GUIDE LEAFLET

GEOLOGICAL SCIENCE FIELD TRIP

Sponsored by
ILLINOIS STATE GEOLOGICAL SURVEY

GALENA AREA

Jo Daviess County, Illinois and Lafayette County, Wisconsin
Cuba City and Galena Quadrangles

Leaders
George M. Wilson, David L. Reinertsen, William Cote

Urbana, Illinois
September 18, 1965
To the Participants:

The Geological Science Field Trip program is designed to acquaint you with the landscape, rock and mineral resources, and the geological processes that have led to their origin. With this program, we hope to stimulate a general interest in the geology of Illinois and a greater appreciation of the state's vast mineral resources and their importance to the over-all economy.

We encourage you to ask the tour leaders any questions that may occur to you during the trip. Discussion often clarifies points that otherwise would remain confused to many of the participants. We also invite your written comments upon the conduct of the trips so that we might improve them as much as possible.

Additional copies of this guide leaflet, as well as itineraries for trips that have been held in the past, may be obtained free of charge by writing to the Illinois State Geological Survey.

We hope you enjoy today's trip and will come again.
INTRODUCTION

The History of Mining In the Illinois Lead-Zinc District

Although the presence of lead ore (galena) in extreme northwestern Illinois was noted by French explorers about 1658, it seems likely that the Indians had already been mining it superficially for about 100 hundred years. Nicholas Perrot, a French commandant and Indian trader, may have been the first white man to view the Indian mines. He was credited with their discovery in 1690.

Little commercial mining was carried on in the area until 1788 when the Sac and Fox Indians gave Julien Dubuque, a French-Canadian, permission to work mines on the west side of the Mississippi River. Dubuque also opened a mine in Illinois near Elizabeth. The mining industry grew very slowly until 1823 when rapid migration into the area caused it to greatly expand. The old locality in northwestern Illinois known as LaPoint became Galena in 1826. It was the first city in this region to organize under a charter, and it grew rapidly because of its mining industry. Mines in the Galena vicinity were the first in the United States to produce large quantities of lead ore, and in 1845 production of 27,000 tons was reported. This tonnage was 90 percent of all the lead produced in the United States, which was then the world's leading lead producer. Although production of lead in the Galena area has declined considerably over the years, some ore is still being mined here.

Zinc ore (sphalerite) called "jack", "blende", and "black jack" by the miners is also found in the Galena area. Although it was first reported in 1839, it was considered useless and was discarded by the miners in their search for lead ore. However, in 1852 a zinc ore reduction plant was opened near LaSalle, and this mineral became important to the economic development of the region. From 1852 to 1909 more zinc ore had been mined than the total production of lead in the same period. At the present time, zinc ore production is the mainstay of the mining industry in this vicinity.

Itinerary

0.0 0.0 Assemble on the northwest side of the new Galena High School. Enter highway and turn left (northwest).

0.2 0.2 STOP. Enter Highway 20. CAUTION. Continue straight ahead.

0.5 0.7 Toward the left notice the extremely even skyline across the river in Iowa. This may represent an old erosion surface, called the Dodgeville Peneplain. At Stop 3 this feature will be discussed in detail.

1.3 2.0 Junction of Routes 20 and 84. Continue ahead on 84.
On the left in the distance is Sinsinawa Mound, an outlier of Silurian dolomite. This outlier and others like it will be discussed at Stops 3 and 4.

Ahead on the right is the chat pile (waste rock) of the Eagle-Picher Graham Mine.

Enter Wisconsin. Route 80. Continue straight ahead.

SLOW. Prepare to turn right.

Turn right.

Old abandoned galena mine on the right.

Stop 1. Exposure of Ordovician dolomite.

In the Galena area there are nearly 2000 feet of Paleozoic sedimentary rocks resting upon a basement of Precambrian granites and gneisses. These sedimentary rocks have a gentle regional dip toward the southwest. They range in age from Late Cambrian through Early Silurian. They consist of sandstones, shales, and limestones which were deposited in the shallow continental seas that submerged the Midcontinent several times from about 500 to 200 million years ago. A few miles farther south in Illinois there are younger rocks of Late Silurian, Devonian, Mississippian, and Pennsylvanian ages. Rocks of these ages may also have been deposited in the Galena area, but if so they were destroyed by erosion. At the end of the Pennsylvanian Period the Midwest was permanently raised above sea level, and for the next 200 million years the region experienced erosion. During this time an estimated 1500 to 2000 feet of sedimentary strata may have been stripped away in the Galena area.

