LIMESTONE RESOURCES OF ADAMS AND BROWN COUNTIES, ILLINOIS

Jonathan H. Goodwin and Richard D. Harvey

Illinois Institute of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY, URBANA, ILLINOIS
Jack A. Simon, Chief

CIRCULAR 512
1980

COVER PHOTO: Exposure of the Dolbee Creek and lower Haight Creek members of the Mississippian Burlington Limestone near a currently inactive adit of the mines of Calcium Carbonate Company near Quincy, Illinois.

Goodwin, Jonathan H

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CONTENTS

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ABSTRACT

Limestone beds of the Valmeyeran Series (Mississippian) contain substantial resources of quarryable stone in Adams and Brown Counties in central western Illinois. In and near the bluffs of the Mississippi River in Adams County, quarries and mines in the Burlington Formation produce limestone of exceptionally high purity and whiteness from the "Quincy Lime" bed. This limestone is used in specialty products such as whiting and animal feed supplements. Quarries in the Keokuk and Burlington Limestones elsewhere in Adams County produce agricultural limestone and crushed stone aggregate generally of low durability grade. In the southwestern part of Brown County, relatively small quantities of agricultural limestone and crushed stone are produced from the St. Louis and Salem Limestones in quarries near McKee Creek.

More than 400 outcrops and quarry sites in Adams and Brown Counties were visited in 1965, 1966, 1967, and 1976, and all but a few localities were sampled extensively and described in detail. The resulting data, combined with well drilling data, indicate that the Valmeyeran rocks dip gently toward the southeast and are overlain southeastward by progressively greater thicknesses of shale, sandstone, and thin coal beds of the Abbott, Spoon, and Carbondale Formations of Pennsylvanian age. Thicknesses of Pleistocene till and loess are greater far away from the major river valleys, in eastern Adams County and northwestern Brown County, because less postglacial erosion occurred there. In these areas, total thicknesses of Pleistocene and Pennsylvanian rocks above the Valmeyeran Series exceed 300 feet (100 m).

Possible sites for exploration for future limestone quarries are available in both counties. Results of chemical analyses and physical tests compiled in this report indicate that stone of significantly better durability grade than that already being produced probably is not present; however, the exceptionally pure limestone in the basal Burlington Limestone is present in the subsurface over a wide area in northern Adams County and may be suitable for exploitation by underground mining methods.

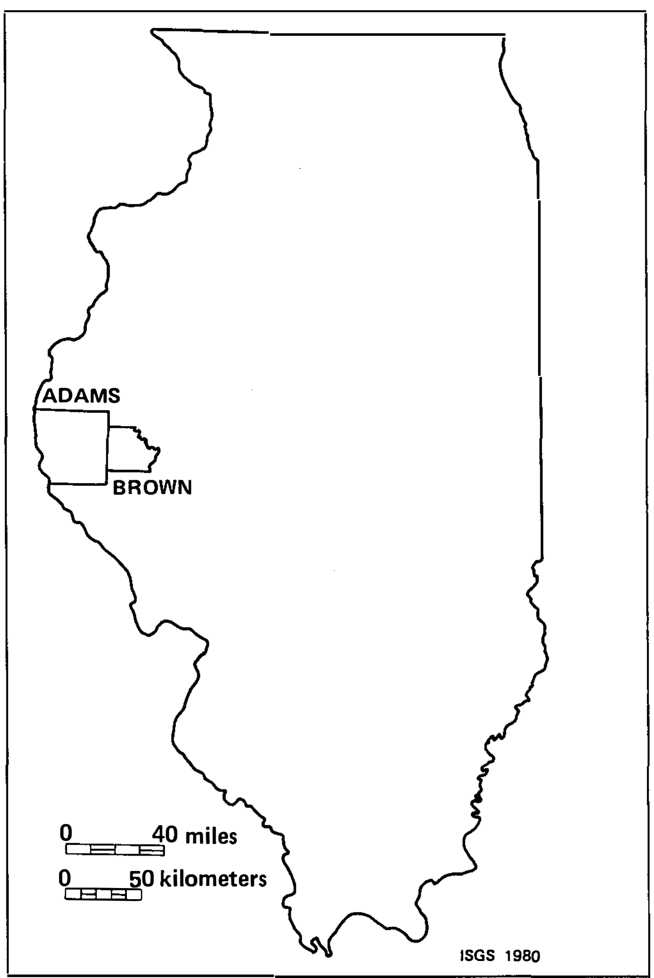


Figure 1. Index map showing location of Adams and Brown Counties in Illinois.

INTRODUCTION

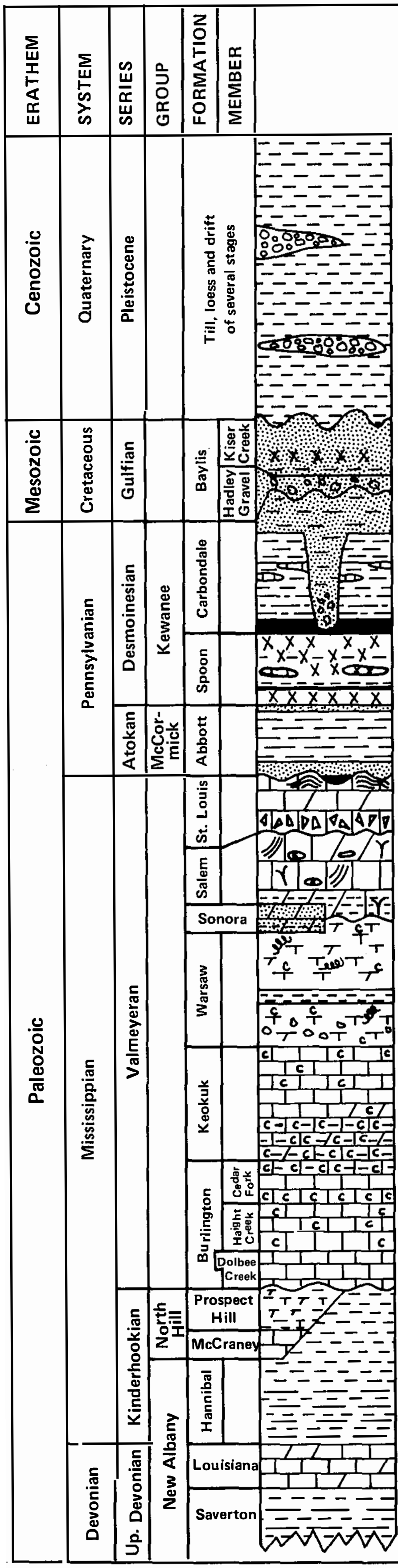
Adams and Brown Counties (fig. 1) are located in the central western part of Illinois between the Mississippi and Illinois River valleys. This area was glaciated during the Pleistocene Epoch, and glacial drift as thick as 200 feet (61 m) is found in some parts of both counties. The bedrock surface in the central and eastern parts of the area is composed of shale, sandstone, siltstone, coal, and thin limestone beds of the Abbott, Spoon, and Carbondale Formations of Pennsylvanian age. To the west, successively older rocks of Mississippian age form the bedrock surface. In bluffs adjacent to the Mississippi and Illinois Rivers and in the more deeply incised stream valleys in other parts of the two counties, thick limestone formations of Valmeyeran (Mississippian) age are exposed. These formations, especially the Burlington Limestone, have provided most of the stone produced so far in both counties.

Several quarries and underground mines in Adams County have been operated for long periods of time near Quincy, adjacent to the Mississippi River. Records on file at the Illinois State Geological Survey indicate that dimension stone was produced from the Mississippian limestones in Adams County as early as 1880. Crushed stone products valued at $26,370 were produced in 1914 from several quarries and mines still in operation. In Brown County, production of limestone did not begin until 1934, and has continued only sporadically since then. Table 1 lists the names and locations of all the limestone quarries that produced in each of these two counties during 1976, the formations mined, and the operators' names and addresses.

The cooperation of all the quarry operators in Adams and Brown Counties is gratefully acknowledged.

SAMPLES AND TESTS

More than 400 outcrops and abandoned and active quarry sites were visited and sampled during the summers of 1965, 1966, 1967 and 1976 in Adams and Brown Counties. All but a few of these localities were sampled extensively



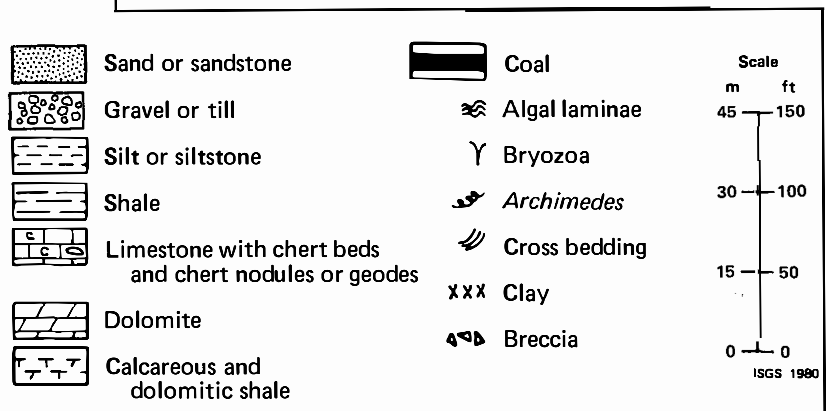


Figure 2. Diagrammatic columnar section of bedrock formations and surficial deposits exposed in Adams and Brown Counties.

and described in detail. Selected representative outcrops and quarry sites are described in Appendix A.

All samples were processed to determine acid soluble percentages. Average values for 66 localities are presented in tables 2a and 2b, along with information on the thicknesses of the units and location of the outcrops and quarries from which the samples were collected.

Samples of chert-free stone from 22 of the 66 localities listed in tables 2a and 2b were selected for complete chemical analysis. Tables 3a and 3b give the results of these analyses. Values of calcium carbonate equivalent (CCE) and $CaCO_3$ and $MgCO_3$ ratios calculated from the reported oxide analyses also are listed in tables 3a and 3b.

The Bureau of Materials and Physical Research of the Illinois Department of Transportation maintains a continuing testing program for aggregate materials. Table 4 lists average values for sodium sulfate soundness and Los Angeles abrasion tests of some coarse aggregates produced from 1971 to 1976 at quarries in Adams and Brown Counties.

SURFICIAL MATERIALS AND BEDROCK FORMATIONS

The stratigraphic succession of bedrock formations and the overlying glacial and surficial deposits in Adams and Brown Counties are shown diagrammatically in figure 2. Lithologic characteristics of the formations are shown with appropriate symbols. Rocks of Pennsylvanian age are separated from underlying rocks of Mississippian age by a major erosion surface. Erosion since the Pennsylvanian Period also has been extensive; for this reason the complete succession of formations illustrated in figure 2 commonly is not present anywhere in the study area.

Limestones of potential economic value in Adams and Brown Counties are contained in the Valmeyeran Series of the Mississippian System. Overburden on these limestones consists of various thicknesses of surficial and glacial deposits, bedrock of Pennsylvanian age, and, in some places, Cretaceous sand and gravel. In the following sections we will describe these overburden strata and the rocks of the economically important Mississippian System.

QUATERNARY SYSTEM

Pleistocene Series

Surficial and glacial deposits. Glacial till, loess, lacustrine silt, outwash sand and gravel, and buried soil profiles related to continental glaciation of the Nebraskan, Kansan, Illinoian and Wisconsinan Stages are exposed in stream banks and cover the upland plateaus of Adams and Brown Counties. Although glaciers of the Wisconsinan Stage did not flow as far southwestward as Adams and Brown Counties, deposits of Roxana Silt, Robein Silt and Peoria Loess of the Altonian, Farmdalian and Woodfordian Substages of the Wisconsinan Stage are found in most areas of Adams and Brown Counties. Tills and related deposits of the Nebraskan and Kansan Stages are exposed only in the western part of Adams County and are either absent or buried beneath drift of the Illinoian Stage elsewhere (Frye and Willman, 1965). Modern soils are developed on the upland silt and loess of Wisconsinan age. Over most of Adams and Brown Counties glacial drift thicknesses do not exceed 50 feet (15 m), but they may exceed 200 feet (61 m) in some areas (Piskin and Bergstrom, 1975).

