quarry at the top of the West Fourteenth Street hill. Because of the thick transition zone, the base of the Dubuque has been placed at several positions, not always clearly identified. As recommended by Levorson and Gerk (1975), who have traced widely many individual beds, the contact is presently placed at a distinctive and persistent marker bed that is exposed in the type section in Dubuque and in the Wise Lake type section in Illinois (described earlier under Wise Lake). Acceptance of the marker bed as the base of the Dubuque moves the formation contact about 8 feet higher than previously used in Illinois (T and W, 1963).

Distribution and thickness. Dubuque strata have been eroded from a large part of the area where the Galena Group occurs (fig. 1). However, it is well exposed near Galena (geol. secs. 11, 16; and T and W, 1963, geol. sec. 32), Apple River (geol. sec. 17), Mt. Carroll (geol. sec. 43), Freeport (geol. sec. 18), Mt. Morris (geol. sec. 46), Rockford (geol. sec. 39), and Belvidere (geol. sec. 42). Where overlain by the Maquoketa Shale Group, the Dubuque is 35 to 40 feet thick.

Lithology. The Dubuque is characterized by well defined, flat bedding (fig. 16A), and the wide extent of individual beds. The beds are mostly 4 inches to 1 foot thick and are separated by shaly partings. In northern Illinois the formation is entirely dolomite. In the lower 10 to 15 feet the dolomite is thick bedded and relatively pure, and the shaly partings are thin. It becomes increasingly argillaceous upward, and in the upper half the dolomite is mostly dense to slightly vesicular, fine grained, light brownish gray to buff, and strongly argillaceous, and the partings thicken to beds of brownish gray dolomitic shale 2 to 6 inches thick. Red shale partings occur in a bed a few inches thick about 20 feet below the top.

Fauna. The Dubuque Formation contains a rich but poorly known fauna. Many typical Wise Lake fossils, including *Hormotoma major* (Hall) (fig. 17E), range up into the Dubuque Formation in northern Illinois. One of the most distinctive fossils is the inarticulate brachiopod *Pseudolingula iowensis* (Owen) (fig. 17D), which occurs most commonly in the shaly beds. The articulate brachiopods *Sowerbyella* and *Dalmanella* are locally abundant. Although most of the fossils are preserved as internal and external molds, recrystallized shelly debris occurs, particularly on shaly bedding surfaces.

Stratigraphic relations. The Dubuque is conformable with the Wise Lake below. In the few localities where its contact with the overlying Maquoketa Shale Group can be seen, the contact is sharp and in places is a ferruginous corrosion surface. There is no evidence of erosion of the uppermost beds and the Dubuque appears to be uniform in thickness. Southward in western Illinois, however, the Maquoketa successively truncates the Dubuque and Wise Lake Formations and the upper half of the Dunleith Formation, apparently as a result of uplift of the Ozark Dome (T and W, 1963).

Correlation. The Dubuque Formation appears to correlate with similar shaly strata in the Hillier Member of the Cobourg Formation in New York, the Cynthiana Formation in Kentucky, and the Catheys Formation in Tennessee (T and W, 1963).

TABLE 1. Mineral analyses

Sample number	Geologic section[a] (no.)	Stratigraphic unit	Clay minerals[b] Montmorillonite (%)	Illite (%)	Kaolinite (%)	Mixed layer (%)	Lithology[c]
1	12	Millbrig Bent. Bed				100	bentonite
2	12	Glencoe Mbr.		100	P		shale
3	41	Calmar Bent. Bed	7	64	5	24	mixture
4	41	Nasset Bent. Bed		77	2	21	mixture
5	22	Haldane Bent. Bed		P	1	99	bentonite
6	20	Guttenberg Fm.	87			13	mixture
8	32	Guttenberg Fm.	83			17	mixture
9	32	Guttenberg Fm.	80			20	mixture
10	d	Guttenberg Fm.	80			20	mixture
14	d	Nasset Bent. Bed	P			100	bentonite
15	d	Elkport Bent. Bed				100	bentonite
23	d	Deicke Bent. Bed	P			100	bentonite
24	d	Millbrig Bent. Bed	P			100	bentonite
26	d	Deicke Bent. Bed				100	bentonite
27	d	Millbrig Bent. Bed				100	bentonite
30	58	Guttenberg Fm.		43	44	13	mixture
32	47	Haldane Bent. Bed				100	bentonite
33	59	Haldane Bent. Bed			1	99	bentonite
34	3	Millbrig Bent. Bed			3	97	bentonite
35	1	Millbrig Bent. Bed				100	bentonite
37	1	Elkport Bent. Bed		P		100	bentonite
39	45	Elkport Bent. Bed				100	bentonite
40	26	Dickeyville Bent. Bed		P		100	bentonite
46	d	Elkport Bent. Bed		P	2	98	bentonite
58	d	Conover Bent. Bed		P	3	97	bentonite
63	74	Calmar Bent. Bed		60	3	37	mixture
67	55	Dunleith Fm. (base)		67	10	23	mixture
68	d	Wise Lake Fm. (base)		P		100	bentonite
70	40	Wise Lake Fm. (base)			2	98	bentonite
71	d	Nasset Bent. Bed		73	1	26	mixture
73	d	Buckhorn Mbr.		100		P	shale
77	50	Dunleith Fm. (near base)		20	46	34	mixture
78	49	Buckhorn Mbr.		P	4	96	bentonite
79	49	Elkport Bent. Bed		P	33	67	mixture
81	14	Dygerts Bent. Bed		P		100	bentonite
82	15	Calmar Bent. Bed	40	32	7	21	mixture
86	d	Millbrig Bent. Bed		P		100	bentonite
88	d	Dygerts Bent. Bed		P		100	bentonite
89	21	Sherwood Mbr.	21	66	13		shale
95	1	Deicke Bent. Bed		P			monoclinic potash feldspar
98	1	Dickeyville Bent. Bed				100	bentonite
102	d	Dygerts Bent. Bed			3	97	bentonite
110	61	Mifflin Fm.		P		100	bentonite
112	3	Dickeyville Bent. Bed		P		100	bentonite
114	73	Galena Grp. (8' below top)		56	20	24	mixture
120	d	Millbrig Bent. Bed		P	6	94	bentonite
124	d	St. James Mbr.	23	68	9		shale
125	42	Dygerts Bent. Bed		P	13	87	bentonite
132	74	Calmar Bent. Bed		P		100	bentonite
139	74	Conover Bent. Bed		P		100	bentonite

TABLE 1 Continued

[a]See Geologic Sections for localities.

[b]Calculations were made from oriented aggregates of <2 μm fraction solvated in ethylene glycol. To determine the relative percentage of the clay minerals, X-ray intensity values for the first order reflections were corrected by multiplying the expandable clay minerals (5.1 Å 2θ) by 1, illite (8.8° 2θ) by 3, kaolinite (12.3° 2θ) by 2, and the mixed layer clay minerals (7.0° to 7.5° 2θ) by 2.4. P - present but not calculable because of coincidence with strong mixed lattice reflection.

[c]Mixtures consist of bentonite and shale.

[d]Localities listed below.

10 - Honey Creek Section, quarry along tributary of Honey Creek, 2½ mi northeast of Martintown, Green County, Wisconsin (NE SW SW 23, 1N-6E, Browntown Quad.).
14 - Guttenberg North Section, roadcut on U.S. Highway 52 on northwest side of Guttenberg, Clayton County, Iowa (SW SW 5, 92N-2W, Elkader Quad.).
15 - Same as 14.
23 - McGregor South Section, roadcut on east side of State Highway 340, ½ mi south of McGregor, Clayton County, Iowa (Center S. line NE NW 34, 95N-3W, Waukon Quad.).
24 - Fennimore West Section, roadcut on U.S. Highway 18, 3½ mi west of Fennimore, Grant County, Wisconsin (SE NW NW 22, 6N-3W, Fennimore Quad.).
26 - Same as 24.
27 - Arthur Section, small quarry behind cheese factory in southwest corner of Arthur, Grant County, Wisconsin (SE SE SE 2, 4N-1W, Mineral Point Quad.).
46 - Byron Northwest Section, quarry on south side of main stream and east side of tributary, 1½ mi north of Byron, Ogle County, Illinois (SW NW NE 19, 25N-11E, Oregon Quad.).
58 - Decorah South Section, quarry on south side of Decorah, Winneshiek County, Iowa (SE SW 21, 98N-8W, Decorah Quad.).
68 - Kishwaukee Forest Preserve East Section, roadcut on east side of Mulford Road east of the Kishwaukee Forest Preserve, 3 mi southeast of Rockford, Winnebago County, Illinois (SW NW NW 22, 43N-2E, Cherry Valley Quad.).
71 - Kishwaukee Forest Preserve North Section, quarry 100 yards east of Mulford Road and ¼ mi north of Kishwaukee Forest Preserve, 2½ mi southeast of Rockford, Winnebago County, Illinois (Center SE NE SE 16, 43N-2E, Rockford South Quad.; 300 yards southeast of geol. sec. 40).
73 - River Street Section, abandoned quarry on east side of River Street in Dixon, Lee County, Illinois (SE SE SE 32 and SW SW SW 33, 22N-9E, Dixon Quad.).
86 - Platteville West Section, small quarry located 2½ mi west of Platteville, Grant County, Wisconsin (NE NW 19, 3N-1W, Lancaster Quad.).
88 - Freeport East Section, abandoned quarry on south side of U.S. Highway 20, 1 mi east of Freeport, Stephenson County, Illinois (NW SE SE 3, 26N-8E, Freeport Quad.).
102 - Sinsinawa River West Section, roadcuts of U.S. Highway 20 on west side of Sinsinawa River, 4 mi northwest of Galena, Jo Daviess County, Illinois (NW NW NW 4, 29N-1W, Menominee Quad.).
120 - Annaton South Section, quarry located 3 mi south of Annaton, Grant County, Wisconsin (NE SE 25, 5N-2W, Lancaster Quad.).
124 - Same as 14.

GEOLOGIC SECTIONS

1. Dickeyville Northwest Section

Quarry and roadcuts along U.S. Highway 61, 4 mi northwest of Dickeyville, Grant Co., WI (NE NE SW 7 and S½ NW 7, 2N-2W, Potosi Quad.).

Galena Group

Dunleith Formation (64' 7")

Fairplay Member

Dolomite, pure, buff, medium grained; 8" to 20" beds; very thin partings; *Receptaculites* . . . . . 15'

Eagle Point Member

Dolomite, cherty, buff, vuggy; 1' dense bed at base; *Receptaculites*. . . . . 20'

Beecher Member

Dolomite, buff, gray mottled; 8" to 15" beds; thin partings; rough weathered face; vuggy at top; coarser grained than unit below . . . . . 6' 6"

St. James Member

Dolomite, slightly argillaceous, buff, gray mottled, vuggy; 2" to 20" beds; thin, green shaly partings; thick shaly partings at top and 2' below top; lower 2' exposed high in bluff in roadcuts to the southeast . . . . . 14'

Buckhorn Member (9' 1")

Limestone, very argillaceous, dolomitic, light greenish gray, fossiliferous; green shale beds; 12" shale at top . . . . . 6' 8"

Shale, green . . . . . 4"

Calcarenite. . . . . 0" to 2"

Shale, dolomitic, green . . . . . 4"

Limestone, dolomitic, gray speckled; calcite vugs; green shale on upper surface; brown shale on lower surface; corrosion surface at top and 5" below top . . . . . 1' 8"

Guttenberg Formation (14' 9")

Glenhaven Member (13' 8")

Limestone; thicker bedded than below; 4" calcarenite at top. . . . . 3' 6"

Bentonite, orange; on wavy surface (**Dickeyville Bentonite Bed**, type section) (sample 98). . . . . ½" to 2"

Limestone, slightly argillaceous, light gray, very fine grained; 4" to 8" beds; thin, dark reddish brown shale partings; chert nodules 1' below top; much fine fossiliferous debris . . . . . 5'

Limestone, argillaceous, gray, lithographic, very fossiliferous; conchoidal fracture; 2" to 6" wavy, lenticular beds; thick, dark reddish brown shaly partings . . . . . 5'

Bentonite, gray (**Elkport Bentonite Bed**) (sample 37). . . . . ½"

Garnavillo Member

Limestone, argillaceous, brownish gray; phosphatic grains and pebbles in lower 2"; in 2 beds locally separated by 3" green calcareous shale; fewer fossils than above. . . . . 1' 1"

Spechts Ferry Formation (6' 8")

Glencoe Member (6')

Shale, green, fossiliferous; 1" to 9" beds of purple calcarenite, *Pionodema*-rich coquina, and 2" to 4" beds of fine-grained, argillaceous limestone . . . . . 5' 6"

Bentonite, orange (**Millbrig Bentonite Bed**) (sample 35) . . . 1" to 1½"

Shale, green . . . . . 3" to 6"

Castlewood Member (8")

Limestone, dark purplish gray, medium grained; abundant comminuted fossil debris . . . . . 0" to 6"

Limestone, argillaceous, greenish gray, dense, fine grained. . 0" to 2"

Shale, brown . . . . . 2"

Sandstone, very fine grained, reddish buff, fossiliferous . . . 0" to 3"

Shale, dark brown . . . . . 1"

Platteville Group

Quimbys Mill Formation

Limestone, brown, dense, glassy, very fine grained; *Chondrites* in upper part . . . . . 7" to 9"

Grand Detour Formation

Limestone, argillaceous, dolomitic, gray to buff, fossiliferous; 2" to 10" beds; thin, brownish gray shaly partings; thin lenses calcarenite; 16" relatively pure, gray, glassy, dense limestone at top . . . . . 11' 4"

Mifflin Formation

Limestone, very argillaceous, dolomitic, fossiliferous; 1" to 6" wavy, lenticular beds; thick, greenish gray shaly partings; 2" calcarenite at top . . . . . 15' 1"

Pecatonica Formation (18' 7")

New Glarus Member

Dolomite, relatively pure, buff, vuggy; thicker bedded and less argillaceous than unit above; prominent ferruginous corrosion surface at top; 9", 21", and 35" below top. . . 2' 5"

Dane Member

Dolomite, argillaceous, gray to buff; 2" to 6" beds; thin shaly partings; corrosion surface at top; prominent shaly bed 4' below top. . . . . 10' 6"

Chana Member (5' 8")

Dolomite; as above but slightly less argillaceous. . . . . 1' 6"

Dolomite, moderately argillaceous; prominent reentrant at top; black fossiliferous debris and burrows near top . . . . 4' 2"

2. Platteville Southwest Section (T and W, 1963, p. 63)

Roadcut on west side of U.S. Highway 151, 4 mi northeast of Dickeyville, Grant Co., WI (SE SW SE 1, 2N-2W, Lancaster Quad.), from the top: Galena Group, Spechts Ferry 2', Platteville Group, Quimbys Mill 5" to 12", Nachusa? 3' 2", Grand Detour 16' 2", Mifflin 11' 3", Pecatonica 22'; Ancell Group, Glenwood 4', St. Peter.