The exposure here is about 5 to 6 feet of the Ordovician Dunleith Formation. The Dunleith Formation is part of the Galena Group which contains the principal mineralized zones in the zinc-lead district of northwestern Illinois.

The rock exposed here is the lower part of the Dunleith. It consists of medium-grained, light brownish gray, cherty, dolomitic limestone. Upon weathering the rock becomes slightly darker in color. This portion of the Dunleith is characteristically cherty with irregularly-shaped, gray to pink chert nodules. The top of the Dunleith is also cherty, and the sharp transition from cherty to non-cherty dolomite marks the contact of the Dunleith and the overlying Wise Lake Formation.

The fossil sponge (?) Receptaculites oweni occurs in the Dunleith, but here dolomitization and recrystallization have largely destroyed the fossils. Only poorly preserved fossil casts are evident. Later at Stop 9 there will be an opportunity to see specimens of Receptaculites.
0.0 8.6 Leave Stop 1. Continue ahead (east). Outcrops of Dunleith can be seen on both sides of the road.

0.6 9.2 Cross bridge. Continue ahead on blacktop.

0.3 9.5 SLOW. Prepare to stop.

0.2 9.7 Stop 2. Buncombe Section. Exposures of Dunleith and Guttenberg Formations.

Here adjacent to the floodplain of the Galena River the elevation is about 50 feet lower than at Stop 1. Downcutting of the river has exposed the lower Dunleith Formation and the underlying Guttenberg Formation of the Decorah Subgroup. In the small draw on the left the exposed section includes the following units:

**Dunleith Formation**

- **"Drab"** Gray to brown mottled, vuggy dolomite, cherty in zones
- **"Gray"** Gray to buff, slightly vuggy dolomite, thin green shale partings
- **"Blue"** Blue-gray dolomite, sandy, thin green shale partings

**Guttenberg Formation**

- **"Oilrock"** Fine-grained, brown, thin to medium-bedded dolomite and limestone, gray in lower part; wavy bedding planes; chalky on weathered surfaces; highly fossiliferous; thin red-brown shale layers.

The Middle Ordovician (Champlainian) formations have persistent, characteristic lithologies that are readily distinguished in outcrops and in the subsurface. Over the years of mining the lead and zinc deposits the miners and drillers have given common names to these formations (see geologic column in back of guide leaflet). The Guttenberg is called the "Oilrock" because some of the red-brown shales contain enough distillable oil to burn briefly when ignited by a match.

Some zones in the Guttenberg are extremely fossiliferous. The fossils are rather difficult to collect because of the dense character of the rock, but with patience one can collect excellent specimens of a large variety of fossils. These include trilobites, gastropods, pelecypods, cephalopods, crinoids, bryozoans, brachiopods, and corals. Especially abundant are the brachiopods Pionodema subaequata, Dinorthis pectinella, Rafinesquina trentonensis, Sowerbyella curdsvillensis, and Strophomena filitexta.
0.2 9.9 T-road and bridge on right. Continue ahead and veer left.

0.3 10.2 Y-intersection. Veer right. Continue ahead.

0.4 10.6 Cross Galena River.

1.2 11.8 T-road intersection. Turn right. Ascend hill and enter Illinois.

1.5 13.3 T-road intersection. STOP. Turn left and then right.

0.6 13.9 Stop 3. Discussion of regional geomorphology.

The geomorphic history of the Galena area is primarily erosional. This has been modified only slightly by the deposition of loess on the uplands and the aggradation of the Mississippi Valley and lower parts of its major tributaries during the Pleistocene glaciation. The Galena area is part of the Wisconsin Driftless Area and was not glaciated.