CRETACEOUS SYSTEM

Gulfian Series

Baylis Formation. Cretaceous rocks of the Baylis Formation crop out, or are overlain by glacial drift, in an area of 80 to 100 square miles (200 to 260 sq km) in southeastern Adams County and adjoining Pike County to the south. Drift of the Illinoian Stage commonly is absent where the Baylis Formation is present. Frye, Willman, and Glass (1964) divided the Baylis Formation into two members: the Hadley Gravel Member and the Kiser Creek Member.

The Kiser Creek Member, at the top of the formation, consists predominantly of uncemented, fine- to medium-grained quartz sand and clayey sand that contains dispersed granules of angular white chert in some zones. In other zones there are lenses of silty clay. Moderately well-rounded pebbles of chert, quartz and quartzite are common at some places in the Kiser Creek. The maximum thickness of the Kiser Creek Member is 25-30 feet (8-9 m); because the upper surface is an erosional contact with the overlying surficial deposits, the original total thickness of the member is unknown.

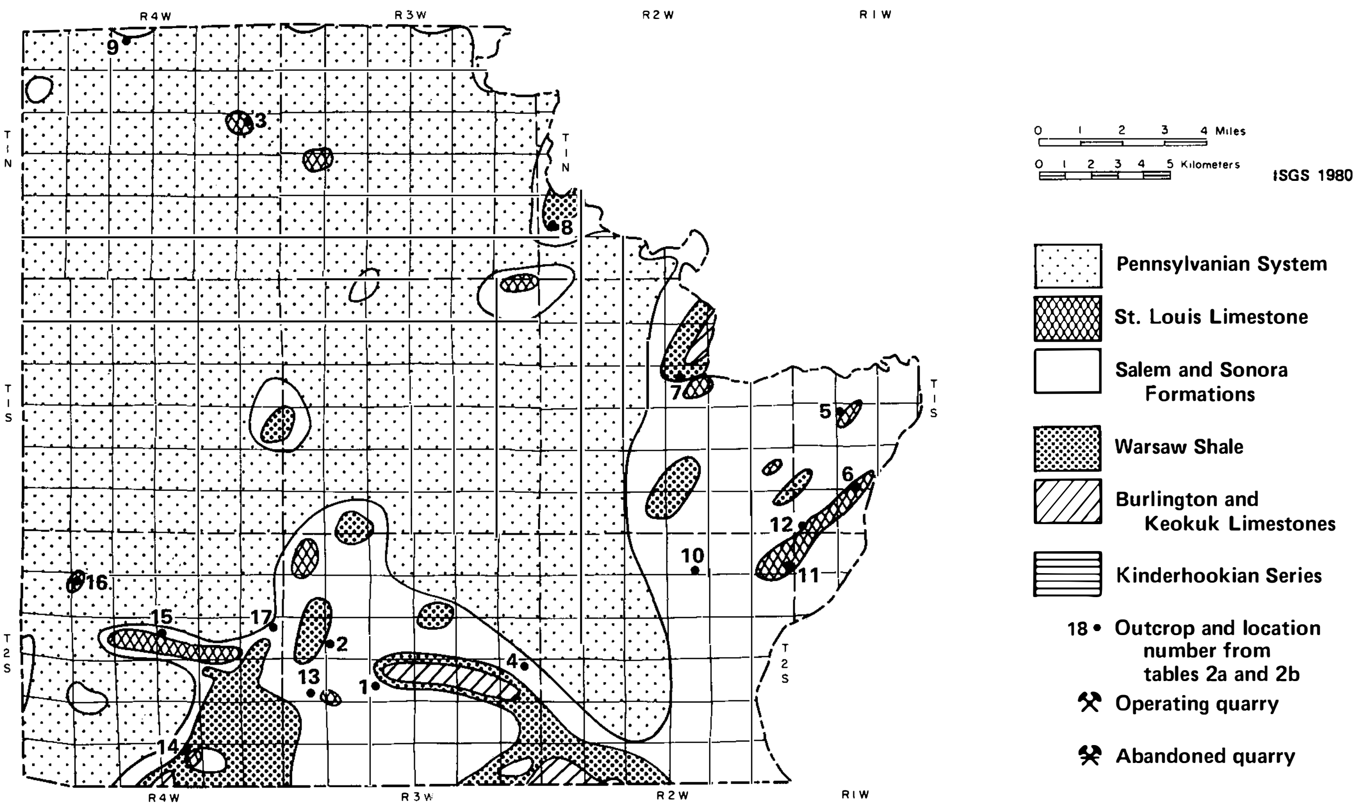
The Hadley Gravel Member underlies the Kiser Creek and consists predominantly of pebbles and small cobbles of chert, quartz and quartzite. Sand occurring with the gravel is largely quartz. The base of the member is commonly marked by an iron-cemented zone that ranges up to several inches in thickness; this zone is so tightly cemented that the rock breaks through the pebbles. The member is generally less than 10 feet (3 m) thick, although it may reach 15 feet (4.6 m) in some places and may be represented locally only by a layer of pebbles a few inches thick at the base of the Kiser Creek Member. Although no indigenous fossils have been recovered from the Baylis Formation so far, the formation is believed to be part of the Gulfian Series (Frye, Willman, and Glass, 1964; Willman et al., 1975).

PENNSYLVANIAN SYSTEM

Shale, sandstone, coal, and thin limestone beds of the Abbott, Spoon and Carbondale Formations crop out in

many of the stream banks and underlie surficial and glacial deposits in most of Brown County and the eastern half of Adams County. Figures 3 and 4 show the distribution of pre-Cretaceous rocks in Adams and Brown Counties, respectively. These maps are interpretations of the bedrock surface as it might appear if all materials of Cretaceous age and younger were stripped away. Since knowledge of the thickness and nature of the Pennsylvanian rocks is based almost entirely on drilling logs on public file at the Illinois State Geological Survey, the accuracy of these maps varies considerably from place to place, depending on the distribution of outcrops and logged wells drilled to explore for water and oil and gas. Coal is rare in the Pennsylvanian rocks of Adams and Brown Counties and therefore the stratigraphy of this area is poorly known in comparison with other areas of Illinois. Rocks of Pennsylvanian age are separated from the underlying rocks by a major erosion surface which has considerable relief. Any part of the succession of Pennsylvanian rocks in Adams and Brown Counties may overlie any part of the rocks of the Valmeyeran Series of the Mississippian System below.

Figures 3, 4. Geologic map of the top of Paleozoic rocks in Adams County (left) and in Brown County (below).



Desmoinesian Series (Kewanee Group)

Carbondale Formation. The Carbondale Formation is the youngest formation of the Pennsylvanian System exposed in Adams and Brown Counties. In most of the area it consists of dark gray to black shale and thin silty sandstone and silty limestone lenses. The Pleasantview Sandstone, Purington Shale, Oak Grove Limestone, and Francis Creek Shale Members, from youngest to oldest, respectively, of the Carbondale Formation are represented. Younger Pennsylvanian rocks have either been removed by erosion or were never deposited.

Spoon Formation. The Spoon Formation underlies the Carbondale Formation and consists of micaceous sandstone and silty mudstone, shale, thin limestone lenses and minor thin coal beds. The Seahorne Limestone Member of the Spoon Formation is a gray, dense, fossiliferous limestone that does not exceed 2 feet (0.6 m) in thickness in northeastern Brown County and occurs elsewhere in the area only as a zone of limestone nodules within the surrounding shale.

Atokan Series (McCormick Group)

Abbott Formation. The oldest rocks of the Pennsylvanian System exposed in Adams and Brown Counties are assigned to the Abbott Formation of the McCormick Group. The Abbott consists of sandstone, minor shale and rare coal beds. Some of the thicker coal beds occurring in isolated pockets were strip mined several years ago in Adams County. Although attributed to the Abbott Formation, the stratigraphic assignment of these coal beds is uncertain (Reinertsen, 1964).

MISSISSIPPIAN SYSTEM

Valmeyeran Series

Limestone resources of economic importance in Adams and Brown Counties are confined to formations of the Valmeyeran Series of the Mississippian System. Limestones of the lower part of the Valmeyeran Series form massive bluffs along the Mississippi River in Adams County and are mined extensively near Quincy.

St. Louis Limestone. The St. Louis Limestone is the youngest formation of the Valmeyeran Series exposed in Adams and Brown Counties. Because of pre-Pennsylvanian erosion, the St. Louis Limestone varies in thickness from a maximum of about 30 feet (9 m) to barely recognizable, thin beds of brecciated limestone or algal-laminated limestone less than 5 feet (1.5 m) thick. Where exposed, the St. Louis commonly consists of a breccia of angular fragments of massive bedded or algal-laminated limestone cemented in a matrix of coarser-grained, silt-sized, equigranular limestone. In some areas the basal brecciated zone is overlain by undisturbed, fine-grained, algal-laminated limestone. Brecciated zones in some places grade laterally into zones where the bedding is undisturbed; this brecciation may have been caused by solution and removal of evaporite beds interlayered with the limestone when it was deposited on the shallow shelf of the western edge of the Illinois Basin. Evaporite beds are a significant part of the St. Louis Limestone to the southeast of Adams and Brown Counties (Willman et al., 1975).

The St. Louis Limestone in Adams County may overlie the Salem, Sonora, or Warsaw Formations because of erosion of the pre-St. Louis depositional surface and facies relationships. In Brown County, the St. Louis, where present, overlies only the Salem Limestone or a siltstone facies of the Salem (Willman et al., 1975).

Salem Formation. The Salem Formation consists of up to 60 feet (18 m) of richly fossiliferous, cross-bedded, porous, silty limestone, silty dolomite, limestone, and dolomite. The rock commonly is cross-bedded, and some bedding surfaces are ripple marked. Fossil fragments commonly are rounded and abraded and oolitic overgrowths are common. Large pieces of bryozoan fronds up to several centimeters across are common on some bedding planes. In most exposures in Adams and Brown Counties the unit weathers to a yellowish-buff or pale orange color. Thin beds and lenses of greenish-gray shale similar in lithology to the underlying Warsaw Shale occur at some localities. In northwestern Adams County the Salem Formation overlies and grades laterally into the Sonora Sandstone. To the southeast the Salem Formation directly overlies the Warsaw Shale. The Salem Formation may be overlain by the St. Louis Limestone, by any part of the Pennsylvanian Section, and/or by Pleistocene glacial deposits.

Sonora Sandstone. The Sonora Sandstone underlies and grades laterally into the lower part of the Salem Formation in the northwestern part of Adams County near the border with Hancock County. The Sonora is rarely more than 2 to 3 feet (0.6 to 1 m) thick in Adams County and Brown County. The lithology of the Sonora is similar to that of the Salem, but the Sonora generally is much more sandy and less fossiliferous, consisting mostly of argillaceous and dolomitic, cross-bedded sandstone interlayered with sandy shale. It is only sparsely fossiliferous in contrast to the Salem; but fragments of fenestrate bryozoans occur throughout. The lower part of the Sonora overlies and grades laterally into the uppermost part of the underlying Warsaw Shale (Willman et al., 1975).

Warsaw Shale. The Warsaw Shale commonly is exposed in the banks and beds of streams and in the bluffs of the Mississippi and Illinois Rivers in Adams and Brown Counties. To the east of Brown County the Warsaw is up to 300 feet (91 m) thick; however, in the area covered in this report, the thickness does not exceed 100 feet (30 m) because of pre-Pennsylvanian and later erosion. The Warsaw Shale consists of greenish-gray siltstone, silty mudstone and silty shale interlayered with rare, thin beds of argillaceous limestone. Quartz geodes are common and are locally abundant, especially near the base of the formation. The Warsaw is fossiliferous, and the corkscrew-shaped bryozoan *Archimedes* is especially abundant. The Warsaw Shale is underlain by the Keokuk Limestone throughout Adams and Brown Counties, but the contact is gradational. In some areas the Warsaw has been completely removed by pre-Pennsylvanian or later erosion. In Adams and Brown Counties the Warsaw is commonly overlain by the Salem or Sonora Formations, but any of the younger formations already mentioned may directly overlie the Warsaw.