3. Mineral Point Southwest Section

Small quarry on north side of road and long roadcut of U.S. Highway 151, 3 mi southwest of Mineral Point, Iowa Co., WI (SE SE SE 10, NW NE 15, NE NE 15, 4N-2E, Mineral Point Quad.).

Galena Group

Dunleith Formation (24' 6")

St. James Member (16')

Dolomite, buff, medium grained; 8" to 12" beds; green shale partings; prominent reentrant at 1' green shale bed 8' above base . . . . . 12'

Dolomite; as above but purer, thicker bedded, and vuggy . . 4'

Buckhorn Member

Dolomite, very argillaceous, gray to buff, dark gray speckled; 8" to 12" beds; 2" to 8" interbeds of green shale. . . 8' 6"

Guttenberg Formation (8' 6")

Glenhaven Member (7' 6")

Dolomite, moderately argillaceous, gray to buff, medium to coarse grained, very fossiliferous; ½" to 2" beds; thick, dark reddish brown shale partings; corrosion surface at top. . . . . 1' 6"

Bentonite, gray (**Dickeyville Bentonite Bed**) (sample 112). . ½"

Dolomite; as above bentonite. . . . . 6'

Garnavillo Member

Dolomite, light gray-brown; phosphatic grains at base. . . . . 1'

Spechts Ferry Formation (1')

Bentonite, orange (**Millbrig Bentonite Bed**) (sample 34) . . . 2"

Dolomite, argillaceous, fine grained. . . . . ½" to 10"

Platteville Group

Quimbys Mill Formation (12' 6")

Dolomite, buff, dense, fine grained, fossiliferous; 2" to 6" wavy beds; smooth bedding surface; corrosion surface at top . . . . . 10' to 11'
Dolomite; as above but purer; possibly equivalent to Nachusa Formation . . . . . 2'

Grand Detour Formation (13')

Forreston Member

Dolomite, argillaceous, buff, fossiliferous; ½" to 3" beds; brown shaly partings; *Streptelasma* . . . . . 4'

Stillman Member (9')

Dolomite, relatively pure, buff, vuggy; 1' to 2' beds . . . . . 4'
Dolomite; as above but in 6" to 12" beds with rough weathered face; prominent reentrant at top . . . . . 5'

Mifflin Formation (13' 6")

Limestone, argillaceous, buff to gray, fossiliferous; some beds grade laterally to dolomite; 1" to 3" nodular beds; thick, green shaly partings; 2" to 3" calcarenite at top . . 9' 6"
Limestone, dolomitic; ¼" to 4" brittle, platy beds. . . . . 4'

Pecatonica Formation (10')

Exposed in small quarry on north side of the road, SW NW NE 15

New Glarus Member (6' 6")

Dolomite, relatively pure, buff; mostly dense but contains small vugs; corrosion surface at top. . . . . 2'
Dolomite, argillaceous, platy . . . . . 8"
Dolomite, relatively pure, buff; 8" to 12" beds . . . . . 3' 10"

Dane Member

Dolomite, argillaceous, buff; 2" to 6" wavy, lenticular beds; prominent shaly reentrant at top . . . . . 3' 6"

4. Darlington South Section

Quarry in south bluff of Pecatonica River in Darlington, Lafayette Co., WI (NE NE SE 3, 2N-3E, Darlington Quad.).

Galena Group

Dunleith Formation (34')

Eagle Point Member

Dolomite, cherty, buff, medium grained . . . . . 6'

Beecher Member

Dolomite; as above but without chert . . . . . 8'

St. James Member

Dolomite; as above but with green shaly partings. . . . . 14'

Buckhorn Member

Dolomite, argillaceous, bluish gray to buff, dark gray speckled; 3" to 12" beds; green shaly partings, *Dalmanella* common . . . . . 6'

Guttenberg Formation

Dolomite, moderately argillaceous, pinkish gray to buff, fossiliferous; 1" to 12" beds; dark reddish brown shale partings . . . . . 5' 2"

Platteville Group

Quimbys Mill Formation

Dolomite, relatively pure, buff, fine grained; 3" to 12" beds; *Chondrites*; shaly reentrant just above base. . . . . 12' 6"

Nachusa Formation

Dolomite, pure, buff; 6" to 18" beds; *Chondrites* and *Palaeophycus* abundant; prominent reentrant at base. . . . . 6'

Grand Detour Formation (16' 11")

Dolomite, argillaceous, bluish gray to buff, fossiliferous; 1" to 8" beds; brown shaly partings; *Streptelasma* common. 13' 8"
Dolomite, relatively pure, gray to buff. . . . . 3' 3"

Mifflin Formation

Dolomite, argillaceous, bluish gray to buff, fossiliferous; 1" to 3" wavy, lenticular beds; dark bluish gray shaly partings. . . . . 9' 1"

5. South Wayne Section

Quarries on east side of State Route 176, south side of South Wayne, Lafayette Co., WI (W½ NE NE 15, 1N-5E, South Wayne Quad.).

Galena Group

Dunleith Formation (29')

St. James and Beecher Members

Dolomite, gray to buff; vuggy in lower 6'; no chert; exposed high in south face of quarry but inaccessible . . . . 20' to 25'

Buckhorn Member

Dolomite, very argillaceous, greenish gray, dark gray speckled, very fossiliferous; thick, green shaly partings; 8" bluish green shaly bed at top; coarser grained than unit below . . . . . 6' 6"

Guttenberg Formation (8' 9")

Dolomite, moderately argillaceous; 1" to 2" beds; thin shaly partings; prominent 2" to 3" light buff bed 1' below top; upper 1' is transitional with overlying unit; corrosion surface at top . . . . . 4' 6"
Dolomite, pinkish gray, fossiliferous; 1" to 4" wavy, lenticular beds; thick, dark reddish brown shaly partings; thicker bedded near base. . . . . 4' 3"

Platteville Group

Quimbys Mill Formation (7' 7")

Dolomite, cherty, brownish gray, dense, prominent ferruginous corrosion surface at top . . . . . 3'
Dolomite; as above but gray to buff and lacking chert; 2" to 6" beds; thin, brown shaly partings. . . . . 4' 7"

Nachusa Formation (8' 7")

Everett Member

Dolomite, pure, buff, gray mottled, medium grained; *Chondrites* . . . . . 5' 1"

Elm Member

Dolomite, slightly argillaceous, buff . . . . . 1'

Eldena Member

Dolomite; like 5' 1" unit above . . . . . 2' 6"

Grand Detour Formation (16' 2")

Forreston Member

Dolomite, relatively argillaceous, light gray to buff, fossiliferous; 6" to 12" beds; shaly partings; laminated; smooth weathered face; *Streptelasma* and *Öpikina* abundant . . . . . 8'

Stillman Member

Dolomite, pure; 6" to 12" even beds; upper 1' very cherty . 8' 2"

Mifflin Formation

Dolomite, argillaceous, bluish gray, fossiliferous; weathered buff; 1" to 2" wavy, lenticular beds; greenish gray shaly partings; 2" to 5" beds in lower 6' . . . . . 16' 6"

Pecatonica Formation (22' 8")

Dolomite, pure, buff; small vugs; 6" to 12" beds; moldic fossils in upper 2'; ferruginous corrosion surface at top; thin shaly partings in upper 1' . . . . . 4' 8"
Dolomite; as above but with even beds and no vugs; *Phycodes*; prominent 2" to 3" shaly reentrant at top. . . . . 7'
Dolomite relatively argillaceous; ½" to 6" platy beds; shaly partings; *Chondrites*. . . . . 3'
Covered. . . . . 3'
Dolomite, sandy, buff; large phosphatic pebbles in lower 6'. 3'
Covered. . . . . 2'

Ancell Group

St. Peter Sandstone

Sandstone, white, fine to medium grained . . . . . 5'

6. Martintown Section

Quarry and roadcut along State Highway M on the north

side of the Pecatonica River at Martintown, Green Co., WI (N½ NE SE 32, 1N-6E, South Wayne Quad.).

Galena Group
Dunleith Formation (19')
St. James Member
Dolomite exposed in roadcut, buff, medium grained; 3" to 4" beds; thin, green shaly partings . . . . . 12'
Buckhorn Member
Dolomite, gray to buff, dark gray speckled, fossiliferous; shaly partings; 8" green dolomitic shale at base . . . . . 7'
Guttenberg Formation (8' 4")
Glenhaven Member
Dolomite, moderately argillaceous, pinkish gray to buff, medium grained, fossiliferous; 1" to 4" wavy, lenticular beds; thick, dark reddish brown shale partings. . . . . 7' 4"
Garnavillo Member
Dolomite, gray to buff; finer grained than above; 2" calcarenite with phosphatic grains at base . . . . . 1'
Platteville Group
Quimbys Mill Formation
Dolomite, buff, fine grained, dense; 3" to 6" beds; smooth bedding surfaces; chert nodules in upper 1'; ferruginous corrosion surface at top . . . . . 5'
Nachusa Formation (12' 10")
Everett Member
Dolomite exposed in quarry, relatively pure, buff, medium grained; 3" to 6" beds . . . . . 6'
Elm Member
Dolomite, moderately argillaceous, buff, fine grained, laminated, fossiliferous; 1" to 3" beds; thick, brown shaly partings . . . . . 2'
Eldena Member
Dolomite, pure, buff; 1" to 6" beds; molluscan fossils common at base and 2' above base . . . . . 4' 10"
Grand Detour Formation
Forreston Member
Dolomite, argillaceous, buff, fine grained, laminated, fossiliferous; ¼" to 1" wavy, lenticular beds; thick, brown shaly partings; *Streptelasma* abundant in upper 1'; reentrant at top and 1' below top . . . . . 6' 3"

7. Clarno East Section
Quarry in south bluff of Richland Creek, 1¼ mi east of Clarno, Green Co., WI (SW NE SE 26, 1N-7E, Juda Quad.) from the top: Galena Group, Dunleith 22' 6" (St. James 15', Buckhorn 7' 6"), Guttenberg 7' 10"; Platteville Group, Quimbys Mill 3' 2", Nachusa 16' 10" (Everett 7' 6", Elm 2' 4", Eldena 7'), Grand Detour (Forreston 6').

8. Avon Southeast Section
Quarry on north side of Stateline Road, 3 mi southeast of Avon, Rock Co., WI (SE SW SW 34, 1N-10E, Brodhead Quad.).
Platteville Group
Mifflin Formation
Dolomite, argillaceous, buff, fine grained, fossiliferous; 1" to 4" wavy, lenticular beds; thick, greenish gray shaly partings . . . . . 10'
Pecatonica Formation (20' 10")
New Glarus Member
Dolomite, relatively pure, gray to buff, gray mottled; 2" to 8" beds; rough weathered face; prominent ferruginous corrosion surface at top . . . . . 10' 1"
Dane Member (10' 9")
Dolomite, very argillaceous, greenish gray; prominent reentrant . . . . . 3" to 4"
Dolomite, moderately argillaceous, gray to buff; 4" to 12" beds . . . . . 5' 10"
Dolomite, fossiliferous; slightly more argillaceous than above, particularly in lower 18"; wavy, lenticular 1" to 12" beds . . . . . 4' 7"
Ancell Group
Glenwood Formation (7' 2")
Dolomite, very argillaceous, greenish buff; conchoidal fractures; scoured, wavy top . . . . . 3'
Dolomite, buff, fine grained, dense; 4" to 12" beds; green shaly partings; floating sand grains and small calcite-lined cavities . . . . . 2' 2"
Sandstone, dolomitic; grades upward to sandy dolomite; base concealed, but overlies 20 ft of St. Peter Sandstone in north-facing bluff. . . . . 2'

9. East Dubuque Section (T and W, 1963, geol. sec. 28) Exposures in the Mississippi River bluffs at East Dubuque, Jo Daviess Co., IL, at and above the tunnel of the Illinois Central Gulf Railroad and north of the tunnel (SE 19, 29N-2W, East Dubuque Quad.), from the top: Galena Group, Wise Lake (Sinsinawa 10'), Dunleith 113' 5" (Wyota 19' 9", Wall 9' 8", Sherwood 13' 7", Rivoli 19', Mortimer 11' 3", Fairplay 19' 7", Eagle Point 11' 10", Beecher 8' 3", St. James 6").

10. Menominee Station Section
Quarry in Mississippi River bluff at Menominee Station, Jo Daviess Co., IL (SE NW SW 17, 28N-1W, Menominee Quad.) from the top: Galena Group, Wise Lake 38', Dunleith 42' 8" (Wyota 18' 8", Wall 10' 6", Sherwood 13' 6", base concealed).

11. Galena Northwest Section
Roadcut of U.S. Highway 20, 3 mi northwest of Galena, Jo Daviess Co., IL (S½ NW 3 and N½ SE NE 4, 28N-1W, Galena Quad.), from the top: Galena Group, Dubuque 32', Wise Lake 75', Dunleith 5'.