The topography of the Galena area is classified as being in the mature stage of the erosional cycle. The rolling terrain contrasts sharply with more subdued topography of the glaciated areas surrounding the Driftless Area. In the glaciated areas the topography is youthful, and the streams have just begun to cut into the glacial deposits. Here in the Driftless Area the land surface is almost entirely in slope, and the streams flow in narrow V-shaped valleys. However, here and there are remnants of a flat upland surface underlain by outliers of Silurian (Niagaran) dolomite, which once completely covered the area. These upland remnants occur on the tops of mounds and irregular ridges that were left isolated during the erosion and southerly recession of the Silurian escarpment. Similar flat uplands are present on Niagaran dolomite in Iowa and Wisconsin.

When the tops of these Silurian flats are joined by an imaginary plain, a surface is formed that slopes gently downward from northeast to southwest (in the Galena Quadrangle from about 1150 to 1000 feet). When viewed from a distance, this surface is apparent in the extremely even skyline (observe toward the west). This flat upland surface, considered by many geologists to be a peneplain, is called the Dodgeville Peneplain, and was formed in late Tertiary (Pliocene) time.

A peneplain is a land surface that has been worn down by stream erosion and mass wasting to a low, nearly featureless plain, which gradually slopes upward from the sea. Such an erosion surface would require a very long time to form and would be characterized by sluggish streams flowing in broad valleys and by deep residual soils. Bedrock structures would have no influence on the topography, but would be uniformly beveled.
Within the Galena Quadrangle the slope of the Dodgeville Peneplain and the dip of the Niagaran dolomite are the same. The erosion surface corresponds to the dipslope. This fact is used by some geologists to argue that the upland surface is not a peneplain at all, but a structurally-controlled feature that formed when strata less resistant than the Silurian dolomite were stripped away. However, northward in Minnesota and Wisconsin the surface bevels Ordovician strata which dip more steeply. Other arguments against the peneplain idea are the absence of a thick residual soil and the apparent control of present-day streams by bedrock joints, which should not be true if the region had been peneplained.

Another erosion surface considered to be a partial peneplain forms the general upland level in the Galena area. This surface, called the Lancaster Peneplain, occurs about 150 feet below the Dodgeville level, and is believed to have formed in late Tertiary or early Pleistocene time following uplift of the Dodgeville Peneplain. The Lancaster Peneplain is not notably flat (observe in the foreground), but is characterized by rolling terrain developed on top of the Galena Dolomite and in a few places on the lower part of the Maquoketa Shale. The knobs of Niagaran dolomite stand prominently above this surface. The Lancaster Peneplain has been deeply dissected following late Pleistocene uplift and Recent rejuvenation of streams.

0.7 14.6 T-road intersection. Turn left on Scales Mound road.
0.9 15.5 Abandoned quarry in Galena Dolomite on the right.
0.1 15.6 Railroad Crossing. CAUTION
1.3 16.9 On the right note the prominent ridge of Silurian dolomite.
1.3 18.2 T-road intersection from left. Continue straight ahead.
0.5 18.7 Y-intersection. Keep right.
0.1 18.8 STOP. Intersection with blacktop road. Continue straight ahead slowly. PREPARE TO STOP.
0.0 18.8 Stop 4. Scales Mound. Silurian Edgewood and Kankakee Formations.

Scales Mound is capped by an outlier of the Silurian Kankakee Formation. The Kankakee Formation consists of cherty dolomite which is quite resistant to erosion. The lower slopes of the mound are formed by the softer, argillaceous Silurian Edgewood Formation. At the base of the mound along the roadcut the soft Ordovician Maquoketa Shale is exposed. The gentle slopes in the foreground are also developed on Maquoketa Shale, and beyond toward the north and west is the dissected Lancaster erosion surface on Galena Dolomite.
About 20 miles to the north two other Silurian outliers, the Platte Mounds, are visible. Toward the west Sinsinawa Mound stands prominently above the Lancaster Peneplain. Towards the southwest are remnants of the Silurian escarpment over which the itinerary will pass later.

The Kankakee Formation exposed here consists of light tan, cherty, thin-bedded dolomite. Bedding planes are undulating. Outcrop surfaces are coated with brilliant orange algae. In places along the exposure the bedding planes die out laterally into massive dolomite, which may represent small reefs. These contain fragments of Stromatoporids, colonial, reef-building animals, now extinct, that may be related to the Corals. Other fossils are scarce, but in a few beds there are scattered fragments of silicified colonial corals, brachiopods, and crinoid columnals.