Keokuk Limestone. The Keokuk Limestone consists of thick beds of coarse-grained, crinoid-fragment calcarenite or calcirudite limestone interlayered with thinner beds of fine-grained, argillaceous dolomite, fine-grained limestone, and calcareous gray shale similar to the overlying Warsaw Shale. These shale beds become progressively thicker and more numerous upward through the section until the lithology of the Keokuk becomes indistinguishable from the overlying Warsaw. Much of the coarser-grained limestone of the Keokuk consists of light gray to white crinoid columnals and plates set in a slightly finer-grained, dark gray to gray-brown matrix or cement similar in texture to some porphyritic igneous rocks. The basal 30 feet (9 m) of the Keokuk contain a high proportion (sometimes as much as 70%) of bedded and nodular chert; in most areas where this unit is exposed, chert makes up 30 percent to 50 percent of the rock. The chert beds and nodules are interlayered with beds of light gray, medium- to coarse-grained biocalcarenite limestone and dolomite in layers from 2 to 10 inches (5 to 25 cm) thick. This cherty member has been formally named the Montrose Chert Member of the Keokuk. The Montrose is underlain by the Burlington Limestone, but the contact may be difficult to pick in most areas because of the similar lithologic characteristics of the two. Where the Keokuk and underlying Burlington are not easily distinguished they are referred to as the Burlington-Keokuk Limestone. Throughout Adams and Brown Counties, the Keokuk Limestone is uniformly 60 to 80 feet (18 to 24 m) thick. Almost nowhere has the pre-Pennsylvanian erosion reached as deep as the top of the Keokuk; however, post-Pennsylvanian to modern erosion has removed the Keokuk in some of the deeper stream valleys and near the bluffs of the Mississippi and Illinois Rivers.

Burlington Limestone. The Burlington Limestone consists of massive- to thick-bedded, coarse- to medium-grained, highly fossiliferous biocalcarenite or biocalcirudite limestone. The unit is commonly thicker than 80 feet (24 m) in the subsurface in Adams and Brown Counties. Three members of the Burlington Limestone have been named in Iowa by Harris and Parker (1964). The uppermost 20 to 40 feet (6 to 12 m) of the Burlington in Illinois, designated the Cedar Fork Member (Harris and Parker, 1964), consists of glauconitic and slightly cherty, coarse-grained, richly fossiliferous biocalcarenite and biocalcirudite limestone. The contact of the Cedar Fork Member with the overlying Keokuk Limestone may be difficult to pick where chert is locally abundant in both, although fossil assemblages clearly distinguish the two. The middle 30 to 50 feet (9 to 15 m) of the Burlington, designated the Haight Creek Member (Harris and Parker, 1964), consists of medium-grained biocalcarenite limestone locally interbedded with dolomitic limestone and thin shale partings. The member contains some chert in beds and nodules and some glauconite, and is characteristically finer grained than either the overlying Cedar Fork or underlying Dolbee Creek Members. The Dolbee Creek Member (Harris and Parker, 1964) is the basal member of the Burlington and is an exceptionally pure, white, coarse-grained, thick- to massive-bedded, stylolitic, biocalcirudite limestone. The "Quincy Lime," mined for high purity limestone near Quincy, Illinois, is contained within the Dolbee Creek Member. The member ranges in thickness from 10 to 40 feet (3 to 12 m) and becomes thinner and more dolomitic outside Adams County. Chert beds and nodular chert may occur in the Dolbee Creek Member, especially in the upper part.

The lower contact of the Burlington Limestone is unconformable with the underlying rocks of the Kinderhookian Series, but relief on the erosion surface is low.

Kinderhookian Series

Rocks of the North Hill Group of the Kinderhookian Series are present only in the western half of Adams County. Of the three formations in the Group, only the middle formation, the Prospect Hill Siltstone, and the lower, the McCraney Limestone, outcrop in Adams County. The uppermost Starrs Cave Limestone is present only in Hancock County to the north. Where the North Hill Group is absent in Adams and Brown County, the Burlington Limestone unconformably overlies the Hannibal Shale of the New Albany Shale Group that underlies the North Hill Group.

Prospect Hill Siltstone (North Hill Group). In the bluffs of the Mississippi River, in extreme southwestern Adams County, the Prospect Hill Siltstone of the North Hill Group is exposed in outcrop beneath the Burlington Limestone. The siltstone is light gray to buff, calcareous, pyritic, massive bedded and friable. In western Adams County the Prospect Hill is up to 29 feet (8.8 m) thick, but it is overlapped by the Burlington a short distance east of the bluffs where the underlying McCraney Limestone is in contact with the Burlington.

McCraney Limestone (North Hill Group). The McCraney Limestone of the North Hill Group and the overlying Prospect Hill Siltstone are well exposed along Fall Creek in southwestern Adams County (SE, Sec. 23, T. 3 S., R. 8 W.). Here the McCraney consists of alternating thin layers of light gray to buff, very fine-grained limestone and buff to brown, fine-grained dolomite. The contacts of the McCraney with the overlying Prospect Hill Siltstone and the underlying Hannibal Shale are conformable. The McCraney Limestone reaches a maximum thickness of about 60 feet (20 m) in extreme northwestern Adams County (Willman et al., 1975).

Hannibal Shale (New Albany Shale Group). The Burlington Limestone unconformably overlies the Hannibal Shale where the North Hill Group has been removed by pre-Burlington erosion. The Hannibal is the oldest unit exposed in the study area and can be seen in the steep banks of Pigeon Creek in southern Adams County (Sec. 28, T. 3 S., R. 7 W.). There the Hannibal is a green to gray, argillaceous siltstone that does not greatly exceed 50 feet (16 m) in thickness. At Pigeon Creek, the Hannibal is conformably overlain by the McCraney Limestone and the McCraney is unconformably overlain by the Burlington Limestone.

REGIONAL GEOLOGY

Bedrock geology

Figures 3 and 4 are geologic maps of the top of Paleozoic rocks in Adams and Brown Counties. These maps, based on interpretation of drilling records on file at the Illinois State Geological Survey, represent the rock surface as it would appear if all post-Paleozoic rocks and surficial materials were stripped away. The Burlington and Keokuk limestones are exposed at the bedrock surface in a large area of southwestern Adams County (fig. 3), but are buried beneath younger Paleozoic rocks in most other areas. The large outlier of Upper Valmeyeran rocks in northwestern Adams County is especially noteworthy. Virtually all of eastern Adams County is capped by rocks of the Pennsylvanian System.

In Brown County (fig. 4), most of the Paleozoic bedrock surface is capped by Pennsylvanian rocks. Rocks of the upper part of the Valmeyeran Series are exposed at the bedrock surface only in the southern and eastern parts of the county along McKee Creek and the La Moine and Illinois Rivers in T. 1 S., R. 2 W., and T. 2 S., R. 2 W. and R. 3 W.

Burial depth of Burlington-Keokuk Limestone

Maps showing depth to the top of the Burlington-Keokuk Limestones in Adams and Brown Counties (plate 1) have been constructed using combined data from about 700 drill holes and 400 surface outcrops and information from topographic maps. Overburden measurements contoured in plate 1 include both unconsolidated surficial materials and any bedrock overlying the Burlington-Keokuk. Although actual surficial drainage courses are not shown in plate 1, their effect on total overburden thickness is reflected in the contouring.

Plate 1 shows that in Adams County the greatest burial depth of the Burlington-Keokuk, as much as 300 feet (91 m), is found in the northeastern sector, especially in the southeastern quarter of T. 1 N., R. 5 W. Burial depths in Adams County generally decrease in all directions away from this sector. As would be expected, the shallowest burial depths are found near the exposures in the bluffs of the Mississippi River in the western half of the county. These shallow burial depths resulted from erosion of Paleozoic and younger rocks overlying the Burlington-Keokuk that occurred before the Pleistocene glaciation (fig. 3) and from post-Illinoian and post-Wisconsinan erosion of the glacial deposits nearest the Mississippi River.

As shown in plate 1, the depth to the top of the Burlington-Keokuk Limestone in Brown County is greatest in the west central sector, especially in the southeastern quarter of T. 1 S., R. 4 W., where burial depths exceed 300 feet (91 m). Except along the McKee Creek in the southern sector and the La Moine and Illinois Rivers in the eastern sector, the depth to the top of the Burlington-Keokuk is greater than in much of Adams County. The extensive Pennsylvanian bedrock area shown in figure 4 clearly indicates that most of Brown County was less deeply incised by pre-glacial erosion than Adams County. This factor more than any other probably accounts for the generally greater overburden thicknesses in Brown County.

Regional geologic structure

Upper Paleozoic (Mississippian and Pennsylvanian) rocks in Adams and Brown Counties are thinner than those in the main part of the Illinois Basin to the southeast. Major subsidence of the Illinois Basin area, as indicated by thicknesses of rock series, probably began as early as middle Ordovician (Willman et al., 1975). Throughout all the period from middle Ordovician through Pennsylvanian, central western Illinois remained relatively higher than the Illinois Basin depocenter and formed the stable western shelf of the basin.

The Mississippi River Arch, a poorly defined, north-south trending zone of domes and anticlines, separates the Illinois Basin from the Forest City Basin to the west. The thinning of Mississippian and Pennsylvanian rocks on both east and west sides of the Arch indicates that deformation of the Mississippi River Arch began in early Mississippian and continued at least through the Pennsylvanian (Atherton, 1971).

During the Silurian period the area just south of Adams and Brown Counties was uplifted along the east-west trending Sangamon Arch. Rocks of Silurian and Early Devonian age were uplifted and eroded along this arch. The Upper Devonian-Lower Mississippian New Albany Group is continuous across the Arch and overlying rocks are undisturbed (Whiting and Stevenson, 1965).

In southeastern Adams County and southwestern Brown County the Kellerville and Siloam oil fields mark the positions of small structures on the northeast flank of the northwest-southeast trending Fishhook Anticline. Both oil fields are in structural and stratigraphic traps in Silurian rocks about 250 feet below the base of the Burlington Limestone (Howard, 1961).

In general, the Valmeyeran rocks of Adams and Brown County dip gently to the east and southeast toward the Illinois Basin and away from the axis of the Mississippi River Arch. Small flexures, especially in the vicinity of the Fishhook Anticline, slightly disrupt this regional dip.

TABLE 1. Data on limestone quarries operating in 1976 in Adams and Brown Counties.

Quarry name	Location	Nearest town	Formation mined	Owner/operator and address
		ADAMS COUNTY		
Marblehead Quarry	SW SE SE 31, 2S-9W	Marblehead	Burlington	Adams Stone & Materials Callender Bros. Const. Pittsfield
Black and White Quarry	SW SW SE 14, 2S-9W	Quincy	Burlington	Calcium Carbonate Co. Quincy
Menke Quarry	NE SE SE 23, 2S-9W	Quincy	Burlington	Calcium Carbonate Co. Quincy
CCC Plant No. 2	SE NW NE 23, 2S-9W	Quincy	Burlington	Calcium Carbonate Co. Quincy
Loraine Quarry	S½ NE NE 33, 2N-7W	Loraine	Keokuk	Western Ill. Stone Co. Moline Consumers Co. Moline
Mill Creek Quarry	SW 1, 2S-8W	Quincy	Burlington-Keokuk	Western Ill. Stone Co. Moline Consumers Co. Moline
Lima Quarry	SW SE SW 14, 2N-9W	Lima	Keokuk	Western Ill. Stone Co. Moline Consumers Co. Moline
Richfield Quarry	C NW 21, 3S-6W	Richfield	Salem-St. Louis	Missouri Gravel Co. Moline Consumers Co. Moline
Campbell Quarry	SW SE NW 25, 1N-9W	Ursa	Keokuk	Turner Stone Co. Ursa
		BROWN COUNTY		
Mt. Sterling Quarry	NE 13, 2S-4W	Mt. Sterling	Salem-St. Louis	Western Ill. Stone Co. Moline Consumers Co. Moline
Benville Quarry	SW NW NE 34, 2S-4W	Benville	Salem-St. Louis	Edwin C. Hammitt New Salem

LIMESTONE RESOURCES

ADAMS COUNTY

Present production

Twelve quarry sites in Adams County supplied stone to the Illinois Department of Transportation between 1972 and 1976, but most of these were active only sporadically. Table 1 lists nine quarries operated by five companies that reported production in 1976 to the U.S. Bureau of Mines and/or to the Illinois Department of Transportation.