12. Millbrig Southeast Section
Cutbank along east side of Galena River, 1 mi southeast of Millbrig, Jo Daviess Co., IL (near center 34, 29N-1E Galena Quad.).
Galena Group
Dunleith Formation (34' 4")
Eagle Point Member
Dolomite, buff, medium grained, pure, vuggy; contains chert in lenses and layers of nodules; 4" to 8" beds . . . . 5'
Beecher Member
Dolomite; as above but massive except for faint partings. . . 9' 7"
St. James Member
Dolomite; as above but buff-gray; 2" to 8" beds; thin, green shaly partings; upper 1' is argillaceous and has thin beds of green shale . . . . . 14' 4"
Buckhorn Member
Dolomite, argillaceous, medium to dark gray; more shaly than above; shaly beds abundant in upper 1 ft; black speckled; 2" to 4" beds; lower 1' has thin, brown shale partings . . . . . 5' 5"
Guttenberg Formation (14' 2")
Glenhaven Member (11' 6")
Limestone, tan, fine grained; 2" to 5" wavy beds; red-brown shale partings up to ¼" thick; fossils abundant on bedding surfaces; some beds especially in upper 4' are very fossiliferous; chert nodules in band 33" below top . 11' 5"
Bentonite (Elkport Bentonite Bed) . . . . . 0" to 1"

Garnavillo Member

Limestone, light gray-tan, fine grained, slightly argillaceous; 3" to 6" beds; fewer red-brown shale partings than above; small black phosphatic nodules in lower 2". . . . . 2' 8"

Spechts Ferry Formation (3' 4")

Glencoe Member

Shale, green, fossiliferous (sample 2) . . . . . 1' 2"

Bentonite, orange (**Millbrig Bentonite Bed**, type section) (sample 1) . . . . . 4"

Castlewood Member (1' 6")

Limestone, light gray, fine grained, pure to slightly argillaceous, massive; thin dolomite streaks; *Pionodema* abundant . . . . . 1' 4"

Limestone, shaly; much fossiliferous debris . . . . . 2"

Shale, dark brown . . . . . ½"

Platteville Group

Quimbys Mill Formation

Strawbridge Member

Limestone, light brown, lithographic, glassy; 2" to 6" beds; dolomite in thin horizontal bands; base concealed 2' above low water level . . . . . 3' 11"

13. Galena Northeast Section (T and W, 1963, p. 93)

Quarry in the north bluff of East Fork, 3 mi northeast of Galena, Jo Daviess Co., IL (NW NE SE 3, 28N-1E, Galena Quad.), from the top: Galena Group, Dunleith 79' 3" (Wyota 4' 8", Wall 9' 2", Sherwood 18' 3", Rivoli 18' 7", Mortimer 11' 5", Fairplay 17' 2").

14. Galena Roadcut Section (T and W, 1963, geol. sec. 33)

Roadcut on U.S. Highway 20 on the east side of Galena River in Galena, Jo Daviess Co., IL (SW SE NE 20, 28N-1E, Galena Quad.), from the top: Galena Group, Wise Lake (Sinsinawa 33', Dygerts Bentonite Bed 23' 8" above base), Dunleith (Wyota 12' 9").

15. Galena Junction Section

Railroadcut of Burlington Northern Railroad and Mississippi River bluff, 2½ mi south of Galena, Jo Daviess Co., IL (SW SW NE 1, 27N-1W, Bellevue Quad.). Insoluble residues shown in parentheses (sample number, position above base of unit, percentage insoluble in HCl; for example 27, 9", 1.0).

Galena Group

Wise Lake Formation

Sinsinawa Member (19' 3")

Dolomite, pure, buff, massive, very vuggy; locally prominent reentrant at base. (27, 9", 1.0) (28, 2' 6", 1.0) (29, 4' 3", 1.5) (30, 6' 6", 1.6) (31, 8' 6", 1.4) (32, 9' 6", 0.9) (33, 11', 1.1) (34, 12' 6", 0.2) (35, 14', 1.0) . . . . . 15' 3"

Dolomite, as above but more dense and slightly argillaceous (25, 9", 1.9) (26, 3' 9", 1.8) . . . . . 4'

Dunleith Formation (72' 3")

Wyota Member

Dolomite, slightly less pure than above, gray-brown, medium to thick bedded, vesicular; several 2" to 4" dense beds with argillaceous burrows; many bands of gray chert nodules; red-brown chert in lower 3' (19, 6", 1.4) (20, 3' 6", 0.2) (21, 6' 9", 2.5) (22, 12' 6", 1.7) (23, 13' 6", 1.4) (24, 17' 6", 2.1). . . . . 19'

Wall Member (12' 6")

Dolomite, shaly, reddish brown; prominent reentrant. . . . . 2" to 5"

Dolomite, slightly argillaceous, brownish gray; large chert nodules at top (18, 6", 1.7). . . . . 1' 10"

Dolomite, moderately pure; bands of chert nodules in lower half; *Receptaculites* at base (17, 3' 3", 1.6) . . . . . 5'

Shale, green and light gray, shaly dolomite; prominent reentrant; possible position of the Haldane Bentonite Bed . 2" to 6"

Dolomite, argillaceous, brownish gray (16, 1' 6", 3.3) . . . . 1' 5"

Dolomite, pure, brown, mostly vuggy; upper part weathered to prominent reentrant . . . . . 1' 10"

Dolomite, argillaceous; large chert nodules at base . . . . . 1' 10"

Sherwood Member (15' 1")

Dolomite, very argillaceous, light buff, dense; many nearly continuous bands of chert nodules (15, 2' 9", 4.8). . . . . 3' 7"

Shale, dolomitic, green, laminated; local lenses of clay; probable position of Nasset Bentonite Bed . . . . . 2"

Dolomite, argillaceous, gray, dense; chert nodules at top; corrosion surface at base and 6" above base; *Receptaculites* (13, 1', 6.8) (14, 2' 9", 5.0) . . . . . 3' 6"

Dolomite, mixed argillaceous and pure; red-brown chert in lower part . . . . . 2' 4"

Dolomite, very argillaceous, dense; prominent corrosion surface at base (12, 1", 8.3). . . . . 1" to 2"

Dolomite, pure, vuggy . . . . . 9"

Shale and fine-grained dolomite with red shale partings. . . . 1"

Dolomite, pure; vuggy at top; grades to moderately argillaceous dolomite with burrows at base (11, 3", 2.1). . . . . 2'

Dolomite, moderately pure, vuggy . . . . . 1' 5"

Chert, persistent bed . . . . . 2" to 4"

Dolomite, very argillaceous, laminated; *Receptaculites* . . . . 11"

Rivoli Member (20')

Shaly reentrant; smooth bedding surface; many joints below end at this surface; probable position of Conover Bentonite Bed. . . . . 1"

Dolomite, mostly very argillaceous and dense, but contains pure vuggy beds; 2 bands of chert nodules; burrows near base; prominent corrosion surface at base (9, 9", 10.3) (10, 4' 5", 2.5) . . . . . 5' 5"

Dolomite, medium and thick bedded; interbedded pure, vuggy dolomite and slightly argillaceous, dense dolomite; bands of chert nodules in lower half (6, 2' 9", 1.4) (7, 4' 4", 1.6) (8, 6', 1.8) . . . . . 7' 6"

Bentonite, green, and laminated shaly dolomite (**Calmar Bentonite Bed**) (sample 82). . . . . 1" to 3"

Dolomite, slightly argillaceous, brown, vesicular, cherty; corrosion surface 3" above base (4, 1' 10", 1.8) (5, 4' 9", 1.2) . . . . . 5' 3"

Dolomite, pure, vuggy; chert nodules at base; *Receptaculites* (3, 1' 4", 1.5). . . . . 1' 7"

Mortimer Member (5' 8")

Dolomite, argillaceous, gray, dense, cherty; *Receptaculites* (2, 3", 2.3). . . . . 1' 6"

Dolomite, pure, brown, vuggy, massive; *Receptaculites* (1, 2', 1.3) . . . . . 4' 2"

16. Wise Lake Section (T and W, 1963, geol. sec. 32)

Compiled from 2 exposures in the Mississippi River bluff 6 mi south of Galena, Jo Daviess Co., IL (near center W line NE SE 21 and north of center NE 21, 27N-1E, Galena Quad.), from the top: Galena Group, Dubuque 33', Wise Lake 69' 11" (Stewartville 40' 9", Sinsinawa 29' 2", Dygerts Bentonite 8' above base).

17. Apple River West Section

Quarry on south side of Illinois Central Gulf Railroad, 2 mi west of Apple River, Jo Daviess Co., IL (SW NE NW 23, 29N-3E, Shullsburg Quad.), from the top: Maquoketa Group, Scales 3'; Galena Group, Dubuque 37'.

18. Pearl City East (Doyle, 1965, geol. sec. 7)

Stream cuts and quarries along the north side of Yellow Creek, 4 mi east of Pearl City, Stephenson Co., IL (SE NE NE 13, 26N-6E, Lena Quad.), from the top: Galena Group, Dubuque 16' 3", Wise Lake (Stewartville 18' 8").

19. Buena Vista Section (T and W, 1963, geol. sec. 29)

Quarry on west side of Richland Creek, north of bridge at Buena Vista, Stephenson Co., IL (NW SW NE 15, 28N-7E, Freeport Quad.), from the top: Galena Group, Dunleith 39' 7" (Eagle Point 12' 6", Beecher 5' 6", St. James 13' 3", Buckhorn 8' 4"), Guttenberg 3'.

20. Orangeville South Section

Quarry in northwest facing bluff of Richland Creek, 1 mi south of Orangeville, Stephenson Co., IL (NE SE SW 1, 28N-7E, Freeport Quad.), from the top: Galena Group, Dunleith 26' (Beecher 5', St. James 14' 6", Buckhorn 6' 6"), Guttenberg 6' 11"; Platteville Group, Quimbys Mill 3' 6".

21. Cedarville Section (Doyle, 1965, geol. sec. 4)

Roadcut of Illinois Highway 26 and north wall of Cedar Creek below and west of bridge on north side of Cedarville, Stephenson Co., IL (NW SW NW 31, 28N-8E, and NE SE NE 36, 28N-7E, Freeport Quad.), from the top: Galena Group, Dunleith 77' 3" (Sherwood 10', Rivoli 12' 3", Mortimer 13' 1", Fairplay 17' 5", Eagle Point 16', Beecher 8' 6").

22. Krape Park Section

Quarry in south-facing bluff along Yellow Creek in Krape Park, Freeport, Stephenson Co., IL (NW SE SE 2, 26N-7E, Freeport Quad.).

Galena Group

Wise Lake Formation

Dolomite, pure, buff, vuggy, thick bedded . . . . . 6'

Dunleith Formation (28')

Wyota Member

Dolomite, buff, vuggy; chert nodules in bands near top; prominent bedding reentrant at top; 1' dense bed 4' above base . . . . . 18'

Loves Park Member (10')

Dolomite; as above but lighter buff; 12" to 20" beds . . . . . 3' 10"

Dolomite, argillaceous; brown shaly partings. . . . . 3" to 4"

Bentonite, light gray (Haldane Bentonite Bed) (sample 5) . . 0" to 1"

Dolomite, cherty, pure, buff, vuggy; 8" to 36" beds. . . . . 5' 10"

23. Freeport South Section

Quarry on south side of Freeport, Stephenson Co., IL (SE NE SW 6, 26N-8E, Freeport Quad.), from the top: Galena Group, Wise Lake 16', Dunleith 15'.

24. Freeport Southeast Section

Quarry ¼ mi south of U.S. Route 20 on the southeast side of Freeport, Stephenson Co., IL (SW NW SE 4, 26N-8E, Freeport Quad.).

Galena Group

Dunleith Formation (54' 2")

Wyota Member (16')

Dolomite, cherty, buff, medium grained, vuggy; 4" to 12" beds . . . . . 10'

Dolomite, as above but not vuggy; 12" even beds; chert in upper 2'. . . . . 6'

Loves Park Member (38' 2")

Dolomite; as above but without chert; smooth weathered face; prominent bedding reentrant near top may be position of Haldane Bentonite Bed. . . . . 6' 10"

Dolomite, buff; cherty near top and base; several prominent ferruginous corrosion surfaces . . . . . 6' 7"

Dolomite; as above but lacks chert; *Receptaculites*; several ferruginous corrosion surfaces . . . . . 7' 9"

Dolomite, buff; 6" to 12" beds . . . . . 5' 3"

Dolomite, cherty, light gray to buff, dense, vuggy; in two 1' beds . . . . . 2'

Dolomite, cherty, buff, vuggy; 4" to 12" beds; corrosion surface at top . . . . . 9' 9"

25. Freeport Northeast Section

Quarry on north side of State Route 75 on northeast side of Freeport, Stephenson Co., IL (SW NE SE 28, 27N-8E, Freeport Quad.).

Galena Group

Dunleith Formation (46' 8")

Fairplay Member

Dolomite, pure, buff, medium grained; 12" to 20" beds; *Receptaculites* common . . . . . 15'

Eagle Point Member (16' 3")

Dolomite, buff, cherty, vuggy; 4" to 6" beds; bands of chert nodules near top; more massive and purer near top; reentrant at top in east face of quarry . . . . . 8' 7"

Dolomite; as above but gray mottled; several corrosion surfaces . . . . . 6' 10"

Dolomite, light gray to buff, dense; persistent bed throughout quarry . . . . . 10"

Beecher Member

Dolomite, relatively pure, buff; gray mottled; 4" to 6" beds, several prominent corrosion surfaces . . . . . 7' 5"

St. James Member

Dolomite, slightly argillaceous, buff mottled; 4" to 6" beds; thin, green shaly partings; *Dalmanella* and crinoid fragments on some bedded surfaces; 4" to 6" bed of green shaly dolomite at top . . . . . 8'

26. Rock City East Section

Quarry ¼ mi south of State Route 75, ½ mi east of Rock City, Stephenson Co., IL (SE SW NW 22, 28N-9E, Pecatonica Quad.).