Note the large slump blocks which have slid down on the underlying shale.

0.0 18.8 Leave Stop 4. The itinerary gradually ascends the Silurian ridge seen from Stop 4. For about two miles the road runs along the ridge on the level of the Dodgeville Peneplain.

3.4 22.2 Abandoned quarry in Silurian dolomite on the right. The road is crossing Maquoketa Shale. Note the gentle slopes.

1.3 23.5 T-road intersection from the right. Continue straight ahead. The slopes here are underlain by Galena Dolomite.

Another T-road from the left. Continue Straight ahead on blacktop.

2.8 26.3 Abandoned quarry in Galena Dolomite on the right.

0.8 27.1 Bridge over railroad.

0.7 27.8 Entering Galena. SLOW.

0.6 28.4 T-intersection. Turn right on Meeker Street. CAUTION. Cross bridge over Galena River. Hughlett Branch.

0.1 28.5 Turn left on Bench Street. CAUTION.

0.1 28.6 STOP. Intersection with Franklin Street. Continue straight ahead and veer right.

0.2 28.8 STOP. Continue straight ahead.

0.4 29.2 STOP. Intersection with Routes 20 and 84. Turn left onto highway and cross bridge. CAUTION.

0.1 29.3 Cross bridge over Galena River and railroad.
Turn left on Park Avenue at east end of bridge.

Descend hill and turn right at sign pointing to General Grant's home.

Stop 5. Lunch in park near Grant's home. Discussion of Wisconsin Driftless Area.

During the Pleistocene Epoch or "Great Ice Age" northern North America was covered by immense continental glaciers. During the four major glacial advances (Nebraskan, Kansan, Illinoian, and Wisconsinan) most of Illinois was glaciated at one time or another. These glaciers left behind extensive deposits of glacial drift and drastically changed the landscape. However, a ten thousand square mile area in southwestern Wisconsin and northwestern Illinois appears to have been by-passed by the glaciers. This unglaciated area, surrounded by glacial deposits, is called the Wisconsin Driftless Area.

The Driftless Area is not significantly higher topographically than the areas bordering it, and considering the great thickness of the glacial ice (many thousands of feet), the topography was not a factor in preventing its glaciation. The reason why the glaciers did not cross the area is probably related to the lobate form of the ice margins and the locations of the major centers of dispersion. The Pleistocene glaciers advanced from two main centers in Canada, an eastern Labradorean center in the Labrador Mountains and a western Keewatin center west of Hudson Bay. The Driftless Area is situated in the middle, and lobes moving outward from these centers passed around it.

In the Illinois section of the Driftless Area there is no evidence that glacial ice ever covered the area. In the northern and central parts of the Wisconsin section there are reports of glacial erratics on upland slopes. These erratics consist of igneous rock fragments and sedimentary rocks that are higher than their normal stratigraphic positions. There are also gravels containing igneous rocks and Baraboo Quartzite on bedrock terraces of the Wisconsin River. From this evidence and by other less direct evidence, some geologists suggest that part, if not all, of the Driftless Area was glaciated. If so, the effects of glaciation were slight, and in Illinois they have been effectively obliterated by erosion.
Y-intersection. Keep right.

CAUTION. Descend steep grade. Note the loess exposure in the roadcut on the left.

Cross Smallpox Creek.

Stop 6. Sunset Point. Walk west through field to point.

From this vantage point there is an excellent view of the Mississippi Valley and the Dodgeville and Lancaster Peneplains. The conspicuous mound toward the northwest is Pilot knob.

In the Galena area the Mississippi River is flowing through a narrow gorge with steep walls 100 to 400 feet high. This gorge was cut into the Ordovician bedrock following uplift of the region in early Pleistocene time. During late Pleistocene time the valley was partially filled by outwash from the melting Wisconsinan glaciers in the north, so that the bedrock floor of the gorge is about 150 feet below the present floodplain. Terraces in the outwash along the valley walls indicate that the river had resumed downcutting during Recent time, but this was checked by the building of dams farther south. At the present time the river is slowly aggrading its channel.

T-road intersection from left. Continue straight ahead.

Stop 7. View of Mississippi Valley.

Toward the west is an excellent view of the Mississippi Valley and the Dodgeville Peneplain in Iowa.