The total reported production of limestone in Adams County in 1976 was 895,411 short tons (814,010 T). Almost 38 percent of this total was produced for chemical uses and specialty products such as fillers and poultry grit. Slightly more than 38 percent was used as dense road base aggregate and about 20 percent for other aggregate purposes and as asphalt filler. The remaining 3.75 percent of production was sold as agricultural limestone.

TABLE 2a. Acid solubilities of limestones from selected localities in Adams County.

Loc. no.	Sample no.	Formation name	Thickness (ft)	Average solubility (wt %)	Location	Near	Outcrop or quarry
1	67-14a-f	Salem	18	57.9	SE NE 20, 3S-6W	Richfield	o
2	67-15a-d+	Salem	20.5	66.0	C NW 21, 3S-6W	Richfield	q
2	67-15e-f+	St. Louis	9.5	62.5	C NW 21, 3S-6W	Richfield	q
3	876-1A-4*	Burlington	26	99.65	SW SE SE 31, 2S-8W	Marblehead	q
4	67-31*	Burlington	20	99.13	NW NW SE 22, 3S-8W	Bluff Hall	o
5	67-47*+	Burlington	45	99.65	NW SW SW 36, 3S-8W	Seehorn	q
6	67-50a-e	Burlington	12.5	96.61	SW NW SE 16, 3S-7W	Payson	o
7	67-61a-r	Burlington	21.5	99.09	NW NW NW 34, 3S-7W	Plainville	o
8	67-63abc	Keokuk	7.5	88.68	NW SE NW 15, 3S-7W	Payson	o
9	67-64a-d	Warsaw	4.5	95.45	NE SW NE 15, 3S-7W	Payson	o
10	67-67	Burlington	15	98.74	SW NW SE 25, 2S-8W	Payson	o
11	67-74a-c_1-c_3	Burlington-Keokuk	14	99.16	NW SE SW 19, 3S-6W	Plainville	o
12	67-84abc	St. Louis	3.5	81.36	SW SW SE 9, 3S-6W	Richfield	o
13	67-85a-f	St. Louis	4	97.24	SE SW SE 8, 3S-6W	Richfield	o
14	67-87a-d	Salem	10	96.68	SE SW NE 21, 3S-6W	Richfield	o
15	67-100a-i	Burlington-Keokuk	22.3	97.19	SW NE NE 11, 2S-8W	Quincy	q
15	67-100j-v	Burlington-Keokuk	26.1	86.60	SW NE NE 11, 2S-8W	Quincy	q
16	67-107	Keokuk	17	91.45	SW NW NW 3, 3S-7W	Adams	o
17	67-109a-d	Warsaw	8	49.49	NW NE SW 34, 2S-7W	Adams	o
18	67-112aa_1-aa_4	St. Louis	7	93.96	W½ SW 6, 2S-5W	McKee Creek	o
19	67-113a-c	St. Louis	7.5	83.24	SE NW SW 6, 2S-5W	McKee Creek	o
19	67-113de	Salem	10	86.49	SE NW SW 6, 2S-5W	McKee Creek	o
20	67-114+ and 876-20-30*+	Salem	27	89.95	SE SE NW 28, 1N-8W	Ursa	q
21	67-119a-s+	Burlington-Keokuk	47.5	94.06	SE NW NW 36, 1S-8W	Quincy	q
22	67-120a-d	Burlington-Keokuk	12.5	97.55	NE SE SE 26, 1S-8W	Quincy	q
23	67-131a-i	Burlington	16	98.34	NW NE SE 26, 1S-9W	Quincy	o
24	67-134a-1	Burlington	25	96.25	SE NE SW 11, 1S-9W	Quincy	o
25	67-135 and 876-5-15*+	Burlington	24	99.07	SE SW NW 14, 1S-9W	Quincy	q

+Indicates an outcrop or quarry described in Appendix A.
*Indicates an outcrop or quarry for which chemical analyses are reported in tables 3a and 3b.

Burlington Limestone. Almost all the limestone presently produced in Adams County is won from the Burlington Limestone. The high purity limestone ("Quincy Lime") of the lowermost Dolbee Creek Member of the Burlington is exposed in the bluffs of the Mississippi River near Quincy and has been mined by Calcium Carbonate Company and other companies for many years.

The variable chert content of the Burlington is a continuing problem for producers. Because of its high porosity and low specific gravity, much of the chert is classed as deleterious under the standards of the Illinois Department of Transportation. Thus, if chert makes up more than 5 percent by volume of the stone in the quarry there may be grounds for rejecting the coarse aggregate for Class A and B uses. For use in an agricultural limestone, moderate amounts of chert can be tolerated so long as the purity of the interbedded limestone remains high. The solubility of chert-free Burlington Limestone from throughout Adams County consistently exceeds 90 percent (table 2a). Chemical analyses of Burlington Limestone shown in table 3a give calcium carbonate equivalent (CCE) values in excess of 98 percent in all but two cases. It is worth noting, however, that four of the chemically analyzed Burlington samples contain less than 95 wt percent $CaCO_3$ as calcite. $MgCO_3$ is present in all the chemically analyzed samples in amounts ranging from 0.82 to 13.74 wt percent.

TABLE 2a —*continued*

Loc. no.	Sample no.	Formation name	Thickness (ft)	Average solubility (wt %)	Location	Near	Outcrop or quarry
26	67-136	Keokuk	14	99.23	SW SW SW 30, 2S-7W	Burton	o
27	67-137a-d	Keokuk	64	97.77	SE SE SW 24, 2S-8W	Burton	o
28	67-149a-c	Salem	14	91.49	SW SW SE 27, 1N-8W	Fowler	o
29	67-151a-f	Salem/ Sonora	33	38.57	W½ 5, 1S-8W	Quincy	o
30	67-152a-f	Keokuk	42	89.17	W½ 30, 1N-8W	Ursa	o
31	67-158a-e and 67-158aa-dd	Burlington-Keokuk	21	97.56	NE NW SW 13, 1N-9W	Ursa	o
32	67-160a-d_3	Keokuk	30	94.94	SE NW SE 13, 1N-9W	Ursa	o
33	67-170a-c	Burlington-Keokuk	24	89.14	SE SW SE 19, 2N-8W	Marcelline	q
34	67-172_{1-12}	Burlington-Keokuk	12	89.86	NE SW SW 28, 2N-8W	Marcelline	o
35	67-182a_{1-7}	Keokuk	24	89.11	SW SW 19, 2N-7W	Loraine	o
35	67-182b	Warsaw	4	86.53	SW SW 19, 2N-7W	Loraine	o
35	67-182c	Salem	5	87.10	SW SW 19, 2N-7W	Loraine	o
35	67-182d	St. Louis	2.5	97.50	SW SW 19, 2N-7W	Loraine	o
36	67-187a-d	Keokuk	28	92.79	SE SW NW 25, 2N-9W	Marcelline	o
37	67-190a-c*+	Burlington-Keokuk	45	98.41	NW NE NE 2, 1S-9W	Quincy	o
38	67-192a-j*+	Keokuk	50	91.75	NW NW SW 11, 2N-9W	Lima	o
39	67-197a-i*+	Salem	20	78.44	NE SW SE 3, 1N-7W	Mendon	q
40	67-202a-i	Salem	18	86.01	NE SW NW 2, 1N-7W	Loraine	o
41	67-206ab*+	St. Louis	15	85.47	NE SW SW 6, 2N-7W	Loraine	o
42	67-108a-i	Keokuk	19	95.88	NE NE SE 36, 2N-9W	Marcelline	o
43	67-226_{1-5}	Salem	5	33.37	NW SW NW 12, 1N-7W	Camp Point	o
44	67-230a-g*	Keokuk	15	98.77	NW NE NE 30, 1S-7W	Columbus	o
45	67-234*	Keokuk	40	98.98	19 & 20, 2S-7W	Adams	o
46	67-238a-d	Salem	7.5	92.64	SW SW SE 36, 1S-6W	Liberty	q
47	67-241a-d*	St. Louis	6.5	87.60	NE NE NW 9, 3S-6W	Kingston	o
48	67-246a-d	Salem	7.5	70.52	SE SW NE 5, 2S-5W	Liberty	o
49	67-247a-e	Salem	18	86.15	SE NW SW 9, 2S-5W	Liberty	o
50	67-252a-c	Warsaw	18	80.97	NW SW NE 27, 2S-5W	Kingston	o

+Indicates an outcrop or quarry described in Appendix A.
*Indicates an outcrop or quarry for which chemical analyses are reported in tables 3a and 3b.

In Adams County extensive areas exist where the Burlington Limestone is exposed or relatively near the surface with a minimum of overburden. One such area is near Pigeon Creek (SW SW SE, Sec. 28, T. 3 S., R. 7 W.) where the basal Burlington and underlying McCraney Limestone and Hannibal Shale are exposed in a steep bluff. Away from the creek, the Burlington is overlain by thin, unconsolidated till or loess.

Two exploration holes drilled by New Jersey Zinc Company in northern Adams County near Mendon, Illinois show that the high-purity Dolbee Creek Member of the Burlington is present in the subsurface at a depth of 240 feet (73 m) to 256 feet (78 m) (see C7894 and C7879, table 3a). In both of these drill holes, the cored interval of high purity, chert-free limestone (>97 percent $CaCO_3$) is about 30 feet (9 m) thick. If total reserves of high purity limestone are great enough, this area near Mendon and south toward Fowler and Quincy might be suitable for underground mining.

Keokuk Limestone. Some stone has been produced in Adams County from quarries in the Keokuk Limestone. Chert is much more common in the Keokuk than in the Burlington, especially in the lower member known as the Montrose Chert. Some thick zones of relatively pure limestone are present in the Keokuk above the Montrose,

TABLE 2b. Acid solubilities of limestones from selected localities in Brown County.

Loc. no.	Sample no.	Formation name	Thickness (ft)	Average solubility (wt %)	Location	Near	Outcrop or quarry
1	67-45a-l*	Salem	30	77.47	NW SW 21, 2S-3W	Morrelville	q
2	65-47a-g*	Salem	15.5	77.25	SW NW SW 17, 2S-3W	Morrelville	q
3	65-51aa-c*	St. Louis	12	94.74	SE NW NW 13, 1N-4W	Pea Ridge	q
4	65-56a-f	Salem	12	64.55	SW NW NE 24, 2S-3W	Versailles	q
5	66-10a-d+	St. Louis	10	93.94	SW NW NW 20, 1S-1W	Cooperstown	q
6	66-12a-q*+	Salem	27.5	84.15	SE SE SW 29, 1S-1W	LaGrange	q
6	66-12r-s+	St. Louis	4	92.12	SE SE SW 29, 1S-1W	LaGrange	q
7	66-23*	Salem	36	88.65	NW SE NW 15, 1S-2W	Cooperstown	q
8	66-38ab*	St. Louis	8	97.1	SW NE SW 30, 1N-2W	Ripley	0
9	66-70a-d+	Salem	10	84.42	SW NE NW 4, 1N-4W	Pea Ridge	0
10	66-98b*	Salem	12	82.75	SE SW SE 3, 2S-2W	Versailles	q
11	66-99*	St. Louis	7.4	92.45	NW SE SE 1, 2S-2W	Versailles	0
12	66-100aa-c*+	Salem	30	83.84	NE SW SW 31, 1S-1W	LaGrange	0
12	66-100d+	St. Louis	6	98.60	NE SW SW 31, 1S-1W	LaGrange	0
13	66-133e*	Salem	25	81.37	SW SE 19, 2S-3W	Morrelville	0
14	66-155bc*	Salem	25	91.98	SW NW NE 34, 2S-4W	Morrelville	q
15	66-159*	St. Louis	13	92.15	SW SW NW 15, 2S-4W	Siloam	0
16	66-161a-k*	St. Louis	24	87.25	SW NW NW 8, 2S-4W	Siloam	0

+Indicates an outcrop or quarry described in appendix A.
*Indicates an outcrop or quarry for which chemical analyses are reported in tables 3a and 3b.

however. Values of solubility (table 2a) and chemical analyses of chert-free samples of Keokuk (table 3a) show that the chert-free rock does not differ significantly from chert-free Burlington in its chemical characteristics. Because chert cannot be easily extracted from the crushed quarry product, stone produced from the Keokuk commonly is less desirable than that won from the Burlington. Chert in the Keokuk is nearly always classified as deleterious because of high porosity and low specific gravity; however, if a relatively chert-free zone of sufficient extent can be found, production of satisfactory agricultural limestone and road stone of Class C or D quality should be possible. Most of the sporadically active quarries in the bluffs of the Mississippi River north of Quincy near the towns of Ursa, Marcelline and Lima, Illinois produce from the Keokuk.