Galena Group

Dunleith Formation (24' 2")

Beecher Member

Dolomite, relatively pure, buff, mottled, medium grained; top covered . . . . . 6'

St. James Member

Dolomite, light gray to buff, mottled; 6" to 12" beds with thin shaly partings; 3" bed of green shaly dolomite at top; several corrosion surfaces . . . . . 8' 2"

Buckhorn Member

Dolomite, moderately argillaceous, gray, dark gray speckled, medium grained, fossiliferous; 3" to 10" beds; *Dalmanella* common; prominent 1" to 2" green shaly partings at top and 3' and 4' above the base . . . . . 10'

Guttenberg Formation

Dolomite, moderately argillaceous, light pinkish gray to buff, medium grained; 1" to 3" wavy, lenticular beds; thick, dark reddish brown shale partings; abundant and diverse fauna; *Sowerbyella* particularly abundant. . . . . 3' 7"

Bentonite, orange (Dickeyville Bentonite Bed), (sample 40). 2" to 3"

Dolomite; as above . . . . . 2' 6"

Platteville Group

Quimbys Mill Formation

Dolomite, cherty, gray to buff, dense, fine grained; 4" to 12" beds; large chert nodules near top; 1' argillaceous dolomite with brown shale partings at base, a marker bed traceable throughout northern Winnebago Co.; prominent ferruginous corrosion surface at top . . . . . 6'

Nachusa Formation (12' 4")

Everett Member

Dolomite, relatively pure, cherty, buff, medium grained, vuggy; 4" to 12" beds; *Foerstephyllum*; prominent 10" dense bed at top . . . . . 5' 9"

Elm Member

Dolomite, moderately argillaceous, buff, fine grained, laminated; smooth weathered face. . . . . 1' 6"

Eldena Member

Dolomite, buff, medium grained, vuggy; *Chondrites, Palaeophycus* . . . . . 5' 1"

27. Durand North Section

Quarry on east side of road ½ mi north of Durand, Winnebago Co., IL (NE SW NE 10, 28N-10E, Pecatonica Quad.).

Platteville Group

Grand Detour Formation

Dolomite, buff, fine grained; 2" to 6" beds; rough weathered face . . . . . 6' 5"

Mifflin Formation

Dolomite, argillaceous, greenish gray to buff, fossiliferous; 1" to 8" wavy, lenticular beds; thick, green shaly partings; 1" to 2" calcarenite at top; prominent ferruginous corrosion surface 1' below top; lumpy nodular bed 2' below top . . . . . 17'

Pecatonica Formation (18' 5")

New Glarus Member

Dolomite, relatively pure, buff; 3" to 12" beds; ferruginous corrosion surface in 5" bed at top. . . . . 10'

Dane Member (8' 5")

Dolomite; as above but in 2" to 4" beds; thin, green shaly partings . . . . . 1' 10"

Dolomite, argillaceous, greenish gray, fossiliferous; prominent reentrant . . . . . 4" to 5"

Dolomite, moderately argillaceous, bluish gray to buff, fossiliferous; 3" to 10" wavy, lenticular beds; thin shaly partings . . . . . 6' 3"

28. Durand Northeast Section

Quarry on east side of road ¼ mi northeast of Durand, Winnebago Co., IL (NE SW NW 11, 28N-10E, Pecatonica Quad.); located approx. ½ mi southeast of Durand North Section.

Platteville Group

Grand Detour Formation

Dolomite, buff, fine grained; 3" to 10" even beds; lithistid sponges in lower 1' to 2' . . . . . 10'

Mifflin Formation

Dolomite, argillaceous, gray to buff, fine grained, fossiliferous; 1" to 6" wavy, lenticular beds; thick, greenish gray shaly partings; 2" to 3" calcarenite at top; prominent corrosion surface 1' below top; 3" to 4" lumpy nodular bed with thick, shaly partings 32" below top is a marker bed in upper part of the Mifflin Formation in Winnebago Co. . . . . 18' 2"

Pecatonica Formation

Dolomite, relatively pure, buff; 6" to 10" even beds; prominent ferruginous corrosion surface at top . . . . . 2'

29. Harrison West Section

Quarry on west side of Winslow Road, 2½ mi west of Harrison, Winnebago Co., IL (NE SE SE 17, 28N-11E, Rockford Quad.), from the top: Platteville Group, Grand Detour 9', Mifflin 17', Pecatonica 15'.

30. Durand Southeast Section

Quarry on north side of State Route 70, 4½ mi southeast of Durand, Winnebago Co., IL (SW SE SE 36, 28N-10E, Pecatonica Quad.)

Platteville Group

Quimbys Mill Formation (7' 6")

Dolomite, buff, fine grained, dense, fossiliferous; 1" to 3" beds . . . . . 6' 6"

Dolomite; as above but more argillaceous; 1" nodular beds; molluscan fossils common; small *Chondrites*. . . . . 1'

Nachusa Formation (14')

Everett Member

Dolomite, pure, buff, medium grained, vuggy; rough weathered face; 2" to 12" beds; silicified *Foerstephyllum* and *Streptelasma*; chert nodules at top and 2' above base . . . 5' 8"

Elm Member

Dolomite, moderately argillaceous, fine grained, dense, laminated; 6" to 12" beds, smooth weathered face; silicified fossils . . . . . 2'

Eldena Member

Dolomite, pure, buff, medium grained, vuggy; rough weathered face; 4" to 6" beds; silicified *Öpikina* and *Streptelasma*; molluscan fossils abundant 3' above base; *Palaeophycus* . . . . . 6' 4"

Grand Detour Formation (32' 3")

Forreston Member (16' 9")

Dolomite, argillaceous, gray to buff, fine grained; 1" to 4" wavy beds; dark brown shale partings; smooth weathered face; diverse and abundant fauna . . . . . 12' 6"

Dolomite; as above but less abundant shelly fauna and numerous, small, light colored, horizontal burrows; 1" to 6" beds . . . . . 2' 5"

Dolomite; as above but without burrows; prominent shaly reentrant at top; 1" calcarenite 6" above base. . . . . 1' 10"

Stillman Member (15' 6")

Dolomite, relatively pure, buff, vuggy, fossiliferous; rough weathered face; 6" to 8" beds; lumpy, irregular bedding surfaces; *Vanuxemia* common 3' above base . . . . . 6' 8"

Dolomite; as above but cherty; thin, reddish brown shaly partings. . . . . 1'

Dolomite, pure, buff; small chert nodules in upper 1'; 4" to 6" graded calcarenite 2' above base. . . . . 4' 4"

Dolomite; as above but without chert; 2 calcarenite beds 1" to 4" thick. . . . . 2'

Dolomite, argillaceous, buff; 1" to 2" wavy, lenticular beds; abundant and diverse fauna; lithistid sponges (*Anthaspidella, Zittelella*); 2 thin calcarenite in lower part . . . . . 1' 6"

Mifflin Formation

Dolomite, argillaceous, gray to buff, fine grained, fossiliferous; 1" to 3" wavy lenticular beds; green shale partings . 6"

31. Pecatonica South Section

Quarry and roadcut in Seward Forest Preserve 2 mi south of Pecatonica, Winnebago Co., IL (SE SE NW 5, 26N-10E, Pecatonica Quad.), from the top: Galena Group, Dunleith 56' 1" (Loves Park 35', Fairplay 16', Eagle Point 5' 1").

32. Harrison South Section

Quarry on south side of Stephenson Road 2½ mi south of

Harrison, Winnebago Co., IL (SW SW NE 36, 28N-11E, Rockford Quad.).

Galena Group

Dunleith Formation (33' 11")

Eagle Point Member

Dolomite, cherty, buff, medium grained . . . . . 5'

Beecher Member

Dolomite; as above but not cherty; several corrosion surfaces . . . . . 4' 7"

St. James Member

Dolomite, gray to buff; slightly more argillaceous than above; thin, green shaly partings. . . . . 14' 4"

Buckhorn Member

Dolomite, moderately argillaceous, bluish gray, dark gray speckled, fossiliferous; 2" to 6" beds; green shaly partings. . . . . 10'

Guttenberg Formation (2' 4")

Dolomite, slightly argillaceous, pinkish gray to buff, fossiliferous; 1" to 8" wavy beds; dark reddish brown shale partings . . . . . 1' 8"

Shale, light reddish brown; green at base (sample 9) . . . . . ½"

Dolomite, argillaceous, greenish gray. . . . . 2" to 3"

Clay, gray to green (sample 8) . . . . . ½" to 1"

Dolomite, argillaceous, greenish gray; mottled with lenses of bright green clay . . . . . 4"

Platteville Group

Quimbys Mill Formation

Dolomite, gray to buff, fine grained, dense; 4" to 16" beds; scattered, elongate chert nodules; gently undulating corrosion surface at top; shaly in lower 1'; *Chondrites* . . . . 11'

Nachusa Formation

Dolomite, relatively pure, cherty, bluish gray to buff, medium grained, dense; 8" to 12" beds; rough weathered face; *Palaeophycus*, *Chondrites* . . . . . 6' 10"

33. Rockton South Section

Quarry (SW NE NE 35, 46N-1E) and roadcut (SW SW SW 25, 46N-1E) on the west side of State Highway 2, 2 mi south of Rockton, Winnebago Co., IL (South Beloit Quad.).

Galena Group

Dunleith Formation (64' 10")

Loves Park Member (15')

Exposed in roadcut

Dolomite, relatively pure, buff, medium grained, vuggy; 4" to 10" beds; several bands of chert nodules . . . . . 9'

Exposed in quarry; top approximately 10' below roadcut

Dolomite, buff; chert nodules at base and 2' above base; *Receptaculites* . . . . . 6'

Fairplay Member (17')

Dolomite, pure, buff; 6" to 10" beds; irregular, lumpy bedding surfaces; *Receptaculites*. . . . . 11'

Dolomite; as above but vuggy and mottled; numerous small burrow cavities in top bed; *Receptaculites*. . . . . 6'

Eagle Point Member (14' 8")

Dolomite, buff, vuggy, fossiliferous; 4" to 10" beds; *Sowerbyella* common; 5 chert bands approximately 1' apart in upper part . . . . . 11' 4"

Dolomite; as above but cherty throughout; 1" to 4" wavy beds . . . . . 2' 6"

Dolomite, slightly argillaceous, dense, fossiliferous; prominent light buff bed; chert nodules at base . . . . . 10"

Beecher Member

Dolomite, buff; ½" to 4" beds; molluscan fossils in some beds; several corrosion surfaces . . . . . 5' 3"

St. James Member (11' 6")

Dolomite, slightly argillaceous, buff, fossiliferous; 1" green shaly partings at top. . . . . 10"

Dolomite, slightly argillaceous, buff to gray, vuggy, fossiliferous; rough weathered face; 1" to 8" beds; thin, green shaly partings; *Dalmanella* and trepostome bryozoans abundant; numerous corrosion surfaces . . . . . 10' 8"

Buckhorn Member

Dolomite, moderately argillaceous, gray and dark gray speckled, medium grained, fossiliferous; green shaly partings; trepostome bryozoans common. . . . . 1' 5"

34. Rockton Lime-kiln Section

Quarries and roadcuts near the old Rockton lime kiln along west side of State Highway 2 south of Rockton, Winnebago Co., IL (SW SE and SW SE SE 24, NW NE 25, 46N-1E, South Beloit Quad.).

Galena Group

Dunleith Formation (32' 6")

Eagle Point Member

Dolomite, cherty, buff, medium grained, vuggy. . . . . 7'

Beecher Member

Dolomite; as above but not cherty; several corrosion surfaces . . . . . 5'

St. James Member

Dolomite, buff to gray, fossiliferous; 1" to 8" beds; thin, green shaly partings; several corrosion surfaces . . . . . 14' 6"

Buckhorn Member

Dolomite, moderately argillaceous, gray, dark gray speckled, medium grained, fossiliferous; 2" to 6" beds; green shaly partings; brachiopods and trepostome bryozoans abundant . . . . . 6'

Guttenberg Formation

Dolomite, moderately argillaceous, pinkish gray to buff, fossiliferous; 1" to 6" wavy, lenticular beds; dark reddish brown shaly partings; beds of megarippled calcarenite . . . . . 1' 6"

Platteville Group

Quimbys Mill Formation

Dolomite, gray to buff, fine grained, dense, cherty; 3" to 12" beds; *Chondrites*; lower 1' argillaceous, in 1" to 2" beds . . . . . 14' 6"

Nachusa Formation (15' 4")

Everett Member

Dolomite, pure, medium grained; 3" to 6" beds; *Chondrites, Palaeophycus*. . . . . 5' 4"

Elm Member

Dolomite, moderately argillaceous, buff, fine grained, laminated, fossiliferous . . . . . 4'

Eldena Member

Dolomite, pure, buff, medium grained. . . . . 6'

Grand Detour Formation

Forreston Member

Dolomite, argillaceous, gray-blue to buff, fine grained, laminated, fossiliferous; 1" to 12" beds; thin, brown shaly partings . . . . . 4' 4'

35. Carrico Quarry Section

Abandoned quarry east of Kilburn Avenue and south of Auburn Street in north part of Rockford, Winnebago Co., IL (SE NE SE 15, 44N-1E Rockford 7½ Quad.). Described in 1942, 1944, 1946. Now partially filled.