STOP. Crossroads. Continue straight ahead.

T-road intersection from right. Continue straight ahead.

In cuts along this road note the exposures of loess. The loess consists of silt which was blown from the floodplain of the Mississippi River during Pleistocene time.

T-road intersection from right. Continue ahead and veer left.

Descend steep hill. CAUTION.

T-road intersection from left. Continue ahead.

Note the terraces on both sides of Beaty Hollow. Similar terraces occur along Galena River, Sinsinawa River, and Smallpox Creek.

The deposition of outwash in the Mississippi Valley during Wisconsinan time raised the valley floor and blocked its tributaries. This caused alluviation of the tributary valleys upstream from their mouths. Resumption of downcutting later formed the terraces.

Crossroads at Blanding. Turn right.
0.2 43.2 Note the sand dunes on the right.

1.0 44.2 Railroad crossing, CAUTION. TWO TRACKS. Veer right and continue ahead.

0.5 44.7 Railroad underpass.

0.2 44.9 Y-intersection. Veer left.

0.2 45.1 CAUTION. For the next few miles the road is very rough and narrow.

0.4 45.5 Stop 8. Abandoned crevice mine in Galena Dolomite.

   For the next mile or so the river bluff is honeycombed with abandoned lead mines, which may date from pre-Civil War days. These deposits were very rich but small. The lead ore occurred in fissures along joints in the dolomite. A more detailed discussion of the crevice deposits is given on the next page.

   Some of the mine shafts are still open and large enough to enter. However, the mines were dangerous when they were being worked and are even more dangerous now. DO NOT ENTER ANY OF THE MINES!

1.3 46.8 Ski chair lift.

1.2 48.0 T-road intersection from right. Turn right.

0.5 48.5 STOP. Intersection with road from right. Continue ahead and veer left.

   Railroad crossing in Rice. CAUTION.

1.6 50.1 Turn sharply right. Do not go through the gate, but drive to the right around the edge of the mine area.

0.3 50.4 Stop 9. Mineral collecting in waste piles of Tri-State Mine.

   Calcite, pyrite, galena, and sphalerite can be collected here. The waste piles are rather old and weathered, but with patience one can collect some fairly good specimens. Note the blocks of Galena dolomite with Receptaculites oweni.

   This is the last stop of the field trip. To return to Galena turn right at the mine entrance.

0.3 50.7 Leave mine entrance.

0.8 51.5 On the left is the site of the old Blackjack Mine. Do not enter the mine property.

   End of trip

   Drive carefully on your way home.
THE ZINC-LEAD DEPOSITS OF NORTHWESTERN ILLINOIS

Location

The principal mineralized area in which the zinc-lead deposits in northwestern Illinois have been found occurs in Jo Daviess County in a belt from 5 to 10 miles wide and 15 miles long, extending approximately northeast through Galena from the Wisconsin line to the Mississippi River. Lead ore has been mined at other places in Jo Daviess County, as near Elizabeth, Apple River, and Warren. These occurrences increase the known mineralized district to include most of the county. Small amounts of lead ore are also reported to have been mined outside of this area near Freeport in Stephenson County and near Mt. Carroll in Carroll County.

Stratigraphic Position of Ore Deposits

The zinc-lead ore deposits occur in the carbonate formations of the Galena and Platteville Groups (Middle Ordovician) of the Ordovician System. The major deposits of zinc ore (sphalerite) are found in the lower part of the Galena Group, which includes the "Drab," "Gray," and "Blue" zones of the Dunleith Formation, the "Oilrock" or Guttenberg Formation, the "Claybed" or Spechts Ferry Formation, and in the "Glassrock" or Quimby's Mill Formation which is in the top of the Platteville Group. These deposits are mainly of the "flat-and-pitch" type.

The major deposits of lead ore (galena) with little associated sphalerite are found principally in the upper part of the Galena Group, which includes the top half of the Dunleith ("Drab") and the overlying Wise Lake Formation ("Buff"). These deposits are of the "crevice" type. Locally the lead ore may grade into mixed lead-zinc ore, especially in the lower part of the Wise Lake Formation.