Salem and St. Louis Limestones. Production of stone from the Salem and St. Louis Limestones in Adams County has been rather limited over the years, probably because of the variable thickness and quality of the stone in these units. Outcrops are limited generally to the outlier in northwestern Adams County and to the zone along the edge of the Pennslyvanian outcrops (fig. 3). Elsewhere, the St. Louis and Salem have either been removed by post-Mississippian erosion or are buried beneath the Pennsylvanian bedrock.

Determinations of acid solubility shown in table 2a and the chemical analyses in table 3a illustrate the variability and generally lower calcium carbonate contents of samples of Salem and St. Louis Limestone as compared with values for the Burlington and Keokuk. Solubility of the Salem, in particular, falls as low as 38.57 percent. Both Salem and St. Louis samples generally have CCE values lower than Burlington or Keokuk samples and higher amounts of impurities (SiO_2 in particular), indicating significant contamination of the carbonate by quartz sand or silt.

Prospects for future production

Results of physical tests of coarse aggregates produced in Adams County (table 4) indicate that most do not meet the standards for Class A aggregate of the Illinois Department of Transportation. The generally poor abrasion performance of the Keokuk and Burlington samples probably results from their relatively high porosity and coarse grain size. High porosity and clay content probably caused the poor test results for sodium sulfate soundness, especially in samples of the Salem and St. Louis (Harvey et al., 1977). It seems unlikely that any new quarries opened in Adams County will produce stone having significantly better test results than the presently operating quarries.

BROWN COUNTY

Present production

Only two limestone quarries have operated in Brown County during the period from 1972 to 1976, and only the Mt. Sterling Quarry of the Western Illinois Stone Company reported production figures to the U.S. Bureau of Mines in

TABLE 3a. Chemical analyses of selected samples of carbonate rocks from Adams County, Illinois.[g]

Location no.	Sample no.	Formations[j]	SiO_2	Al_2O_3	Total Fe[i]	Na_2O	K_2O	CaO	MgO	CO_2	Ign. loss	CCE	$CaCO_3$	$MgCO_3$
3	876-1-4	Bn[a]	2.28	0.36	0.18	2.01	0.10	46.19	6.57	43.25		98.75	82.44	13.74
4	67-31	Bn[a]	0.88	0.16	0.41	0.23	0.02	53.94	1.90	43.29		100.99	96.27	3.97
5	67-47	Bn[a]	2.24	0.30	0.14	0.06	0.01	51.24	2.95	43.38		98.77	91.45	6.17
20	876-20-30	Sm[a]	9.52	0.58	0.69	0.37	0.32	42.98	5.60	38.92		90.61	76.71	11.71
25	876-5-15	Bn[a]	1.44	0.13	0.07		0.09	52.01	2.54	43.34		99.14	92.83	5.31
41	67-206B$_1$	Sl[a]	4.40	0.49	0.22	0.13	0.16	50.88	2.35	41.79		96.64	90.81	4.92
44	67-230a-g	Kk[a]	0.83	0.02	0.23		0.11	52.01	2.75	43.57		99.66	92.83	5.75
45	67-234b-d	Kk[a]	0.88	0.32	0.17	0.29	0.04	51.93	2.26	43.20		98.29	92.68	4.73
47	67-241a-d	Sl[a]	10.34	0.99	5.23		0.37	39.97	6.23	38.15		86.81	71.34	13.03
	C17	Sm[c]	12.41		3.92			44.46	0.94		37.68	81.68	79.35	1.97
	C16	Kk[c]	9.66		1.54			48.38	0.68		39.90	88.04	86.35	1.42
	C15	Bn[c]	19.78		1.94			43.42	0.84		35.70	79.58	77.50	1.76
		Bn[d]			2.18			53.59	0.39		43.84	96.62	95.65	0.82
		Bn[d]	0.50	0.52	0.12			54.64	0.62		31.76	99.06	97.52	1.30
		Bn[d]	0.39					54.65	0.46		44.50	98.68	97.54	0.96
	C7894	Bn[a]	1.04	0.22	0.24	<0.01	<0.01	54.83	0,29	42.47		100.16	97.87	1.93
	C7879	Bn[a]	0.38	0.06	0.01	<0.01	<0.01	54.62	1.23	43.33		100.54	97.48	2.58

TABLE 3b. Chemical analyses of selected samples of carbonate rocks from Brown County, Illinois.[g]

Location no.	Sample no.	Formations	SiO_2	Al_2O_3	Total Fe	Na_2O	K_2O	CaO	MgO	CO_2	Ign. loss	CCE	$CaCO_3$	$MgCO_3$
1	65-45a-1	Sm[a]	7.46	0.89	0.62	0.89	0.40	50.80	0.80	40.27		92.66	90.67	1.67
2	65-47a	Sm[a]	16.32	1.67	5.26	0.73	0.06	25.96	13.70	35.30		80.34	46.33	28.65
2	65-47b-c	Sm[a]	4.04	0.50	5.06	0.10	0.57	48.13	2.12	40.08		91.16	85.90	4.43
2	65-47g	Sm[a]	13.01	1.29	4.89			27.40	14.97	37.48		86.06	48.90	31.31
3	65-51aa	Sl[a]	3.58	0.60	0.37			53.40	0.75	42.55		97.17	95.31	1.57
3	65-51b	Sl[a]	5.04	1.25	3.20			31.40	16.20	42.47		96.26	56.04	33.88
3	65-51c	Sl[a]	4.76	0.81	0.41	0.77	0.30	51.40	0.72	41.32		93.53	91.74	1.51
6	66-12b-e	Sm[a]	15.65	1.05	5.27	0.13	0.37	25.19	15.95	37.12		84.56	44.96	33.36
6	66-12g-i	Sm[a]	7.10	1.64	5.69			25.81	18.97	40.74		93.16	46.06	39.68
6	66-12j-n	Sm[a]	8.23	1.45	3.01	0.86	0.35	29.00	17.50	41.38		95.21	51.76	36.60
6	66-12o-p	Sm[a]	8.39	0.81	2.55	0.13	0.27	26.71	18.79	41.41		94.32	47.67	39.30
7	66-23	Sm[b]	6.54	1.47	4.32	0.75	0.09	39.60	7.30	38.23		88.80	70.68	15.27
8	66-38a,b	Sl[a]	3.46	0.35	1.08	0.12	0.62	40.39	10.63	43.10		98.48	72.09	22.23
10	66-98b	Sm[b]	11.45	2.91	1.54	0.15	0.21	27.40	15.70	38.76		87.88	48.90	32.84
11	66-99a,b	Sl[a]	8.35	0.96	1.11	0.65	0.40	47.65	2.76	39.49		91.89	85.04	5.77
12	66-100a-c	Sm[a]	10.20	1.11	1.85			38.59	8.69	39.56		90.45	68.88	18.18
13	66-133	Sm[b]	13.35	1.19	0.55			46.20	0.60	36.62		83.95	82.46	1.25
14	66-155b	Sm[b]	7.03	1.22	2.58			35.21	13.14	40.79		95.46	62.84	27.48
14	66-155c	Sm[b]	6.10	0.72	0.53			52.90	0.60	40.66		95.91	94.42	1.25
15	66-159	Sl[b]	6.80	0.91	1.48	0.76	0.36	34.00	14.80	42.31		97.42	60.68	30.95
16	66-161a-k	Sl[a]	13.02	1.01	1.01	0.50	0.31	42.97	3.88	37.75		86.32	76.69	8.12
	R142	Sm[e]	30.88	2.15	2.60	0.00	0.00	26.12	7.29	30.00	30.88	64.72	46.62	15.25
	R200	Kk[h]	9.82	0.67	0.77			48.84	0.51	39.16	39.18	88.44	87.17	1.07
	C21	Sm[c]	15.40	3.10				45.32	0.50		36.40	82.13	80.89	1.04

[a]Analysis by Analytical Section, Illinois State Geological Survey, 1976, 1977, or 1978.

[b]Analysis by Analytical Section, Illinois State Geological Survey, 1966 or 1967.

[c]Bleininger, A. V., E. F. Lines, and F. E. Layman, 1912, Portland-cement resources of Illinois: Illinois State Geological Survey Bulletin 17, p. 97.

[d]Lamar, J. E., 1957, Chemical analyses of Illinois limestones and dolomites: Illinois State Geological Survey, Report of Investigations No. 200, p. 6-7.

[e]Lamar, J. E., et al., 1934, Rock wool from Illinois mineral resources: Illinois State Geological Survey Bulletin 61, p. 118.

[g]Analyses are of chert-free samples. Descriptions in Appendix A indicate percent chert in whole rock for some samples.

[h]Analysis by Analytical Section, Illinois State Geological Survey, 1931.

[i]Total Fe as Fe_2O_3.

[j]Key to symbols: Bn, Burlington Limestone; Kk, Keokuk Limestone; Sl, St. Louis Limestone; Sm, Salem Limestone..

TABLE 4. Average results of physical tests of coarse aggregates from Adams and Brown Counties.

Location No.	Location	Unit	L. A. abrasion	Na_2SO_4 soundness	# of tests in 5 yrs	Quality class
			ADAMS COUNTY			
51	NE SW 23, 2N-9W	Burlington	29.2	13.6	1	D
52	S½ NE NE 20, 2N-7W	Keokuk	35.5 ±9	20.3 ±10	19	D
53	SW SW SE 26, 2N-9W	Burlington-Keokuk	40.8	14.1	1	D
54	SE SW 1, 2S-8W	Burlington	36.1 ±8	17.7 ±8	13	C
55	SW SE SW 14, 2N-9W	Keokuk	42.6 ±3	13.9 ±6	15	D
56	SE NW NE 23, 2S-9W	Burlington	36.7 ±1	7.2 ±2.5	3	C
57	NE SE SE 23, 2S-9W	Burlington	35.5 ±1.5	5.4 ±2	6	B
58	SW SW SE 14, 2S-9W	Burlington	34.5 ±5	7.5 ±2.5	5	A
2	C NW 21, 3S-6W	Salem	29.4 ±1	13.5 ±3.5	8	D
			BROWN COUNTY			
14	SW NW NE 34, 2S-4W	Salem-St. Louis	26.7	9.6	1	C
17	NE 13, 2S-4W	Salem-St. Louis	29.7 ±20	19.7 ±13	18	D

Samples collected and tests conducted by Illinois Department of Transportation, Bureau of Materials and Physical Research. Values for (±) express only the range of reported values and not a statistical variance about the stated mean value. Designation of quality class may be determined by factors other than soundness and abrasion loss.

1976. To avoid revealing individual company data, production figures for Brown County have been withheld. Stone produced in Brown County was sold only as dense road base material, according to U.S. Bureau of Mines statistical tables. Limestone has been produced only sporadically in Brown County since about 1934 and most of this production has been from the Salem and St. Louis Limestones. Figure 4 shows that outcrops of Mississippian rocks are limited to the bluffs along the Illinois and La Moine Rivers in the eastern part of Brown County and to the vicinity of McKee Creek in the southern part.

St. Louis Limestone. The St. Louis Limestone rarely exceeds 10 feet (3.0 m) in thickness where it is exposed in Brown County. Acid solubilities compiled in table 2b show that the St. Louis commonly is a fairly pure limestone, and chemical analyses shown in table 3b confirm this. The limited areal extent of exposures and limited thickness of the St. Louis make it unlikely that any large-scale production can be developed from the St. Louis; however, small amounts of good quality aggregate might be produced for some special needs.

Salem Limestone. As in Adams County, the composition and lithology of the Salem Limestone in Brown County are quite variable; the composition ranges from a silty dolomite to a relatively pure limestone containing little dolomite and only 8 wt percent insoluble material (tables 2b and 3b).

Prospects for future production

The variable composition and lithology of the Salem and the limited areal extent of its exposures make it unlikely that new quarries will be opened in the Salem in Brown County. Results of physical tests compiled in table 4 show the generally variable performance of Salem and St. Louis samples in Los Angeles Abrasion and sodium sulfate soundness tests.