Galena Group

Dunleith Formation (47' 5")

Fairplay Member

Dolomite, gray-buff, pure, vuggy; weathered thin to medium bedded; *Receptaculites* . . . . . 4'

Eagle Point Member
Dolomite; as above but contains bands of chert nodules . . . 16′
Beecher Member
Dolomite; as above but not cherty . . . . . 4′
St. James Member (13′ 7″)
Dolomite; as below but contains green shale flakes and several *Prasopora* locally in north face; prominent reentrant 1″
Dolomite, gray-buff to yellow, fine to coarse grained; pure except for few thin shale partings . . . . . 7′ 7″
Dolomite; as above but without green shale partings; ferruginous at base . . . . . 5′ 11″
Buckhorn Member (9′ 10″)
Dolomite, light gray to yellow-buff, dark gray speckled and mottled, medium to coarse grained, vesicular; green argillaceous mottled; abundant *Dalmanella* and gastropods; 8″ to 10″ beds . . . . . 4′ 2″
Dolomite; as above but contains prominent greenish buff shale partings with abundant bryozoans; small species of *Receptaculites* 17″ above base; little fine sand locally in lower 5″; ferruginous at base . . . . . 5′ 8″
Guttenberg Formation
Dolomite, buff to brown, whitish weathering; vesicular, coarse grained, thin bedded; red-brown shale partings; abundant fossiliferous debris . . . . . 1′ 2″
Platteville Group
Quimbys Mill Formation (12′ 10″)
Dolomite, gray to buff, very fine grained, dense, massive, sparsely fossiliferous; chert nodules in bands; small *Chondrites* . . . . . 2′ 5″
Dolomite; as above but in thin wavy beds with shale partings. . . . . 2′ 6″
Dolomite; like 2′ 5″ unit above but mostly buff and more cherty . . . . . 5′ 3″
Dolomite; as above but very little chert; 3″ to 6″ beds . . . . 2′ 8″
Nachusa Formation (14′ 8″)
Everett Member
Dolomite, gray to buff, dense, fine grained; upper 38″ in 4″ beds, lower 3′ massive; chert nodules 11″ below top; *Öpikina, Foerstephyllum, Streptelasma* . . . . . 6′ 2″
Elm Member
Dolomite, buff, dense, very fine grained, cherty; thin wavy beds with brown shale partings; same fossils as above and *Vanuxemia*; prominent shale partings at top . . . . . 2′ 2″
Eldena Member
Dolomite, gray with dark gray streaks, dense to vesicular, massive, burrowed; upper 42″ cherty; *Streptelasma* common . . . . . 6′ 4″
Grand Detour Formation
Forreston Member
Dolomite, gray, dense, fossiliferous; *Trochonema* and *Lophospira* common; floor of quarry in 1942. . . . . 9′ 2″

36. Ruby Section
Quarries and river bank in west bluff of Rock River, in north part of Rockford, west of Loves Park, (SW SE NW 1, 44N-1E, Rockford Quad.). Described in 1944, 1946.
Galena Group
Dunleith Formation (64′ 9″)
Fairplay Member
Dolomite, buff, pure, medium grained, vesicular; *Receptaculites* common . . . . . 17′
Eagle Point Member
Dolomite; as above but cherty, especially in lower 7′ 6″ . . . 17′ 6″
Beecher Member
Dolomite; as above but not cherty . . . . . 6′ 6″
St. James Member
Dolomite; as above but buff and gray mottled; thin, green shale partings . . . . . 19′ 4″
Buckhorn Member
Dolomite; as above but dark gray mottled; some beds very fossiliferous . . . . . 4′ 5″
Guttenberg Formation
Dolomite, brown, argillaceous, thin bedded, vesicular, very fossiliferous; wavy, red-brown shale partings; 1″ shale, possibly bentonitic, 6″ below top; lower 6″ massive. . . . 1′ 10″
Quimbys Mill Formation (8′ 4″)
Strawbridge Member
Dolomite, brownish gray, dense, very fine grained, cherty . . 7′ 8″
Shullsburg Member
Dolomite; as above but buff shale partings; base concealed . 8″

37. Roscoe Southeast Section
Quarries on west side of Interstate 90, 2 mi southeast of Roscoe, Winnebago Co., IL (SE NE 10 and SW NW 11, 45N-2E, Belvidere NW Quad.), from the top: Galena Group, Wise Lake 32′, Dunleith 61′ (Wyota 14′ 10″, Loves Park 46′ 2″).

38. Harlem Southeast Section
Quarry 1 mi southeast of Harlem, Winnebago Co., IL (N center SE 33, 45N-2E, Rockford North Quad.).
Galena Group
Wise Lake Formation (36′ 9″)
Dolomite, pure buff, medium grained, fossiliferous; 8″ to 16″ beds; ½″ to 2″ shaly parting at base possibly position of Dygerts Bentonite Bed . . . . . 20′
Dolomite, pure, buff, vuggy; 1′ to 3′ beds; molluscan fossils including *Hormotoma* common in some beds . . . . . 16′ 9″
Dunleith Formation (78′ 7″)
Wyota Member
Dolomite, cherty, buff; 4″ to 10″ beds; chert nodules very abundant in upper 8′ . . . . . 14′
Loves Park Member (type section) (42′ 7″)
Dolomite; as above but not cherty; 12″ beds; several corrosion surfaces; *Receptaculites* . . . . . 5′ 5″
Dolomite, slightly argillaceous, buff; 4″ to 6″ beds with thin, brown shaly partings; large chert nodules near middle form a nearly continuous bed; small irregular chert nodules near base; 4 corrosion surfaces . . . . . 5′ 2″
Dolomite; as above but not cherty; several corrosion surfaces; *Receptaculites* . . . . . 6′
Dolomite, relatively pure, buff, vuggy; 4″ to 6″ beds; 3 prominent corrosion surfaces. . . . . 4′ 2″
Dolomite, slightly argillaceous, buff, dense; in 2 smooth-faced beds . . . . . 3′ 4″
Dolomite; as above but vuggy; rough weathered face; several corrosion surfaces near top . . . . . 4′
Dolomite, light buff, dense; prominent 5″ to 8″ smooth-faced beds; upper 1′ cherty; 4 or 5 prominent corrosion surfaces; *Receptaculites* . . . . . 3′ 3″
Dolomite; as above but vuggy . . . . . 10′
Dolomite, slightly argillaceous, buff; 1″ to 4″ beds; chert bed near base . . . . . 1′ 3″
Fairplay Member (16′)
Dolomite, pure, buff, medium grained; 3″ to 4″ beds. . . . . 4′ 4″
Dolomite; as above but contains small brown chert nodules. 1′ 4″
Dolomite; like 4′ 4″ unit above; 3 corrosion surfaces in upper 5′; *Receptaculites* . . . . . 10′ 4″
Eagle Point Member
Dolomite, cherty, buff, vuggy; 4″ to 10″ beds . . . . . 6′

39. Rockford Southeast Section

Quarry on west side of Mulford Road on southeast side of Rockford, Winnebago Co., IL (S½ NE SE 33, 44N-2E, Rockford South Quad.).

Galena Group

Dubuque Formation

Dolomite, argillaceous, buff, medium grained fossiliferous; 4" to 6" even beds with thin shaly partings; abundant recrystallized fossil debris on some bedding surfaces; 4" to 5" greenish gray shaly bed 8' below top . . . . . 15"

Wise Lake Formation (70')

Dolomite, pure, buff, medium grained; 12" to 18" beds; abundant moldic molluscan fossils . . . . . 18'

Dolomite; as above but *Receptaculites* abundant . . . . . 13'

Dolomite, pure, buff, medium grained, vuggy; rough weathered face; 1' to 2' beds; moldic molluscan fossils common . . . . . 20'

Dolomite; as above but gray and thin 6" to 20" beds; prominent bedding reentrant at top may be position of Dygerts Bentonite Bed . . . . . 19'

40. New Milford East Section

Quarry on west side of Mulford Road 3½ mi east of New Milford, Winnebago Co., IL (NW NE SE 16, 43N-2E, Rockford South Quad.), from the top: Galena Group, Wise Lake 22', Dunleith 17' 6".

41. Kishwaukee Forest Preserve Section

Quarries on east bank of Kishwaukee River, 3 mi south of Rockford, Winnebago Co., IL (SE NE NE 21, 43N-2E, Cherry Valley Quad.).

Galena Group

Dunleith Formation (38' 6")

Wyota Member

Dolomite, cherty, buff; weathers to 1" to 3" beds; contains thin dense beds with burrows . . . . . 8'

Loves Park Member (30' 6")

Dolomite, slightly argillaceous, cherty, gray to buff, dense to vesicular; prominent bedding reentrant at top and base . . . . . 2' 3"

Dolomite; as above but less argillaceous and not cherty; prominent corrosion surface 53" below top . . . . . 6' 10"

Dolomite, slightly argillaceous, buff; reddish brown shaly partings; lower 4" very shaly; *Receptaculites* in upper part . . . . . 5' 11"

Bentonite, gray, (probably Nasset Bentonite Bed) (sample 4) . . . . . 0" to ½"

Dolomite, relatively pure, cherty, buff; *Receptaculites*; prominent reentrant 1' below top . . . . . 3' 11"

Dolomite, pure, buff, vuggy; *Receptaculites*; 8 corrosion surfaces . . . . . 7' 7"

Bentonite (probably Calmar Bentonite Bed) (sample 3) . . . 0" to ¼"

Dolomite, pure, buff . . . . . 4'

42. Belvidere Southwest Section

Quarry 3 mi southwest of Belvidere, Boone Co., IL (S½ NW 9, 43N-3E, Cherry Valley Quad.).

Galena Group

Dubuque Formation (11' 9")

Dolomite, relatively argillaceous, buff, medium grained, fossiliferous; 2" to 6" beds . . . . . 3' 6"

Dolomite; as above but slightly less argillaceous; 4" shaly dolomite at top; 3" calcarenite 18" below top; recrystallized fossil debris on some shaly bedding surfaces; *Rafinesquina* on bedding surfaces in upper part . . . . . 8' 3"

Wise Lake Formation (57')

Dolomite, buff, medium grained, vuggy; 4" to 16" beds; two 4" calcarenite beds 12" and 18" above base; reentrant at base; *Receptaculites; Pseudolingula* . . . . . 7' 6"

Dolomite, pure, gray to buff, medium grained; 12" beds; vuggy rough weathered face; moldic fossils, *Receptaculites* abundant, *Ischadites, Pseudolingula, Palaeosynapta*; 3" calcarenite 30" above base; prominent reentrant at base . . . . . 10' 5"

Dolomite, pure, gray, medium grained; 1" to 4" beds; *Receptaculites*; reentrant at base . . . . . 14'

Dolomite; as above but vuggy; recrystallized fossil debris on some bedding surfaces, mostly moldic fossils; *Hormotoma* common in upper 2'; 4" graded calcarenite 32" above base . . . . . 14' 6"

Bentonite, gray, (Dygerts Bentonite Bed) (sample 125). . . . ½" to 1"

Dolomite, pure, gray to buff, vuggy; 12" to 20" beds. . . . . 10' 6"

43. Mt. Carroll Southwest Section

Quarry on north side of U.S. Highway 52, 2½ mi southwest of Mt. Carroll, Carroll Co., IL (SW NE SW 10, 24N-4E, Savanna Quad.).

Maquoketa Group

Scales Formation (38' 10")

Shale, gray, buff weathering; *Isotelus* fragments abundant. . 15'

Shale, medium gray; 1" to 6" nodular beds of argillaceous dolomite . . . . . 20'

Shale and dolomite, pyritic, phosphatic; numerous small molluscan fossils (Lower Depauperate Zone) . . . . . 10"

Shale, silty, dark brownish gray . . . . . 2'

Shale and dolomite; like 10" unit above (Lower Depauperate Zone). . . . . 1'

Galena Group

Dubuque Formation (32' 11")

Dolomite, argillaceous, fine to medium grained; 6" to 8" even beds; thick, brown shaly partings; abundant recrystallized crinoidal debris on bedding surfaces . . . . . 7'

Dolomite; as above but in 10" to 12" even beds; prominent reentrant at top; 3" shaly bed at base . . . . . 12' 3"

Dolomite; as above but in 8" to 10" beds; thin shaly partings; *Chondrites* and *Palaeophycus* common . . . . . 7' 10"

Dolomite, dense, massive; 4" shaly at top; 2" shaly at base . 1' 9"

Dolomite; like 7' 10" unit above; 4" to 5" shaly bed 2' below top . . . . . 3' 8"

Dolomite; prominent bed set off by thick shaly partings; widely traced marker bed . . . . . 4" to 6"

Wise Lake Formation (74')

Dolomite, relatively pure, gray; few thin, reddish brown shale partings . . . . . 7' 3"

Dolomite, gray; slightly more argillaceous than above or below; 12" to 24" beds; thin, brown shale partings; vuggy near middle . . . . . 5' 6"

Dolomite, pure, gray; 1' to 2' beds; numerous moldic molluscan fossils. . . . . 10' 6"

Dolomite; two 5" beds with thin, brown shaly partings. . . . 10"

Dolomite, pure, gray, vuggy; 2' to 3' beds; very thin, shaly partings; *Receptaculites* common . . . . . 41' 2"

Dolomite, slightly argillaceous; thin, dark brown to gray partings . . . . . 3" to 4"

Dolomite; like 41' 2" unit above; prominent corrosion surface 66" below top . . . . . 8' 6"

44. Brookville Northwest Section (T and W, 1963, geol. sec. 22; type section of Forreston Member of Grand Detour Formation).

Quarry on north side of a ravine northeast of U.S. Highway 52, 1 mi northwest of Brookville, Carroll Co., IL (NE SE NW 21, 24N-7E, Forreston Quad.).