Flat-and-Pitch Deposits

The flat-and-pitch deposits in the lower ore-bearing zone (fig. 1) consist of "flats," which are nearly horizontal sheet-like bodies of ore between or parallel to the bedding planes of the strata, and "pitches," which are similar bodies cutting across the bedding planes. The pitches usually slope more than 45 degrees and many steepen upward to grade into vertical crevices. Some tend to flatten downward. The mineralized rock between pitches bounding an ore body is called the "core ground."

The flat-and-pitch deposits are associated with small synclinal structures, which trend northwest, northeast, or east. Between pitches bounding an ore body, the Oilrock and Glassrock are thinner than usual, apparently because of being dissolved away, and the overlying strata have sagged to form the synclinal structure. This sagging opened up the fractures which became mineralized. The mineralized sags are usually 50 to 200 feet wide, but may be as wide as 300 feet, and extend longitudinally for thousands of feet in a straight line or in an arcuate manner. Usually the minable thickness is about 40 feet, but sometimes it is thicker. There are many variations in the shape and character of these deposits. The ore generally occurs as filled fissure deposits, but in the Oilrock and Glassrock there are also disseminated-type deposits. Rarely
Fig. 1  Cross section showing ore bodies in flat-and-pitch deposits.
the ore will assay as high as 20 percent zinc, but 10 percent zinc is considered rich ore, and 3 to 4 percent ore is considered minable. In some deposits, minable ground is confined entirely to the pitches, but usually parts of the coreground are also minable. Minerals associated with the zinc ore (sphalerite) other than galena include pyrite, marcasite, and calcite. Above the water table where oxidation has occurred there are secondary minerals including cerussite (lead carbonate), anglesite (lead sulfate), smithsonite (zinc carbonate), and limonite (iron oxide).

Crevice Deposits

The crevice deposits of the upper mineralized zone occur as fissure fillings along joints that are oriented mainly in an east-west direction. The crevices are actually vertical fissures or cavities that were opened up along the joints by solution of the dolomite. Along a typical crevice the minable ore occurs as pods or lenses a few feet to a few hundred feet long scattered along the strike of the joints. The ore bodies are generally only a few inches to a few feet wide, but where there are two or more closely spaced crevices, they extend over widths of 30 feet or more. The ore is usually pure galena, but locally it may grade to mixtures of galena and sphalerite.

The shallow crevice deposits were the nation's principal source of lead ore between 1820 and 1865. These deposits were easily discovered in partial exposures along stream valleys and by the presence of residual accumulations of ore where erosion had intersected mineralized joints. In some cases the topographic expression of crevices as shallow depressions lead to the discovery of ore bodies. When these easily exploited deposits were depleted, lead ore production declined sharply. At present, little ore is mined from shallow deposits each year. Zinc ore obtained almost exclusively from the larger, deeper flat-and-pitch deposits is now the chief mineral commodity of the area.

Origin of Ore Deposits

The origin of the ore bodies is still in question. An early theory that was widely accepted is the "cold water theory." By this theory the lead and zinc minerals were assumed to have been present in trace quantities disseminated throughout the Galena Dolomite or higher rock units. The lead and zinc were originally supposed to have been deposited with the carbonate rocks when they were precipitated from the ancient Ordovician sea more than 400 million years ago. Percolating ground water then dissolved the lead and zinc minerals from these rocks and carried them downward to be reprecipitated in openings in the strata where the ore is now found.

The theory now generally favored by geologists is the "magmatic theory." According to this theory the ore was emplaced by hydrothermal solutions rising from a deep magmatic (igneous) source. The warm mineralized solutions ascended until they encountered the cavernous, jointed Middle Ordovician rocks that had the proper temperature-pressure conditions to allow the precipitation of the lead and zinc sulfides. The neutralizing effect of carbonate-rich ground water on the acid sulfide-bearing solutions could also have been partly responsible. These ideas may explain why the ore bodies are restricted to such a narrow vertical interval of Ordovician strata. However, the absence of deep downward extensions of ore and major faults that could have provided access to the rising solutions has not been resolved.
The open fissures in which the crevice ores were deposited and the synclinal structures associated with the flat-and-pitch ore bodies are solutional in origin and formed before ore emplacement. Whether solution was by meteoric ground water or by hydrothermal solutions has not been definitely determined. If the latter is true, the openings may have formed contemporaneously with ore deposition.