DEEPLY BURIED RESOURCES

Thick limestone beds occur beneath the Kinderhookian rocks in Adams and Brown Counties. The Devonian Wapsipinicon Limestone is present only in northwestern Adams County and the overlying Devonian Cedar Valley Limestone is present only in northern Adams County and the central part of Brown County (Whiting and Stevenson, 1965). Where both limestones are present, the combined thickness rarely exceeds 100 feet (30.4 m). The Wapsipinicon and Cedar Valley Limestones are commonly separated from the overlying Burlington-Keokuk by 220 feet (67 m) to 280 feet (85 m) of shales and siltstones of the Upper Devonian New Albany Group and the Mississippian Kinderhookian Series. Beneath the Wapsipincon-Cedar Valley, about 120 feet (36.6 m) of shales of the Ordovician Maquoketa Group overlie the thick limestone of the Ordovician Kimmswick and Decorah Subgroups of the Galena Group.

None of these deeply buried limestone units is exposed anywhere in Adams or Brown Counties, and because of their great burial depths it seems unlikely that they can be exploited by underground mining methods in the foreseeable future.

SUMMARY

Extensive deposits of Mississippian limestone exist in Adams and Brown Counties in central western Illinois.

In Adams County, high purity limestone is currently produced from the Burlington Limestone in the vicinity of Quincy, Illinois. Given sufficient development of new markets for crushed stone in the region, the area around Pigeon Creek in southernmost Adams County near Plainville, Illinois should be a suitable exploration area for development of a new quarry in the Burlington Limestone. In the area north and east of Quincy, the Dolbee Creek Member at the base of the Burlington Limestone is of sufficiently high purity and whiteness of color to be suitable for exploitation by underground mining. The high cost of underground mining probably requires that stone produced in this manner be marketed as specialty products such as whiting and fillers. The Keokuk Limestone, overlying the Burlington, may also be a suitable target for exploration in northern Adams County near the towns of Ursa, Marcelline, and Lima. Quarries are currently operated in the area by Moline Consumers Company. The common occurrence of large amounts of chert in the Keokuk, especially in the basal Montrose Chert Member, makes it less attractive than the Burlington for quarry development, unless an inexpensive method of removing chert from the product can be found. The Salem and St. Louis Limestones are exposed in only a few places in Adams County. Both units vary considerably in thickness, and in many places they have been removed by post-Mississippian erosion. The lithologic characteristics of both units also are variable. The St. Louis and Salem Limestones, therefore, probably can be exploited only in a limited way for agricultural limestone and for road stone and cannot provide a source rock for a large, high capacity quarrying operation in Adams County.

In Brown County, only the Salem and St. Louis Limestones are exposed at the ground surface or in abandoned quarries. Only a small amount of stone has been produced in Brown County. The thickness of post-Mississippian rocks and surficial deposits in most of Brown County makes the development of new stone quarries unlikely. In the southern third of the county (Township 2 South, Ranges 2, 3 and 4 west), however, overburden thicknesses are smaller and the Salem and St. Louis Limestones are commonly exposed. The development of new quarries here will be limited by the variable thickness and undesirable lithologic characteristics of the Salem and St. Louis Limestones.

Construction aggregate produced from quarries in Adams and Brown Counties is commonly too soft in response to physical tests to receive a quality grade higher than Class C according to standards of the Illinois Department of Transportation. It is unlikely that exploration will locate stone of consistently higher quality class anywhere in Adams and Brown Counties.

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Appendix A.

DESCRIPTIONS OF SELECTED OUTCROPS OF VALMEYERAN LIMESTONE IN ADAMS AND BROWN COUNTIES

Unit	Thickness (ft)
LOCALITY 2: Richfield Quarry, Missouri Gravel Co., 1 mi south of Richfield, near McCraney Creek; Liberty Quadrangle, Adams County (C NW 21, 3S-6W).	
7. **Overburden,** pebbly clay, loess and soil	15.0
■ ST. LOUIS LIMESTONE	
6. **Limestone,** dolomitic, silty to arenaceous, fine to medium grained, equigranular, irregularly bedded; contains fragments of brachiopods, bryozoa, and crinoids; fresh surface pale olive gray (5Y7/1). *Sample 67-15F*	3.4
5. **Limestone,** dolomitic, clayey, brecciated; large blocks of brecciated, algal micrite in matrix of greenish gray calcareous mudstone; blocks of breccia consist of pebbles and cobbles of finely laminated algal micrite tightly cemented in a micrite to fine calcisiltite matrix containing some small spots of greenish gray clay; some coarse sparry calcite has sealed ancient matrix porosity; top of this bed is top of quarried interval. *Sample 67-15E*	6.0
■ SALEM LIMESTONE	
4. **Dolomite,** calcareous, interbedded with mudstone or shale; thin laminated; mudstone beds 0.1 to 0.25 ft thick; dolomite calcareous, very fine grained, silty to clayey; some orange iron oxide stains; general color of dolomite beds very light pinkish gray (5YR9/1). *Sample 67-15D*	4.5
3. **Limestone,** fine to medium grained, dolomitic, silty, somewhat fossiliferous, some stylolites; in beds up to 2.0 ft thick; some orange iron oxide stains; generally well cemented, dense to slightly porous. *Sample 67-15C*	13-14
2. **Dolomite,** fine grained, calcareous, silty, equigranular, porous, slightly fossiliferous; pale orange brown (5YR6/2). *Sample 67-15B*	0.8-1.0
1. **Siltstone,** calcareous, dolomitic, fine grained, finely laminated; slabby weathering; light gray (N7.5); top contact of bed somewhat irregular. *Sample 67-15A*	2.0
Total thickness of Mississippian rocks: 29.7-30.9 ft	
LOCALITY 5: Abandoned quarry, in bluffs of Mississippi River, 100 yds north of point where Illinois Rte 57 crosses boundary between 36, 3S-8W and 31, 3S-7W; Quincy Quad., Adams Co. (NE SE SE 36, 3S-8W). Quarry approached by overgrown dirt road blocked by wooden gate and electrified barbed wire fence; woods block any view of quarry from highway; trees up to 30 ft tall and 8 in. in diameter grow from quarry floor next to face.	
10. **Overburden,** loess and soil	25.0
■ BURLINGTON LIMESTONE	
9. **Limestone,** medium- to coarse-grained, fossiliferous calcarenite or calcirudite; interbedded with zones of nodular chert and some thin but extensive beds of chert; chert ranges from white to brownish gray on weathered surface; total chert in unit is 20-25 percent; overall color of unit tends toward tan on weathered surface; selected samples of chert-free limestone range from pale yellowish orange (10YR8/6) to yellowish orange (10YR7/6) for the carbonate matrix that surrounds abundant white (N9) fossils. *Samples 67-47V, W, X, Y*	6.0
8. **Limestone,** coarse-grained, fossil fragment calcirudite grading upward to a fine- to medium-grained fossil fragment calcarenite similar to units 2 and 4; coarser-grained lower part of unit 8 similar to top of unit 7; chert becomes abundant at top of unit; weathered surface buff to tan; fresh, polished surface pale yellowish orange (10YR8/6). *Samples 67-47T, U*	4.0
7. **Limestone,** medium to coarse grained, fossiliferous, somewhat friable and weakly cemented, slightly porous; top third of unit coarser grained and better sorted than lower two-thirds of unit and slightly darker in color; weathered surface light gray, fresh, polished surfaces white (N9) to light gray (N8). *Samples 67-47Q, R, S*	4.0
6. **Limestone,** medium to coarse grained, fossiliferous, somewhat friable; grain size increases upward through the unit from medium-grained calcarenite to very coarse-grained calcirudite; top of unit marked by fine- to medium-grained calcarenite in lenses and channels, similar in character to units 2 and 4; fresh, polished surfaces in lower part of unit 6 pale grayish orange (10YR8/4) grading upward to pale yellowish gray (5Y9/1) in the coarsest part of the unit; uppermost, finer-grained part of unit pale yellowish orange (10YR8/6). *Samples 67-47 M, N, O, P*	5.0
5. **Limestone,** medium to coarse grained, somewhat friable; generally coarser grained and better sorted in middle 2 ft; highly fossiliferous; crinoid columnals and plates most common, but brachiopods and corals also present; fresh, polished surfaces range from pale pinkish gray (5YR9/1) to white (N9) or very light gray (N8). *Samples 67-47J, K, L*	4.5
4. **Limestone,** fine to medium grained, slightly silty, slightly fossiliferous; occurs as lenses and channel fills in top of unit 3; some coarser crinoid fragments, especially crinoid stalks, present; weathered surface buff to tan; fresh, polished surface pale yellowish orange (5YR 8/4); top of unit marked by 0.2 ft thick zone of chert nodules. *Sample 67-47I*	1.8
3. **Limestone,** fine to very coarse grained, fossiliferous; grain size increases from fine at base to very coarse at top; coarser units very fossiliferous, containing crinoid plates and segments up to 3 cm across and segments of stalks with connected columnals up to 2 cm long; some scattered stylolitic zones; weathered surface pale tannish cream color, slightly darker than unit 1; fresh, polished surface ranges from pale grayish orange pink (5YR9/2) at base of unit to pale yellowish gray (5Y8/2) at top. *Samples 67-47F, G, H*	4.5
2. **Limestone,** medium grained, slightly silty, fossiliferous, slightly cherty; occurs as lenses and channel fills at top of unit 1; fossils in unit 2 finer grained and more comminuted than in unit 1; whole crinoid columnals rare and only smaller ones preserved whole; unit weathers to a darker tan color than unit 1; top of unit marked by thin zone of bright orange weathering, silty limestone or limey siltstone containing some chert nodules. *Sample 67-47E*	1.0

1. **Limestone,** medium to coarse grained, weakly cemented, highly fossiliferous; whole and fragmented, crinoid plates and columnals common; rough fracture, stylolitic, slightly porous; grain size increases somewhat upward through the unit; weathered color ranges from light to grayish tan to pale tannish cream; fresh, polished surfaces pale grayish orange pink (5YR8/2) speckled with light gray (N7) fossils; chert virtually absent (less than 5%). *Samples 67-47 A, B, C, D* 6.0

Total thickness of Mississippian rocks: 37.8 ft

LOCALITY 20: Turner Quarry (abandoned), on south side of Sand Branch of Rock Creek; Mendon Quad., Adams Co. (SE SE NW 28, 1N-8W). Base of quarry is gray, fissile-weathering siltstone containing some geodes; probably part of uppermost Warsaw Shale; contact of this siltstone with quarried limestone is about 2½ ft above floor of quarry; base of quarried limestone about 5 ft above water level of Sand Branch.

6. **Overburden,** loess and soil 10-15

■ **SALEM LIMESTONE**

5. **Limestone,** fine to medium grained, silty, dolomitic, micaceous, fossiliferous; weathers into slabs 0.1 to 0.3 ft thick; most of rubble at base of quarry face comes from this unit; large sheets of fossil bryozoa exposed on bedding planes and planes glint from reflections of mica flakes oriented parallel to surface; weathered and fresh surfaces range from very pale orange (10YR 8/2) at base of unit to pale grayish orange (10YR8/4) at top of unit; fossil fragments increase in abundance toward top of unit and silt-sized carbonate matrix becomes less abundant. *Samples 876-27, 28, 29, 30* 8.5
4. **Limestone,** medium to coarse grained, silty, dolomitic, fossil bearing, oolitic; cross-bedded; cross-bedding shows up because of slight color variations; fossils less abundant and more abraded than in units 1 and 2; color of polished, fresh surface is pale grayish orange (10YR8/4); unit capped by a thin siltstone parting. *Sample 876-26* 2.0
3. **Limestone,** as in unit 4 . . . . 1.7
2. **Limestone,** fine to medium grained; silty, dolomitic in part, base of unit marked by zone of siltstone about 0.3 ft thick grading laterally into zone of fairly abundant geodes and chert nodules up to 0.3 ft in diameter; bottom part of unit similar to underlying top of unit 1 in having fairly abundant fossil bryozoa in matrix of silt-sized carbonate grains; in upper part of unit bryozoa are more abundant; weathered surface and fresh, polished surface both very pale orange (10YR8/2); unit capped by 0.05 ft siltstone parting. *Samples 876-23, 24* 1.8
1. **Limestone,** fine- to medium-grained, silty, dolomitic, fossiliferous calcarenite, cherty in basal part, but less so toward the top; crossbedded in large-scale, low-angle cross-beds that developed as scour channel fills; individual beds about 0.1 ft thick; a thin siltstone parting occurs about 1.2 ft above base of unit; weathered surface of unit ranges from very pale orange (10YR8/2) to pale yellowish orange (10YR8/6) and fresh, polished surface ranges from grayish orange (10YR7/4) to very pale orange (10YR8/2); unit becomes somewhat finer grained and more poorly sorted toward the top, fossil hash becoming less prominent, finer-grained matrix more abundant; bryozoa most abundant fossils. *Samples 876-20, 21, 22* 3.6

Total thickness of Mississippian rocks: 17.6 ft

LOCALITY 21: Nations Quarry, Moline Consumers Corp., beside Mill Creek; Quincy Quad., Adams Co. (C NW 36, 1S-8W). Base of quarry covered by water, but is probably not much below lowest bed described.