Platteville Group
Nachusa Formation
Eldena Member

Dolomite, pure, gray to buff, fine to medium grained; cherty in upper 3' 6"; 1" to 8" beds; *Chondrites* . . . . . 8' 2"

Grand Detour Formation (38' 9")
Forreston Member

Dolomite, argillaceous, cherty, gray to buff, fine to medium grained; reddish brown shaly partings . . . . . 17' 10"

Stillman Member

Dolomite, pure, cherty, gray to buff, medium grained; 1" to 8" beds; rough weathered face; 0" to 3" calcarenite at base . . . . . 13' 2"

Cowen Member (type section)

Dolomite, blue-gray to buff; less argillaceous than below, more argillaceous than above; scattered small chert nodules, less chert than above; lower 2' more argillaceous; 0" to 3" calcarenite at base and 3' below top; lithistid sponges common in some beds. . . . . 7' 9"

Mifflin Formation

Dolomite, argillaceous, greenish gray to blue-gray, fossiliferous; 1" to 2" wavy lenticular bed with thick greenish gray partings; more argillaceous and thicker shaly partings in lower 3' 9"; abundant trace fossils in floor of lower quarry; prominent corrosion surfaces 3' 9" above quarry floor and 10" below top; 4" nodular bed 2' below top; 1" to 2" calcarenite 1' 10" below top; base concealed. . . . . 10' 3"

Along the ravine downstream to the east of the quarry the remainder of the Mifflin Formation is exposed (9' 3" thick) and overlies the following strata:

Pecatonica Formation

Dolomite, buff, poorly exposed . . . . . 18' 3"

Ancell Group
Glenwood Formation
Harmony Hill Member

Shale, green . . . . . 6"

45. Polo West Section

Quarries and ravine along the Burlington Northern Railroad 1 mi west of Polo, Ogle Co., IL (NW NW 17 and SE NE NE 18, 23N-8E, Sterling Quad.).

Galena Group
Dunleith Formation (79' 10")
Loves Park Member (20' 8")

Dolomite, pure, buff; chert near base . . . . . 8' 1"
Dolomite, slightly argillaceous, light buff, cherty. . . . . 4' 6"
Dolomite, pure, cherty, vuggy; *Receptaculites*. . . . . 8' 1"

Fairplay Member (19' 7")

Dolomite, slightly argillaceous, cherty; 2" to 4" beds; wavy partings; *Receptaculites* . . . . . 7'
Dolomite, pure, vuggy; thicker bedded than above; scattered chert nodules in upper part; *Receptaculites*. . . . . 12' 7"

Eagle Point Member

Dolomite, buff, vuggy; 4" to 8" beds; many bands of chert. 17'

Beecher and St. James Members (18')

Dolomite, buff; 1' to 2' beds . . . . . 12'
Dolomite; as above but 6" to 12" beds . . . . . 6'

Buckhorn Member

Dolomite, slightly argillaceous, gray to buff, dark gray speckled, vuggy; 8" to 12" beds; thin, green shaly partings; prominent shaly parting at top . . . . . 4' 7"

Guttenberg Formation (5' 1")

Dolomite, moderately argillaceous, pinkish gray to buff, fossiliferous; 1" to 6" wavy, lenticular beds; thick, dark reddish brown shale partings; chert nodules 28" below top. . . . . 4' 8"
Bentonite, orange (Elkport Bentonite Bed) (sample 39) . . . 2" to 5"
Dolomite; as above the bentonite . . . . . 3" to 4"

Platteville Group
Quimbys Mill Formation

Dolomite, buff, dense, fine grained; 4" to 6" beds; corrosion surface at top. . . . . 6'

46. Mt. Morris Southwest Section

Quarry and stream cut along banks of tributary of West Branch Pine Creek, 4 mi southwest of Mt. Morris, Ogle Co., IL (NW NW SE 36, 24N-8E, Forreston Quad.).

Galena Group
Dubuque Formation (14')

Dolomite, moderately argillaceous, buff, medium grained, fossiliferous; 8" to 12" even beds; thick, reddish brown shaly partings; *Pseudolingula, Hormotoma*; recrystallized fossil debris on some shaly bedding surfaces; prominent 3" shaly bed 1' 2" above base . . . . . 8'
Dolomite; as above but slightly less argillaceous; *Chondrites* on some shaly bedding surfaces; prominent 4" shaly bed at top . . . . . 6'

Wise Lake Formation

Dolomite, relatively pure, buff, vuggy, medium grained; 12" to 30" beds; abundant moldic molluscan fossils; shaly bedding surface at top . . . . . 6'

47. Victory School Section

Abandoned quarry on west side Pine Creek north of Victory School, 2 mi southwest of Mt. Morris, Ogle Co., IL (NW SW SE 32, 24N-9E, Oregon Quad.).

Galena Group
Wise Lake Formation
Sinsinawa Member

Dolomite, brown, pure, medium grained, vesicular, massive; weathers to 2" to 8" beds; scattered chert nodules near base; prominent reentrant at base. . . . . 13'

Dunleith Formation (36' 3")
Wyota Member (19' 5")

Dolomite, brown, dense, slightly argillaceous . . . . . 8"
Dolomite, brownish gray, pure, vesicular; 1" to 3" beds; several 1" to 4" dense, gray, slightly argillaceous, burrowed beds; several beds of chert nodules from 5' below top to 6' above base; prominent reentrant at base . . . . . 18' 9"

Loves Park Member (16' 10")

Dolomite, gray; slightly less pure than above; tight bedding surfaces at 6" to 12" intervals; few *Receptaculites*. . . . . 5' 10"
Bentonite, gray; prominent reentrant (**Haldane Bentonite Bed**, type section) (sample 32). . . . . 1"
Dolomite, gray, massive, slightly argillaceous . . . . . 3' 1"
Dolomite, gray, dense; prominent reentrant at base . . . . . 4"
Dolomite, gray, pure, cherty; *Receptaculites*; prominent reentrant at base . . . . . 2'
Dolomite, buff, pure, medium grained, vesicular; few chert nodules; *Receptaculites* abundant. . . . . 5' 6"

48. Stratford Southeast Section

Quarries along tributary of Pine Creek 1½ mi southeast of Stratford, Ogle Co., IL (NW SW SW 16 and SW NW SW 16,

23N-9E, Dixon Quad.), from the top: Galena Group, Dunleith 30', Guttenberg 2' 4"; Platteville Group, Quimbys Mill 15'.

49. Stronghold Section

Quarry on east side of private driveway to the Stronghold Estate, 2 mi north of Oregon, Ogle Co., IL (SE NE SW 28, 24N-10E, Oregon Quad.), from the top: Galena Group, Dunleith 18'; Platteville Group, Quimbys Mill 15'.

50. Willys Spring Section

Roadcut, quarry, and ravine located ¼ mi northeast of Oregon, Ogle Co., IL (elongate section; 1000' from west line and 2700' from north line, Sec. 2, 23N-10E, Oregon Quad.), from the top: Galena Group, Dunleith 76' 9"; Platteville Group, 38' 3".

51. Thorpe Section

Quarry on Thorpe farm north of State Highway 64, on east side of Oregon, Ogle Co., IL (elongate section; 2200' from west line and 4400' from south line Sec. 2, 23N-10E, Oregon Quad.).

Galena Group

Dunleith Formation (21' 6")

Dolomite, buff, medium grained; 3" to 12" beds. . . . . 18'

Dolomite, brown, mottled; 3" to 10" beds; thin, green shaly partings; *Dalmanella* . . . . . 3' 6"

Platteville Group

Quimbys Mill Formation (14' 7")

Dolomite, buff, fine grained, dense; ¼" to 2" beds; smooth bedding surfaces; large chert nodules in upper part. . . . . 1' 3"

Dolomite, bluish gray to buff, dense; 1" to 3" beds; smooth flat to gently undulating bedding surfaces; small, thin chert nodules along bedding surfaces; *Chondrites*. . . . . 4' 3"

Dolomite; as above but massive . . . . . 3'

Dolomite; as above but mostly 5" beds; numerous small, white chert nodules; 1" bluish gray to buff, dolomitic shale at top . . . . . 1'

Dolomite, bluish gray to buff, fine grained, dense; 1" to 5" beds; smooth, flat to gently undulating bedding surfaces with thin shaly partings; reentrant at top . . . . . 5' 1"

Nachusa Formation (19' 7")

Everett Member

Dolomite, pure, cherty, bluish gray to buff, mottled, medium grained; 9" to 13" beds; rough weathered face; *Chondrites*; silicified *Streptelasma* . . . . . 6' 10"

Elm Member

Dolomite, slightly argillaceous, bluish gray to buff, dense, fine grained; prominent shaly partings 9" and 18" below top; smooth weathered face. . . . . 3' 5"

Eldena Member

Dolomite; like 6' 10" unit above but without chert . . . . . 9' 4"

Grand Detour Formation (25' 10")

Forreston Member

Dolomite, argillaceous, gray to buff, fine grained, laminated, fossiliferous; weathers to 1" to 2" wavy, lenticular beds; thick, dark brown shaly partings; *Öpikina, Streptelasma*; 18" bed at top transitional to Nachusa Formation . . . . . 13' 2"

Stillman Member

Dolomite, relatively pure, gray, mottled buff, vuggy; 4" to 8" even beds; thin shaly partings . . . . . 12' 8"

52. Byron North Section (T and W, 1963, geol. sec. 20)

Quarry north of Byron, Ogle Co., IL (NE NE SE 30, 25N-11E, Oregon Quad.), from the top: Platteville Group, Nachusa (Eldena 5'), Grand Detour 43'.

53. Byron East Section

Quarry on west side of State Highway 2, on east side of Byron, Ogle Co., IL (SE NW SE 29, 25N-11E, Kings Quad.), from the top: Platteville Group, Quimbys Mill 8', Nachusa 18' 10" (Everett 5' 7", Elm 1' 5", Eldena 11' 10"), Grand Detour 30' 6".

54. Chana Northeast Section

Quarry on south side of road, 1½ mi northeast of Chana, Ogle Co., IL (NW NW NE 14, 23N-11E, Rochelle Quad.).

Platteville Group

Grand Detour Formation

Dolomite, buff, fine grained; 3" to 4" beds; weathered. . . . 3'

Mifflin Formation (17' 6")

Dolomite, argillaceous, buff, fine grained, very fossiliferous; 3" to 5" beds; thin shaly partings; mollusks very abundant; 2" to 3" shaly bed with *Chondrites* at top; 1" to 4" graded calcarenite below the shaly bed and 7" above the base. . . . . 10' 6"

Dolomite, argillaceous, bluish gray, weathered buff, fine grained, very fossiliferous; 1" to 3" wavy, lenticular beds; thick, greenish gray shaly partings; 1" to 2" shaly reentrant at top. . . . . 7'

Ferruginous corrosion surface on top of Pecatonica Formation is exposed in floor at north end of quarry.

55. Rochelle North Section

Quarry 100 yd east of U.S. Highway 51, ½ mi north of Rochelle, Ogle Co., IL (NW NW SE 13, 40N-1E, Rochelle Quad.).

Galena Group

Dunleith Formation (12' 1")

Dolomite, slightly argillaceous, buff, medium grained; 2" to 6" wavy beds; much weathered; slightly darker buff than below; prominent reentrant at base. . . . . 12'

Bentonite, green; mixed with shale (sample 67). . . . . ¼" to 1"

Platteville Group

Quimbys Mill Formation (20' 6")

Strawbridge Member (9' 1")

Dolomite, pure, buff, fine grained, dense; 5" to 12" beds; numerous small burrow cavities in basal 15" bed . . . . . 3' 5"

Dolomite, slightly argillaceous, buff; 2" to 6" beds; thin shaly partings . . . . . 2' 8"

Dolomite, pure, cherty, mottled, vuggy; rough weathered face; massive but has very thin partings . . . . . 3'

Shullsburg Member (11' 5")

Dolomite, slightly argillaceous, cherty, buff; 1" to 4" beds; smooth bedding surfaces; numerous, small, lenticular cavities . . . . . 6' 8"

Dolomite, moderately argillaceous, cherty, bluish gray, fine grained; 2" to 6" beds; basal 1' fossiliferous; *Foerstephyllum*; prominent reentrant at base . . . . . 4' 9"

Nachusa Formation (17' 10")

Dolomite, pure . . . . . 3'

Dolomite, pure, cherty, buff, gray mottled; large chert nodules. . . . . 14' 10"

56. Rochelle East Section

Quarry on south side of State Highway 38, 2 mi east of Rochelle, Ogle Co., IL (SE NE NW 20, 40N-2E, Rochelle Quad.).