The preceding brief discussion on the occurrence, character, and origin of the zinc-lead deposits was abstracted from Illinois State Geological Survey Reports of Investigations 116 and 210. For more complete discussions of these deposits, including their possible time of formation, refer to these publications.
The geologic column on the next page shows the major zones of lead and zinc mineralization. The lithologies of the formations shown are described below. The R's in the Wise Lake and Dunleith Formations indicate the upper and lower Receptaculites zones.

<table>
<thead>
<tr>
<th>Formation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silurian dolomite</td>
<td>Dolomite, cherty, gray, lower part argillaceous</td>
</tr>
<tr>
<td>Maquoketa</td>
<td>Shale, greenish gray, some calcareous siltstone, zone of depauperate fossils and phosphate nodules at base</td>
</tr>
<tr>
<td>Dubuque</td>
<td>Dolomite, gray to buff, thin-bedded, shaly</td>
</tr>
<tr>
<td>Wise Lake - &quot;Buff&quot;</td>
<td>Dolomite, buff, massive, very vuggy, red-brown shale partings at base</td>
</tr>
<tr>
<td>Dunleith - &quot;Drab&quot;</td>
<td>Dolomite, gray to brown, mottled, partly vuggy, cherty zones</td>
</tr>
<tr>
<td>&quot;Gray&quot;</td>
<td>Dolomite, gray, green shale partings</td>
</tr>
<tr>
<td>&quot;Blue&quot;</td>
<td>Dolomite, blue-gray, argillaceous and sandy, green shale partings</td>
</tr>
<tr>
<td>Guttenberg - &quot;Oilrock&quot;</td>
<td>Limestone, tan, wavy bedding planes, with thin red-brown shales, very fossiliferous; gray in lower part below thin bentonite or gray-green shale</td>
</tr>
<tr>
<td>Spechts Ferry - &quot;Clay Bed&quot;</td>
<td>Shale, green, fossiliferous limestone beds</td>
</tr>
<tr>
<td>Quimby's Mill - &quot;Glassrock&quot;</td>
<td>Limestone and dolomite, brown, dark brown shale in lower half</td>
</tr>
<tr>
<td>Nachusa</td>
<td>Limestone, gray to buff, dolomitic, cherty</td>
</tr>
<tr>
<td>Grand Detour</td>
<td>Limestone, gray, dolomitic, cherty at top</td>
</tr>
<tr>
<td>Mifflin</td>
<td>Dolomite and limestone, gray, argillaceous, thin gray shale beds</td>
</tr>
<tr>
<td>Pecatonica</td>
<td>Dolomite, brownish gray, dense, sandy at base with small phosphate nodules</td>
</tr>
<tr>
<td>Glenwood</td>
<td>Shale, sandy, green and brown, with interbedded sandstones</td>
</tr>
<tr>
<td>St. Peter</td>
<td>Sandstone, clean, white</td>
</tr>
<tr>
<td>SYSTEM</td>
<td>GROUP</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>SILURIAN</td>
<td>Dubuque</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ancell</td>
</tr>
</tbody>
</table>

**AMOUNTS OF LEAD | ZINC**

(Chart depicting lead and zinc production, not transcribed here.)
PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

COMMON TYPES of ILLINOIS FOSSILS

- Lithostrotion
- Honeycomb coral
- Cup coral
- Archimedes
- Fenestella
- Composita
- Lingula
- Orbiculoidea
- Spiriferoid
- Productoid
- Pentameroid

GRAPTOLITE
CYSTOID
CRINOID
PENTREMITE
BRYOZOA
BRACHIOPODS
COMMON TYPES of ILLINOIS FOSSILS

**PELECYPODS**
- "Clam"
- "Scallop"

**PELECYPODS**
- Low-spired
- High-spired
- Flat-spired

**GASTROPODS**
- Curved cone
- Coiled cone (Nautilus)
- Straight cone

**CEPHALOPODS**
- Calymene (coiled)
- Calymene (flat)

**OSTRACODS**
- (greatly enlarged)

**TRILOBITES**
- Bumastus
- Calymene (coiled)
GALENA
GEOLOGICAL SCIENCE FIELD TRIP
SEPTEMBER 18, 1965