6. **Overburden,** loess and soil 10-15

■ **BURLINGTON LIMESTONE**

5. **Limestone,** containing abundant interbedded and nodular chert; limestone beds 0.4 to 1.5 ft thick; face inaccessible, not sampled 20
4. **Limestone,** medium- to coarse-grained, inequigranular, coarsely fossiliferous calcarenite or calcirudite; contains more chert than lower units (25% or more estimated) and is partly covered; beds 0.3 ft thick; weathered surface pinkish gray (5YR8/1), fresh, wet surfaces yellowish orange (10YR7/6). *Samples 67-119Q, R, S* 6.5
3. **Limestone,** medium- to coarse-grained, inequigranular, fossil calcarenite; whole fossils rare except in coarsest beds; beds 0.3 to 0.9 ft thick, some rather friable, most compact and non-porous; chert content of unit estimated to be 15%; rough, hackly fracture with abundant, sparkling fracture surfaces from fossil fragments. *Samples 67-119L, M, N, O, P* 6.0
2. **Limestone,** fine to medium grained, inequigranular, jointed and disintegrated, brecciated by weathering of contained chert abundantly interbedded with limestone; limestone light gray (N8) on weathered surface, pale orange pink (5YR8/2) on fresh surface. *Samples 67-119I, J, K* 3-5
1. **Limestone,** medium- to coarse-grained, inequigranular, fossil fragment calcarenite, rough, hackly weathering surfaces that glint and sparkle from exposed faces of crinoid columnals and plates; beds 0.3-0.6 ft thick; chert content of unit estimated to be 20%; very light gray (N8) to pale pinkish gray (5YR9/1). *Samples 67-119A, B, C, D, E, F, G, H* 10.0

Total thickness of Mississippian rocks: 45.5-47.5 ft

LOCALITY 25: Abandoned quarry in bluffs of Mississippi River; Quincy Quad., Adams Co. (NE NW SW 14, 1S-9W). Quarry has been abandoned at least 50 years, judging from size of trees growing next to old working face; quarry floor greenish-gray shale now eroded below base of quarry face some 3 to 4 ft by small stream flowing through area in waterfall over rear wall of quarry; shale probably Hannibal Formation, but samples cannot be obtained because exposure too poor.

■ **BURLINGTON LIMESTONE**

6. Top of section is steep, tree-covered slope to top of bluff; little or no outcrop; may contain contact with overlying Keokuk Limestone. Estimated height of slope is 80.0
5. **Limestone,** medium- to coarse-grained, cherty, moderately to poorly sorted, fossil fragment calcarenite to calcirudite; lower part of unit quite cherty (up to 50% chert) and very poorly sorted; some large brachiopod shells in biocalcisiltite matrix containing abundant crinoid columnals, plates, and other fossil fragments; middle of unit moderately sorted crinoid fragment biocalcarenite; top of unit poorly sorted crinoid fragment biocalcirudite containing some larger, brown brachiopod shells set in matrix of medium sand size carbonate fragments; fossils, especially crinoid fragments, stand out in high relief on weathered surfaces; maximum chert content does not exceed 50% and is highly variable from bed to bed. *Samples 876-13, 14, 15* 6.2

4. **Limestone,** coarse- to medium-grained calcirudite to calcarenite; fossiliferous, very cherty; chert ranges from 30% of outcrop at base of unit to over 70% near top; top of unit marked by bed of almost pure chert; bedding ranges from 0.6 to 1.5 ft thick; average grain size decreases somewhat upward through unit; lower beds contain crinoid columnals and plates (up to 1 cm across) in coarse biocalcarenite consisting of a grain supported network of fossil fragments infilled with biocalcisiltite matrix making up no more than 10% of the rock; middle part of unit more equigranular, containing no large fragments and up to 15% matrix; in weathered surfaces of middle beds, matrix is eroded away from fossil fragments, leaving fossil fragments in high relief; uppermost beds even finer grained and vaguely laminated due to orientation of elongate fossils parallel to bedding planes; color on fresh surfaces ranges from very pale orange (10YR9/2) at base of unit through white (N9) at middle to very pale yellowish gray (5Y9/1) at top. *Samples 876-10, 11, 12* 7.9
3. **Limestone,** fine- to medium-grained, cherty, fossiliferous calcarenite; chert increases to more than 30% of rock beginning 2.3 ft above base of unit; top of unit marked by 1.0 ft zone of highly weathered, brecciated chert forming an undercut in outcrop face; grain size generally decreases upward through unit and sorting improves slightly upward; fracture even to slightly hackly at base, becoming subconchoidal at top of unit; except where in contact with weathered chert, rock very tough, dense, compact, non-porous and well cemented; fresh surface very light gray (N7.5). *Samples 876-8, 9*. 4.6
2. **Limestone,** fine- to coarse-grained, slightly cherty, fossiliferous calcarenite to calcirudite; unit finer grained and moderately sorted at base, and grading upward into coarser-grained, more poorly sorted biocalcirudite; chert content about 5%, slightly higher than in unit 1; unit more dense, compact and better cemented than unit 1; bedding irregular, 1.2 to 1.5 ft thick, marked by thin shaly partings, stylolitic zones, and chert nodules; weathered surface very pale pinkish gray (5YR9/1), fresh surface very light gray to white (N8 to N9). *Sample 876-6, 7* 3.6
1. **Limestone**, slightly dolomitic, slightly cherty, slightly glauconitic, fossiliferous calcirudite; beds, ranging from 0.6 to 1.2 ft thick, marked by stylolitic zones and chert nodules; unit fairly dense, compact and well cemented, but fractured (tending to fall apart along fractures); weathered surface pale tan, fresh surface very pale yellowish gray (5Y9/1); top of unit marked by stylolite zone grading laterally into siltstone parting interlayered with and underlain by zone of chert nodules. *Sample 876-5*. 2.3

Total thickness of Mississippian rocks: 104.6 ft

LOCALITY 37: Outcrop in Mississippi River bluffs; Mendon Quad., Adams Co. (E½ NW NE 2, 1S-9W).

9. **Overburden,** till and soil 50.0

■ **KEOKUK LIMESTONE**

8. **Limestone,** medium- to coarse-grained, cherty, slightly silty, crinoid fragment biocalcarenite to biocalcirudite; more uniformly fossiliferous than unit 7; rough, hackly fracture showing abundant sparkles from fossil fragments; even bedded in beds 0.3 to 0.4 ft thick; top of unit partly covered; pale pinkish gray (5YR9/1). *Sample 67-190C₃* 5.0
7. **Limestone,** medium- to coarse-grained, slightly silty, crinoid fragment biocalcarenite to biocalcirudite; similar in appearance to unit 6; fossils less abundant and confined to thin beds less than 0.1 ft thick; matrix very pale brown (5YR6/2); unit in beds 0.3 to 0.4 ft thick. *Sample 67-190C₂*. 5.0
6. **Limestone,** coarse-grained, cherty, slightly silty, crionid fragment biocalcirudite; beds 0.3 to 0.4 ft thick; white crionid columnals and plates set in darker brown matrix give rock a porphyritic appearance; matrix color medium yellowish brown (10YR 5/2). *Sample 67-190C₁*. 5.0

■ **BURLINGTON LIMESTONE**

5. Covered Interval. 10-15
4. **Limestone,** coarse grained, inequigranular, cherty, fossiliferous; cross bedded in part; beds 0.1 to 0.6 ft thick; rough, hackly fracture showing bright sparkles from large fossil fragments; lighter colored fossils in darker matrix give rock dark and light speckled appearance; average color of fresh surface very pale yellowish brown (10YR7/2); unit partially covered; estimated chert content 30%.*Samples 67-190B₁, B₂*. 5.0
3. **Limestone,** medium- to coarse-grained, cherty, brecciated in part, inequigranular, fossiliferous biocalcarenite or biocalcirudite; bed consists in part of pebble- to cobble-size fragments of fine calcilutite in a coarser-grained, tightly-cemented, medium calcarenite matrix; rough, hackly fracture with vitreous luster showing sparkles from fossil fragments; fresh surface yellowish gray (5Y7/2). *Sample 67-190A₃* . . . 4.0
2. **Limestone,** medium-grained, equigranular, cherty, fossiliferous biocalcarenite in beds 0.1 to 0.2 ft thick; rough, hackly fracture with vitreous luster showing tiny glints from fossil fragments; fossils finer grained, whole rock better sorted, than unit 1; fresh surface very pale yellowish brown (10YR7/2). *Sample 67-190A₂* 2.0
1. **Limestone,** medium-grained, inequigranular, cherty, fossiliferous biocalcarenite; hackly, rough fracture with vitreous luster like broken china; numerous large sparkling centers from crinoid plates and columnals; beds 0.1 to 0.2 ft thick; estimated chert content of units 1 to 3 is 70%; fresh surface very pale grayish orange pink (5YR9/2). *Sample 67-190A₁* 4.0

Total thickness of Mississippian rocks: 40-45 ft

LOCALITY 38: Outcrops in bed and banks of Buel Branch, extending upstream about 100 yds from east end of bridge over Bluff Canal; Mendon Quad., Adams Co. (C NW SW 11, 2N-9W).

5. **Overburden** (not estimated, but may be substantial).

■ **KEOKUK LIMESTONE**

4. **Limestone,** and **shale,** interbedded; shale forms thin stringers and partings between beds of limestone; limestone fine- to medium-grained, fossil fragment biocalcarenite; beds 0.2 to 0.5 ft thick; rough, hackly fracture; chert content estimated to be 30-40%. *Sample 67-192J* 15-20
3. **Shale** or **Mudstone,** very fine grained, laminated and brecciated in part where thin stringers of limestone have apparently been disrupted by flowage of the mudstone; light greenish gray (5GY7/1). *Sample 67-192I*. 5.0
2. **Limestone,** fine- to medium-grained, slightly silty, cherty, fossiliferous calcarenite; even-bedded in beds 0.1 to 0.2 ft thick; rough, hackly fracture, with luster of fractured surface like broken vitreous china; weathered surface pale orange (10YR8/2); fresh polished surface ranges from pinkish gray (5YR8/1) to medium gray (N5). *Samples 67-192G, H* 5.0

1. **Limestone,** medium- to coarse-grained, silty, slightly dolomitic and, in part, silicified, fossiliferous calcarenite or calcirudite; rough weathering, hackly fracture, vitreous, crystalline luster on fractured surfaces; even bedded in beds 0.1 to 0.2 ft thick; weathered surfaces range from yellowish gray (5Y8/1) to pinkish gray (5YR8/1); fresh, polished surfaces pale olive gray (5Y7/1); chert content of unit estimated to be 15%. *Samples 67-192A, B, C, D, E, F* . . . 20-25

Total thickness of Mississippian rocks: 45-55 ft

LOCALITY 39: Abandoned quarry, Camp Point Quad., Adams Co. (NE SW SE 3, 1N-7W).