Platteville Group

Quimbys Mill Formation (13' 4")

Dolomite, cherty, buff, fine grained; 1" to 3" beds; smooth bedding surface; lenticular cavities . . . . . 7' 2"
Dolomite; as above but slightly argillaceous . . . . . 6' 2"
Nachusa Formation (24' 8")
Dolomite, pure, cherty; 4" to 12" beds; large chert nodules near top. . . . . 4' 7"
Dolomite; as above but only scattered chert nodules . . . . . 4' 10"
Dolomite, cherty, light buff, dense . . . . . 8"
Dolomite, pure, buff, medium grained; tabulate corals in lower 4'. . . . . 14' 7"
Grand Detour Formation (42' 1")
Forreston Member
Dolomite, argillaceous, gray to buff, fine grained, fossiliferous; 2" to 6" beds; greenish gray and brown shaly partings; *Öpikina* and *Streptelasma* common . . . . . 13' 6"
Stillman Member
Dolomite, relatively pure, gray to buff, vuggy; 2" to 8" beds . . . . . 12' 1"
Cowen Member (16' 6")
Dolomite, argillaceous, fossiliferous; 2" to 5" beds; prominent unit . . . . . 2' 6"
Dolomite, pure, fine grained, partly vuggy; 6" to 12" beds; abundant, diverse molluscan fauna; 1' bed with numerous burrow cavities 10' above base . . . . . 14'

57. Dixon West Section
Quarry on north side of State Highway 2, 1 mi west of Dixon, Lee Co., IL (NE NE SE 2, 21N-8E, Sterling Quad.).
Galena Group
Dunleith Formation (52')
Loves Park Member
Dolomite, buff; large chert nodules. . . . . 2'
Fairplay Member
Dolomite, pure, buff; 1' to 2' beds; few small scattered chert nodules; *Receptaculites*; prominent reentrant 11' above base . . . . . 17'
Eagle Point Member
Dolomite, buff; 4" to 10" beds; vuggy in upper 5'; bands of chert nodules . . . . . 17'
Beecher and St. James Members
Dolomite; as above but not cherty; 6" to 24" beds; several corrosion surfaces; prominent reentrant at top and 7' below top . . . . . 16'

58. Dixon Southwest Section
Three quarries south of the Chicago and Northwestern Railroad on the southwest side of Dixon, Lee Co., IL (SE SE NE 12, 21N-8E; NW SW NW and NW SE NW 7, 21N-9E, Sterling Quad.). Strata dip approximately 10° east.
Galena Group
Wise Lake Formation
Dolomite, pure, buff, vuggy, medium grained; 8" to 20" beds; *Hormotoma, Illaenus*; ferruginous corrosion surface 3' above base; exposed in 2 quarries in Sec. 7 . . . . . 18'
Dunleith Formation (126')
Wyota Member
Dolomite, pure, buff, medium grained; 1' to 2' beds; chert in 3" to 4" bands; very large chert nodules near top; 3" to 4" reddish brown shaly dolomite at base is a widely traceable marker bed . . . . . 19' 2"
Loves Park Member (47' 8")
Dolomite; as above but not cherty; 6" to 12" beds; prominent ferruginous corrosion surfaces 24", 26", and 38" below top . . . . . 29'
Dolomite; as above; 4" to 12" beds; thin partings; *Receptaculites* common . . . . . 9' 8"
Dolomite; as above but lighter; beds up to 2' thick. . . . . 9'

The top of the following section, which is exposed in the large quarry in Sec. 12, projects along the east dipping beds to the base of the quarries in Sec. 7, which are described above.

Fairplay, Eagle Point, and Beecher Members (36' 10")
Dolomite, pure, buff, medium grained; 4" to 10" beds; very thin partings; large vugs in lower 8'; *Receptaculites* and *Sowerbyella* common in lower 10' . . . . . 21' 10"
Dolomite; as above but not vuggy. . . . . 15'
St. James Member
Dolomite; as above but vuggy, rough weathered face; 4" to 16" beds; thin, green shaly partings; several corrosion surfaces in lower part. . . . . 17'
Buckhorn Member
Dolomite, gray to buff, dark gray speckled, vuggy; chert nodules 1' and 4' 10" above base; rough weathered face; 4" to 8" beds; thin, green shaly partings; 1" to 2" green shaly bed at top; corrosion surface 8" below top . . . . . 5' 4"
Guttenberg Formation
Dolomite, pinkish gray to buff; 1" to 4" wavy, lenticular beds; thick, dark reddish brown shale partings; abundant and diverse fauna; molluscan coquina in lower 8", chert nodules 16" above base; thin bentonite and shale at base (sample 30) . . . . . 2' 7"
Platteville Group
Quimbys Mill Formation (6' 10")
Strawbridge Member
Dolomite, pure, cherty, buff, fine grained, vuggy; 4" to 15" beds; *Foerstephyllum*. . . . . 3' 3"
Shullsburg Member
Dolomite, relatively argillaceous, buff, fine grained; ½" to 3" beds; smooth bedding surface; vertical lenticular cavities; lower 1' more argillaceous and weathers shaly. . . . . 3' 7"
Nachusa Formation (19' 9")
Everett Member
Dolomite, pure, very cherty, buff, vuggy; rough face; 4" to 12" beds; large chert nodules at top . . . . . 7' 9"
Elm Member
Dolomite, moderately argillaceous, cherty, grayish blue to buff, dark gray speckled, laminated. . . . . 4'
Eldena Member
Dolomite, pure, cherty, gray to buff; 3" to 6" beds; *Chondrites* and *Palaeophycus* abundant; molluscan fossils abundant near top. . . . . 8'
Grand Detour Formation (20' 7")
Forreston Member (17' 7")
Dolomite, argillaceous, cherty, gray to buff, fossiliferous; 2" to 4" beds; thick, brown shaly partings; *Streptelasma* common . . . . . 10' 9"
Dolomite; as above but less argillaceous; 2" to 7" beds . . . . 6' 10"
Stillman Member
Dolomite, relatively pure, buff; 5" to 8" beds; thin shaly partings . . . . . 3'

59. Dixon South Section
Quarry on west side of Illinois Central Gulf Railroad on south side of Dixon, Lee Co., IL (SW SE NE 8, 21N-9E, Dixon Quad.), from the top: Galena Group, Dunleith (Loves Park 30' 6", Haldane Bentonite Bed 12' below top, sample 33).

60. Dixon East Section (T and W, 1963, geol. sec. 23)
Quarry on east side of Dixon, Ogle Co., IL, east of State Highway 2 at curve where highway descends to floor of

Rock River Valley (SE SE SW 33, 22N-9E, Dixon Quad.), from the top: Galena Group, Dunleith 6' 3" (St. James 8", Buckhorn 5' 7"), Guttenberg 3' 4" (Glenhaven 2' 11", Garnavillo 5"); Platteville Group, Quimbys Mill 11' 8" (Strawbridge 5' 11", Shullsburg 3' 6", Hazel Green 2' 3"), Nachusa 17' 10" (Everett 7' 6", Elm 2' 10", Eldena 7' 6"), Grand Detour (Forreston 9' 10").

61. Medusa Section

Medusa Cement Company quarry north of State Highway 2 at Dixon, Lee Co., IL (27, 22N-9E, Dixon Quad.).

Platteville Group

Grand Detour Formation (32')

Forreston Member

Described in NW NE SE 27.

Limestone, argillaceous, gray, fine grained, fossiliferous; 2" to 6" beds; brown shaly partings; *Streptelasma* common. 12'

Stillman Member

Limestone, dolomite mottled, relatively pure, gray, fine grained; 4" to 8" even beds; thin shaly partings; *Monotrypa* and lithistid sponges including *Anthaspidella* and *Zittelella* in lower 10'; 3" graded calcarenite 4" above base . . . . . 20'

Mifflin Formation (18' 4")

Shale, dolomitic, dark gray, fossiliferous; *Chondrites* and *Planolites* very abundant. . . . . 4" to 6"

Bentonite, orange (sample 110) . . . . . 0" to ½"

Limestone, moderately argillaceous, gray, fine grained, fossiliferous; 1" to 3" beds; thin shaly partings; abundant, fine-grained, fossiliferous debris in some beds; corrosion surface 12" below top . . . . . 7' 4"

Limestone, very argillaceous, gray to buff, very fine grained, very fossiliferous; ½" to 2" wavy, lenticular beds; thick, greenish gray shale partings; conchoidal fracture; thin lenses of calcarenite and calcirudite, some graded; widespread 2" calcarenite at top of unit traced to Walgreen and Dixon North Sections; *Phycodes*; corrosion surfaces at 10" and 40" below top . . . . . 10' 6"

Pecatonica Formation (34' 4")

Medusa Member

Described in NE NW NE 27

Limestone, dolomite mottled, brownish gray, weathered buff, fine grained; 6" to 12" even beds; very prominent ferruginous corrosion surface at top; 0' to 1' prominent burrow-mottled bed at base. . . . . 6'

New Glarus Member (10' 6")

Limestone, relatively pure, dolomite mottled, brown to buff, fine grained; 3" to 6" wavy beds. . . . . 4' 6"

Limestone, moderately argillaceous, dolomite mottled, buff, fine grained, fossiliferous; 2" to 6" wavy beds; few beds of dolomite; 3" to 4" shaly bed at top . . . . . 6'

Dane Member

Limestone; as above but slightly darker and in thinner, tighter beds; scattered small chert nodules in upper 1'; floating sand grains in lower 3'. . . . . 9' 10"

Chana Member

Limestone, relatively pure, dolomitic, buff to brown, medium grained, dense; 4" to 8" beds; rounded sand grains abundant near base . . . . . 8'

62. Dixon North Section

Abandoned quarry on east side Rock River Valley 3½ mi north of Dixon, Lee Co., IL (SW SW NW 22, 22N-9E, Dixon Quad.).

Platteville Group

Mifflin Formation (16' 8")

Limestone, dolomite mottled, gray, whitish weathered, medium bedded, fossiliferous; lower 20" at top of quarry face is thinner bedded . . . . . 6' 8"

Limestone, gray, lithographic, fossiliferous, slightly mottled and streaked with dolomite near the bedding surfaces; thin to medium wavy beds; shale partings; 2" purplish calcarenite at top, key bed in Dixon area . . . . . 10'

Pecatonica Formation (29')

Medusa Member

Limestone, gray, lithographic, burrowed, thick bedding; mottled with fine-grained, light buff weathered dolomite; ferruginous corrosion surface at top . . . . . 5' 8"

New Glarus Member (9' 4")

Limestone, gray, lithographic; thin wavy beds; thin shaly partings . . . . . 4' 7"

Limestone; as above but medium bedded . . . . . 1' 11"

Limestone; as above but thin and medium bedded; 1" dolomitic shale at base . . . . . 2' 10"

Dane Member (14')

Limestone, argillaceous, dolomite mottled, burrowed, thick bedded . . . . . 7'

Section below mostly covered

Dolomite, pure, slightly vuggy, thick bedded . . . . . 3' 2"

Dolomite, argillaceous; thin to thick beds; thin shale partings. . . . . 3' 10"

63. Lee Center East Section

Quarry on west side of road 1½ mi east of Lee Center, Lee Co., IL (SE SW NW 9, 20N-11E, Mendota Quad.).

Platteville Group

Grand Detour Formation

Dolomite, relatively pure, buff, fine grained; 2" to 4" beds; *Streptelasma* common . . . . . 15'

Mifflin Formation (18' 6")

Shale, dolomitic, dark brown; *Chondrites, Planolites* . . . . . 6"

Dolomite, buff; 4" to 12" beds . . . . . 8'

Dolomite, argillaceous, gray to buff, fossiliferous; 1" to 3" wavy, lenticular beds; greenish gray shaly partings; mollusks very abundant . . . . . 10'

Pecatonica Formation (28' 11")

Medusa Member

Dolomite, moderately argillaceous, gray, dark gray mottled, dense; 2" to 6" beds; thin, brown shaly partings; several corrosion surfaces; very prominent ferruginous corrosion surface at top; molluscan fossils common. . . . . 5' 8"

New Glarus Member

Dolomite, relatively pure, cherty, brown to buff, dense; 3" to 12" beds . . . . . 13'

Dane Member (10' 3")

Dolomite, argillaceous, brown . . . . . 2" to 4"

Dolomite, moderately argillaceous, bluish gray; 3" to 12" beds; thin, gray to brown shaly partings; scattered chert nodules . . . . . 10'

64. Troy Grove Section

Quarry on east side of Troy Grove, La Salle Co., IL (NE SW NE 35, 35N-1E, Troy Grove Quad.).

Platteville Group

Nachusa Formation

Dolomite, relatively pure, buff, medium grained; 2" to 3" even beds; *Palaeophycus, Chondrites*; lower 1' 6" transitional to unit below. . . . . 8'

Grand Detour Formation (37' 3")

Forreston Member

Dolomite, argillaceous, buff, fine grained, fossiliferous; 2" to 10" beds; thick, dark brown shaly partings; some beds

laminated; 1' dense light bed at top; *Streptelasma* common . . . . . 9'

Stillman Member (14' 2")

Dolomite, relatively pure, buff, fossiliferous; 5" to 18" beds; thin shaly partings; 5" shaly bed 8' above base; rhombiferan cystoid thecal plates common on some bedding surfaces. . . . . 12' 2"

Dolomite, argillaceous, gray to buff, fossiliferous; 1" to 3" beds; thick, dark brown shaly partings. . . . . 2'

Cowen Member

Dolomite, relatively pure, gray; 6" to 8" even beds; *Chondrites* very abundant on some bedding surface (fig. 8C); two widespread 2" graded calcarenite beds 11" and 15" above base; 4" lumpy, nodular bed 3" to 5" above base . 14' 1"

Mifflin Formation (19' 9")

Dolomite, moderately argillaceous, gray with dark gray 1/8" to 1/4" spots, fine grained, fossiliferous; 8" to 10" beds; thin shaly partings; 4" to 6" greenish gray shaly bed with *Chondrites* 5" below top; 4" lumpy nodular bed at top . . . . . 9' 3"

Dolomite, argillaceous, gray, fine grained, fossiliferous; 1" to 6" wavy, lenticular beds; thin, greenish gray shaly partings. . . . . 10' 6"

Pecatonica Formation (33' 7")

Dolomite, pure, cherty, light brown, fine to medium grained, vuggy; 2" to 12" beds; very prominent ferruginous corrosion surface at top; chert very abundant in upper 12', upper 1' slightly argillaceous. . . . . 18' 7"

Dolomite, cherty, gray, dark gray mottled, fine grained; 4" to 12" even beds. . . . . 7' 10"

Dolomite; as above but slightly more argillaceous; 2" shaly bed at top . . . . . 7' 2"

65. Deer Park Section (T and W, 1963, geol. sec. 15)

Exposures in the north wall of Deer Park Canyon near its mouth and in the east bank of Vermilion River south of the mouth of the canyon, in Matthiessen State Park, east of Oglesby, La Salle Co., IL (NE NE NE 31, 33N-3E, La Salle Quad.), from the top: Pennsylvanian strata not measured; Galena Group, Dunleith (Buckhorn 8'); Platteville Group, Quimbys Mill 13' 6", Nachusa 20' 2", Grand Detour 26' 10", Mifflin 17' 6", Pecatonica about 39'; Ancell Group, St. Peter, not measured.

66. Hollinger Branch Section

Exposures along ravine west of Illinois Highway 178, 1½ mi north of Lowell, La Salle Co., IL (SW NE and SE NW 5, 32N-2E, La Salle Quad.). Because of west dip the oldest strata are exposed in the eastern outcrops. Described by J. S. Templeton and H. B. Willman, 1949.