6. **Overburden,** till, loess and soil. 2-20

■ **SALEM LIMESTONE**

5. **Limestone,** fine to medium grained, slightly fossiliferous, thin bedded; rock between major bedding planes thinly laminated due to orientation of flat fossils parallel to bedding; yellowish gray (5Y9/1) on weathered surfaces to light greenish gray (5GY7/1) on wet, fresh surfaces; contains some pyrite (?) oxidized to rusty, reddish brown specks; evenly bedded in beds that separate into slabs 0.1 ft thick. *Samples 67-197H, I* 6.0
4. **Mudstone,** thinly laminated to shaly; greenish gray, some fossils 2.0
3. **Limestone,** fine to medium grained, silty, dolomitic, containing scattered large fossils such as corals and bryozoa; low porosity and permeability, only slightly friable; siltstone and mudstone layers interbedded, becoming more abundant toward top of unit; light gray (N7) on weathered surface, dark yellowish gray (5Y7/1) on fresh, wet surface; limestone beds between siltstone and mudstone stringers in interbeds are thin bedded to finely laminated, with almost all elongate fossils aligned parallel to bedding planes. *Samples 67-197E, F, G* 5.0
2. **Limestone,** medium to coarse-grained, dolomitic, silty, highly fossiliferous; cross bedded in beds ranging from 0.1 to 2.0 ft thick; bryozoa most common fossil; very pale greenish yellow (10Y9/2) on weathered surface, light greenish gray (5GY8/1) on fresh wet surface. *Samples 67-197C, D* 4.0
1. **Limestone,** fine grained, silty and micaceous, equigranular; silt and micas occur in thin beds interbedded with limestone; light gray (N7) in the limestone, medium light gray (N6) in silty beds; some geodes, some greenish gray shale or mudstone interbedded with the silty limestone. *Samples 67-197A, B* 3.0

Total thickness of Mississippian rocks: 20 ft

LOCALITY 41: Outcrop along intermittent stream on Reuel Meyer farm; Mendon Quad., Adams Co. (C SW 6, 2N-7W).

■ **ST. LOUIS LIMESTONE**

4. **Limestone,** very fine-grained, algal-laminated to massive calcilutite to calcisiltite; smooth to slightly hackly fracture; dull, porcelaneous luster like broken vitreous china; bed lightly veined with sparry calcite, containing some vugs stained by iron oxides; grayish orange (10YR7/4) to pale yellowish gray (5Y8/2). *Samples 67-206B_1, B_2, B_3* 5.0
3. Covered interval. 15.0
2. **Limestone,** medium- to coarse-grained calcarenite occurring as blocks in breccia with matrix similar to unit 1 below; abundant small fossil fragments, including echinoid spines, rough, hackly fracture; dull, sanded luster; very pale yellowish brown color. (10YR 7/2). *Sample 67-206A_2* 9.0
1. **Limestone,** fine- to medium-grained calcarenite; silty, slightly dolomitic, silt occurs in thin, wavy beds and stringers throughout rock; unit lightly veined with coarse, sparry calcite veins cutting perpendicular to bedding; pale yellowish gray (5Y9/1); unit occurs in thick bed (1.0 ft) at base of outcrop in stream bank; also seems to form the matrix surrounding blocks in limestone breccia overlying this basal layer. *Sample 67-206A_1* 1.0

Total thickness of Mississippian rocks: 30.0 ft

LOCALITY 5: Outcrop and abandoned prospect pit, on hillside about 25 yds north of road intersection, 35 ft above road level; Meredosia Quad., Brown Co. (S½ NW NW 20, 1S-1W).

6. **Overburden,** covered section on steep slope, capped by level agricultural field; soil and loess may cover some outcrops of Pennsylvanian rocks 100.0

■ **ST. LOUIS LIMESTONE**

5. **Limestone,** very fine-grained lithographic micrite; syneresis or mud polygon cracks on bedding plane surfaces; hackly to subconchoidal fracture; vitreous luster; sparry calcite in small veins and crack fillings; some iron oxide stains along joints; weathered surface light gray (N8), fresh surface very light olive gray (5Y6/1). *Sample 66-10D*. 0.5
4. **Limestone,** fine-grained, silty, dolomitic calcarenite, slightly porous, hackly fracture, dull or earthy luster; appears brecciated and consists of dusky yellow (5Y6/4) flat pebbles several mm across in matrix of yellowish gray (5Y7/2), silt-sized carbonate mudstone; average color of fresh surface light yellowish olive gray (5Y6/2). *Sample 66-10C* 2.0
3. **Limestone,** fine-grained micrite, unlaminated, brecciated; hackly to subconchoidal fracture; vitreous luster; jointed and stylolitic in part; sparry calcite in veins and as pore fillings; non-porous (all voids filled with calcite); fresh, polished surface pale olive gray (5Y9/1). *Sample 66-10B* 5.0
2. Covered interval; may contain thin bed of green shale similar in lithology to Warsaw Formation 1.0
1. **Limestone,** algal-laminated, fine-grained, micrite, brecciated; hackly to flaggy fracture; dull to vitreous luster; non-porous; stained by iron oxide along joints; unfossiliferous, except for algal laminae; weathered surface yellowish gray (5Y7/2), fresh, polished surface yellowish olive gray (5Y7/1). *Sample 66-10A* 2.5

Total thickness of Mississippian rocks: 11.0 ft

LOCALITY 6: Abandoned quarry in bluff of Illinois River, 3/4 mi west of Lock and Dam LaGrange, Meredosia Quad., Brown Co. (SE SE SE 29, 1S-1W). Quarried face begins about 20 ft above level of nearby road.

9. **Overburden,** loess, till and soil, tree covered. 40-60

■ **ABBOTT FORMATION (?)**

8. **Sandstone,** iron rich or iron-oxide cemented, nodular and clayey, heavily weathered, poorly exposed. 2-3

■ **ST. LOUIS LIMESTONE**

7. **Limestone,** fine grained, silty, clayey, equigranular, brecciated in part; breccia fragments surrounded by somewhat clay-rich matrix; beds 0.5 to 1.0 ft thick; pale gray color on weathered surface. *Sample 66-12S* 2.0

6. **Limestone**, fine grained, dolomitic, equigranular, dense, non-porous brecciated in part; in beds 0.5 to 1.0 ft thick. *Sample 66-12R* 3.0

■ SALEM FORMATION

5. **Limestone**, dolomitic, interbedded with lenses and partings of greenish gray, silty mudstone or shale; mudstone partings and lenses (0.1 to 0.3 ft thick) make up about 40% of unit; limestone beds buff, fine grained, equigranular, brecciated in part. *Sample 66-12Q* 5.0
4. **Limestone**, fine grained, dolomitic, slightly silty, equigranular; dense to moderately porous, glauconitic in part; buff to gray on weathered surface; beds from 0.3 to 3.0 ft thick; irregular in thickness laterally. *Samples 66-12O, P* 5.0
3. **Limestone**, dolomitic, and mudstone, sandy, interbedded; total amounts of mudstone and limestone about equal; limestone occurs in beds 0.3 to 1.0 ft and is fine grained, dense, non-porous, and light gray on weathered surface at base of unit, grading upward to less dense, more porous, buff-colored beds near top; mudstone beds contain some pyrite in places and are slumped, in part. *Samples 66-12G, H, I, J, K, L, M, N* 12.0
2. **Limestone**, dolomitic, silty and shaly in part, fine grained, equigranular, somewhat porous; hackly, rough fracture; weathered surface buff to gray; occurs as one massive bed except for rare, thin shale partings, minor cavities and geodes, and one irregularly bedded or brecciated zone about 3 ft long and 0.75 ft thick; top of unit capped by green sandy mudstone or shale about 0.2 ft thick. *Samples 66-12B, C, D, E, F* 10.0
1. **Siltstone**, or very fine sandstone, fine grained, glauconitic at base, grading upward into limestone, silty, finely laminated, equigranular; weathered surface greenish gray; rough, hackly fracture. *Sample 66-12A* . 1.0

Total thickness of Mississippian rocks: 40-51 ft

LOCALITY 9: Outcrop in stream bank of Missouri Creek, Augusta Quad., Brown Co. (SE NW NW 4, 1N-4W). Base of outcrop in stream bed at water level.

6. **Overburden**, clayey siltstone, loess and soil; may contain some float from buried outcrops of Pennsylvanian rocks 15.0

■ SALEM LIMESTONE

5. **Dolomite**, fine grained but brecciated, calcareous, light gray granules (2-4 mm across) of very fine-grained dolomite in slightly darker, more porous, calcisiltite matrix; fracture is hackly; dull luster; pale grayish orange (10YR9/4) on weathered surface, pale pinkish gray (5YR9/1) on fresh surface; top of unit covered by slope wash and float from overlying overburden and soil. *Sample 66-70D* 1.0
4. **Dolomite**, fine grained, silty, calcareous, equigranular, dull or earthy luster; rough or hackly fracture; in beds 0.1 to 0.4 ft thick, but fissile in places; fresh and weathered surfaces very pale orange (10YR8/2 or 10YR9/2) except where stained to grayish orange (10YR7/4) by oxidation of pyrite to iron oxide. *Sample 66-70C* 1.5
3. **Dolomite**, silty, clayey, earthy luster and fracture, highly porous; interbedded with thin stringers and beds of green, dolomitic shale or mudstone; color of dolomite on fresh and weathered surfaces grayish orange (10YR7/4). *Sample 66-70B* 4.0
2. **Dolomite**, fine to medium grained, calcareous, silty, siliceous, equigranular; bedded 0.1 to 0.3 ft thick; contains silty stringers giving a banded, almost gneissic, appearance; color ranges from very light gray (N8) to very pale orange (10YR9/2). *Sample 66-70A_3*. . . . 1.0
1. **Limestone**, dolomitic, silty, equigranular, unfossiliferous, hackly fracture, dull or earthy luster; beds 0.1 to 0.3 ft thick at base of unit, increasing to 1.0 ft thickness at top; becomes more siliceous toward top and is capped by a 0.1 to 0.3 ft thick laminated chert bed; thin siltstone and silicified stringers common at top of unit; rock is tougher and more strongly cemented at top; color on weathered surface yellowish olive gray (5Y6/2), on fresh surface light yellowish olive gray (5Y6/1); increased silica and silt stringers at top of unit cause apparent surface color to lighten to pale olive gray (5Y7/1). *Samples 66-70A_1, A_2* 2.5

Total thickness of Mississippian rocks: 10.0 ft

LOCALITY 12: Outcrop in ravine containing small stream extending about 200 yds along stream; Meredosia Quad., Brown Co. (NE SW SW 31, 1S-1W). Base of outcrop covered by slump and stream alluvium.

7. **Overburden**, loess and soil 20-40

■ ST. LOUIS LIMESTONE

6. **Limestone**, fine to medium grained, inequigranular, unfossiliferous, dense, non-porous, well cemented, nodular and slightly cherty in part; hackly to subconchoidal fracture; dull to vitreous luster; in beds 0.3 to 0.5 ft thick, minor zones of stylolites; light gray (N7) on fresh surface; unit fills erosional channel in top of unit 5. *Sample 66-100D* 5-7

■ SALEM LIMESTONE

5. **Limestone**, medium grained, silty, dolomitic, consisting of finely broken, unidentifiable fossil fragments; even to hackly fracture; vitreous luster; dense, well-cemented, only slightly porous, in beds 0.5 to 1.0 ft thick; medium yellowish brown (10YR5/2) on weathered surface, grayish yellowish orange (10YR 5/4) on fresh surfaces. *Sample 66-100C* 2-3
4. Covered interval. 12.0
3. **Limestone**, fine to medium grained, silty, dolomitic, equigranular, unfossiliferous, friable, thin-bedded; hackly to flaggy fracture; dull, earthy luster; fresh surface grayish orange (10YR7/4), weathered surface pale yellowish brown (10YR7/2). *Sample 66-100B* 2.0
2. **Limestone**, fine grained, silty, dolomitic, porous, equigranular, unfossiliferous; in beds 0.1 to 0.5 ft thick; hackly to earthy fracture, dull to earthy luster; weathered surface pale olive gray (5Y7/1), fresh surface light gray (N7). *Sample 66-100A* 3.0
1. **Limestone**, medium to coarse grained, silty, dolomitic, inequigranular, moderately porous; hackly to earthy fracture; earthy to porcelaneous luster; consists of fossil fragments and minor oolites set in slightly silty, dolomitic matrix and cement; unit vaguely cross bedded; weathered surface moderate yellowish gray (5Y7/4), fresh surface pale light brown (5YR6/6). *Sample 66-100AA* 5.0

Total thickness of Mississippian rocks: 29-33 ft

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