Galena Group

Dunleith Formation (23')

Calcarenite, light buff, coarse grained, fossiliferous, dolomite mottled. (Exposed ½ mi west of narrow gorge exposing lower strata, from which it is separated stratigraphically by an uncertain but large covered interval.). . 8'

Limestone, gray, dolomite mottled, fine grained, massive; weathered thin bedded; several calcarenite beds; much crinoidal debris . . . . . 9'

Limestone, cherty, brownish gray, mottled dark gray, thick bedded; rough pitted face; *Dalmanella, Sowerbyella*; basal contact sharp but not conspicuous . . . . . 6'

Platteville Group

Quimbys Mill Formation (14' 7")

Strawbridge Member

Limestone, light brownish gray, fine grained, dense, burrowed, thin bedded; chert nodules 38" below top; 6" shaly bed 19" above base; *Opikina, Foerstephyllum;* crinoid debris. . . . . 8' 6"

Shullsburg Member

Limestone, light gray brown, fine grained, dense, cherty, burrowed; thin bedded with smooth bedding surfaces; shale partings; lower 1' dolomite mottled; conspicuous reentrant . . . . . 6' 1"

Nachusa Formation (22' 9")

Everett Member (13' 3")

Limestone, dolomite mottled, cherty, gray, fine grained, massive; *Chondrites*; 2" calcarenite at top; disturbed by cave collapse. . . . . 7'

Limestone, gray, very fine grained, massive; smooth face; prominent bedding reentrant 2" above base . . . . . 7"

Limestone; like 7' bed above . . . . . 5' 8"

Elm Member

Limestone, dolomitic, gray to buff, argillaceous, fine grained, dense, thick bedded; conchoidal fracture; smooth face; calcite filled vugs; *Streptelasma* . . . . . 4' 6"

Eldena Member

Limestone, brownish gray, very fine grained, partly dolomite mottled, medium bedded; rough face; *Chondrites, Streptelasma*. . . . . 5'

Grand Detour Formation

Forreston Member

Limestone, gray, white weathered, very fine grained, fossiliferous; dolomite mottled at top and in lower 18"; 7" to 18" beds; smooth bedding surfaces; thin, red-brown shale partings; ½" shale 40" below top; corrosion surface 11" below top . . . . . 6' 4"

67. Lowell North Section

Exposures both up and downstream from the bridge of Illinois Route 178 over Vermilion River at Lowell, La Salle Co., IL (SE NE SE 8, 32N-2E, La Salle Quad.). Strata dip westward with oldest strata exposed 300 yd east of bridge, and youngest exposed 300 yd west of bridge. Thickness of covered intervals approximate. Described by J. S. Templeton and H. B. Willman, 1949.

Galena Group

Dunleith Formation (150' 1")

Section on north bank

Limestone, dolomite mottled, pure, fine to medium grained, dense, massive. . . . . 4'

Covered. . . . . 2'

Limestone; as above; *Receptaculites* . . . . . 3'

Covered. . . . . 5'

Limestone; as above; weathered to 2" to 6" beds; strophomenid brachiopods . . . . . 5'

Covered. . . . . 1'

Limestone; as above; 12" to 18" beds; *Receptaculites* at base . . . . . 4'

Covered; lower part on south bank contains abundant *Receptaculites* . . . . . 9'

Limestone; as above. . . . . 4'

Covered. . . . . 5'

Dolomite, medium grained, dense to finely vesicular, mottled; 3" to 12" beds. . . . . 5' 6"

Limestone, dolomite mottled. . . . . 6"

Dolomite, massive; prominent reentrant at base may be position of bentonite. . . . . 1'

Limestone, dolomite mottled, massive; weathers thin bedded; *Receptaculites*, strophomenids, bryozoans, much fossil debris . . . . . 15' 6"

Limestone, very fossiliferous; *Sowerbyella*, *Rafinesquina*, many bryozoans; prominent reentrant 18" above base . . 4' 4"
Limestone, dolomite mottled. . . . . 2' 6"
Limestone, coarse grained, laminated, fossiliferous. . . . . 6"
Limestone, dolomite mottled, coarse grained, massive . . . 1' 6"
Covered. . . . . 3'
Limestone, dolomite mottled. . . . . 7'
Covered. . . . . 3'
Limestone, dolomite mottled, massive; prominent bedding reentrant 32" and 44" below top; 2" very prominent shaly reentrant 14" above base. . . . . 6' 6"
Dolomite, slightly argillaceous, gray, dense. . . . . 5"
Limestone, dolomite mottled, massive. . . . . 7'

Eagle Point Member (17' 8")

Limestone; few thin shaly partings; calcite in vugs; few chert nodules; many *Receptaculites*; prominent reentrant at base . . . . . 8'
Limestone, dolomite mottled; bands of chert nodules; *Receptaculites*; prominent reentrant at base . . . . . 5' 2"
Limestone, dolomite mottled; slightly argillaceous; 4" to 6" beds; interbedded with bryozoan coquina; prominent reentrant 18" above base. . . . . 4' 6"

Beecher and St. James Members (32' 2")

Calcarenite and fine grained limestone; 2" to 8" beds; some beds dolomite mottled; many beds are *Dalmanella* coquina; prominent reentrant at base; makes bench on east side of bridge . . . . . 12'
Calcarenite, fine to medium grained . . . . . 2'
Calcarenite, dolomite mottled . . . . . 8'
Covered. . . . . 2'
Calcarenite. . . . . 5'
Limestone, dolomite mottled. . . . . 8"
Calcarenite; base of section east of bridge. . . . . 2' 6"

68. Lowell East Section

Exposures on south bank of Vermilion River (NW SE SW 9 and SW SW SE 9, La Salle Quad.) and north bank (SE SW SE 9, 32N-2E, Ottawa Quad.), east of Lowell, La Salle Co., IL. Described by J. S. Templeton, 1949.

Galena Group

Dunleith Formation

Buckhorn Member

Compiled on south bank

Limestone, dolomite mottled, brown-gray to dark gray, lithographic, dense, cherty; 6" to 12" beds; rough pitted face; lower 9" pyritic; *Dalmanella*, *Sowerbyella*, abundant trepostome bryozoans . . . . . 4' 3"

Platteville Group

Quimbys Mill Formation (13' 8")

Strawbridge Member (9' 3")

Dolomite, light to dark gray, very fine grained, dense, thin bedded; smooth face . . . . . 1' 7"
Covered at fault, downthrown 4' 2" on west side, assuming same thickness as at Hollinger Branch, 1½ mi north . . . . 4' 2"
Dolomite, gray buff, fine grained, dense to slightly vesicular, burrowed, cherty; smooth bedding surfaces; few fossil fragments. . . . . 2'
Dolomite; as above but slightly vuggy and not cherty . . . . . 1' 6"

Shullsburg Member (4' 5")

Dolomite, gray, argillaceous, burrowed, dense, thin bedded; discontinuous very thin shale partings; many large flat chert nodules; makes reentrant. . . . . 1' to 1' 6"
Dolomite; as above but less argillaceous and cherty . . . 2' 9" to 3' 8"

Nachusa Formation

Everett Member (10' 6")

Exposed on north bank

Dolomite, gray and mottled buff, fine grained, dense to vesicular, very cherty, massive; rough pitted face; *Chondrites*, silicified *Foerstephyllum*, *Tetradium*; lower 20" thin bedded and not cherty . . . . . 6'
Dolomite; as above; layer of brown chert nodules at top and scattered white chert nodules below . . . . . 4' 6"

69. Ottawa Southeast Section

Exposures in east bank of Covel Creek 2 mi southeast of Ottawa, La Salle Co., IL (NE NW SE 21 and SW NE SE 21, 33N-3E, Ottawa Quad.), from the top: Platteville Group, Pecatonica 20' 3", Ancell Group, St. Peter 6'.

70. Millbrook Section

Quarry on west bank of Fox River 1¼ mi north of Millbrook, Kendall Co., IL (SW NW SE 4, 36N-6E, Newark Quad.): Galena Group, Wise Lake 20'.

71. Lisbon Section

Quarry on north side of Lisbon, Kendall Co., IL (NE NE NE 25, 35N-6E, Morris Quad.): Platteville Group, Quimbys Mill 12' to 15'.

72. Lisbon Southwest Section

Exposure in stream, 1¼ mi southwest of Lisbon, Kendall Co., IL (SW SW NW 36 to SW NE SW 36, 35N-6E, Morris Quad.): Platteville Group, Nachusa 20'.

73. Central Section

Quarry on west side of State Highway 47, ¼ mi north of Central, Kendall Co., IL (NE SE SW 28, 35N-7E, Morris Quad.).

Galena Group

Dunleith Formation (71' 6")

(May include Wise Lake in upper part)

Limestone, pure, dolomite mottled, gray, fossiliferous; sand-size fossil debris in fine-grained matrix; 2" to 4" beds; *Protozyga* abundant in some beds; stylolites and large calcite-filled cavities near the top. . . . . 8'
Limestone; as above; 6" to 8" beds; several thin lenses of calcarenite; *Hormotoma*, *Illaenus*, *Rafinesquina* . . . . . 3'
Limestone, pure, dolomite mottled, light gray; 8" to 20" beds; very thin partings; crinoid fragments and molluscan fossils common to abundant; several lenses of calcarenite 3" to 18" thick; stylolites in some beds; *Receptaculites*. . . . . 17' 6"
Limestone; as above but slightly more argillaceous. . . . . 5'
Limestone; like 17' 6" unit above but more calcarenite beds and fewer fossils; prominent ferruginous corrosion surface 5' above base . . . . . 18'
Limestone; as above but 1' to 4' beds and more calcarenite; large branching trepostome bryozoans and *Rafinesquina* abundant in some beds . . . . . 20'

74. Engineers Old Cut Section

Stream diversion channel, 1½ mi west of Decorah, Winneshiek Co., IA (SE NE 18, 98N-8W, Decorah Quad.). Described by J. S. Templeton and H. 8. Willman, 1950, 1952.

Galena Group

Wise Lake Formation

Sinsinawa Member

Dolomite and dolomitic limestone, fine to medium grained, medium bedded, noncherty (poorly exposed above quarry top of south face) . . . . . 15'

Dunleith Formation (91' 7")

Wyota Member (17' 6")

Limestone, cherty; corrosion surface at base . . . . . 1′ 4″

Limestone; slightly argillaceous and pure interbedded; corrosion surface 1′ 11″ below top; prominent reentrant at base . . . . . 8′ 7″

Limestone, pure; fine fossiliferous debris; chert bands; shaly reentrant at base . . . . . 1′ 10″

Limestone, argillaceous; shaly in middle; corrosion surface near base; reentrant with brown clay at base . . . . . 5′ 9″

Wall Member (9′ 9″)

Limestone, argillaceous, cherty; much fossiliferous debris; prominent reentrant in middle; red-brown shaly partings in lower 2″. . . . . 1′ 11″

Limestone, slightly argillaceous, cherty; corrosion surface near top; very prominent reentrant at base . . . . . 1′ 5″

Limestone, pure, medium bedded; fossiliferous debris; corrosion surfaces 18″ and 50″ below top; several prominent reentrants . . . . . 6′ 5″

Sherwood Member (22′ 4″)

Limestone, pure, cherty; prominent reentrant at base. . . . . 1′ 11″

Limestone, pure, cherty, upper 1′ 4″ thin bedded; argillaceous partings in lower 1′ 3″; coquina lenses. . . . . 6′ 1″

Limestone, pure, cherty; lower part thin bedded; good reentrants 2′ 5″ and 5′ 8″ below top . . . . . 8′ 2″

Bentonite (**Nasset Bentonite Bed,** type section). . . . . 0″ to 3″

Limestone, tan-gray, purer than below; thin shaly partings . 6′

Rivoli Member (20′ 11″)

Bentonite (**Conover Bentonite Bed**, type section) (sample 139) . . . . . 0″ to 1″

Limestone, blue-gray, massive, burrowed; argillaceous partings; shaly at base . . . . . 2′ 7″

Limestone, dark blue-gray; argillaceous partings; 1″ calcarenite at top; *Receptaculites* . . . . . 4′ 6″

Bentonite and shaly limestone (Calmar Bentonite Bed, type section) (sample 63). . . . . 8″

Limestone, argillaceous, gray; *Receptaculites*; corrosion surfaces 1″, 2′ 6″, 3′ 2″, 3′ 6″ below top and very prominent ferruginous, pitted corrosion surface at base . . . . . 5′ 10″

Limestone, shaly, dark gray, thin bedded; 2 closely spaced corrosion surfaces 4″ above base . . . . . 3′ 1″

Limestone, slightly argillaceous; lower 2″ to 3″ shaly; prominent corrosion at base . . . . . 4′ 2″

Mortimer Member (8′ 7″)

Limestone, massive; 4 beds of large chert nodules . . . . . 2′ 8″

Limestone, very shaly; blue-gray and green shaly partings; black-centered chert nodules in lower 10″; prominent corrosion surfaces at 1′ 9″ below top and at base. . . . . 2′ 7″

Limestone, massive; pure except for prominent shaly partings; 5″ nodular structure 20″ below top; few chert nodules; lower 4″ shaly; ferruginous corrosion surface at base . . . . . 3′ 4″

Fairplay Member (12′ 6″)

Limestone, pure, massive; chert in middle; upper 11″ thin bedded; shaly at base . . . . . 2′ 2″

Calcarenite, fine grained; smooth weathered face; shaly at base . . . . . 5″

Limestone, shaly, thin bedded; *Receptaculites*; corrosion surface near top . . . . . 11″

Limestone, pure, dark gray, massive; corrosion surface near middle. . . . . 2′

Limestone, dolomite mottled, pure, light gray, thin bedded, fine grained; few thin shaly partings; *Receptaculites* abundant . . . . . 7′

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