42nd Annual Meeting of the American Institute of Professional Geologists
"Geologic Information: Racing into the Digital Age"

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Physiography and the Field Trip Route

The field trip route follows U.S. 60 northwest from Lexington, Ky., to exit 58 on Interstate 64 south of Frankfort, Ky. We enter I-64 at the interchange and proceed west to Louisville, Ky. There we get onto I-65 and proceed north, crossing the Ohio River into southern Indiana, where we will visit the Falls of the Ohio State Park and Visitors' Center in Clarksville, Ind.

The route to the Louisville area is wholly in the Lexington Plain or Bluegrass Section of the Interior Low Plateaus physiographic province (Fig. 1). The Lexington Plain largely coincides with apical portions of the Jessamine Dome, a structural culmination on the larger Cincinnati Arch. Because the dome is nearly symmetrical and truncated, lithologic units and resulting landforms form roughly concentric belts around the Lexington area, which is located near the center of the dome. Consequently, the Lexington Plain is di-

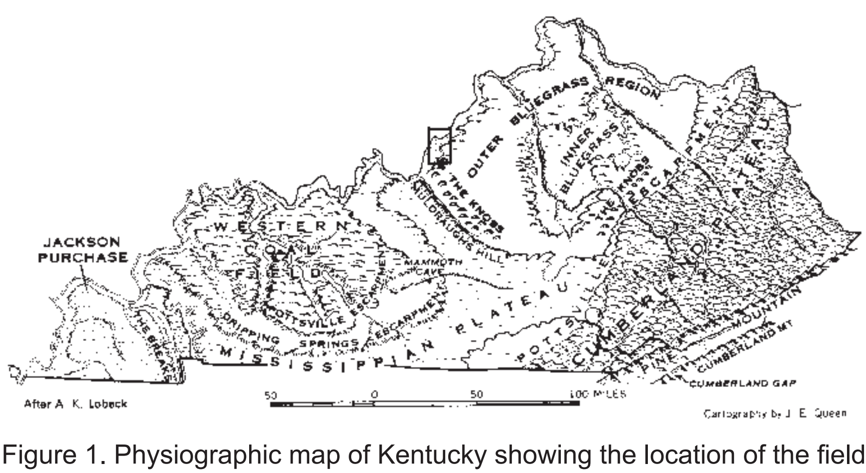

Figure 1. Physiographic map of Kentucky showing the location of the field trip area (box).

vided into approximately concentric Inner and Outer Bluegrass belts. The Inner Bluegrass is relatively flat-lying to gently rolling, and is the agriculturally richest part of the Lexington Plain. The area is underlain by soluble, phosphoritic, Middle Ordovician limestones of the Lexington Limestone (Fig. 2), which generate very fertile soils. The flat terrain and fertile soils make this an agriculturally prosperous region with large-scale tobacco farming and grazing, as well as the breeding and raising of horses. Karstic features are locally common, and the entire area may represent a karstic solutional plain. Many of the surface streams are entrenched in steep-walled valleys.

After exit 48 (Graefenburg), the Inner Bluegrass gives way to the Outer Bluegrass, an area of hummocky, irregularly rolling hills and low ridges underlain by Upper Ordovician shales and shaly limestones. In some sources, the Outer Bluegrass is divided into the Eden Belt and Outer Bluegrass proper. At this point on the Interstate, the route enters the Eden Belt, composed of Middle and Upper Ordovician shales with thin interbedded limestones, largely in the Clays Ferry Formation (Fig. 2). Because nonresistant shales predominate, rocks in the Eden Belt have been dissected into sharp, narrow ridgetops and steep-sided valleys. Because of steep slopes and poor, clayey soils, the area is not of major agricultural importance, except for grazing and

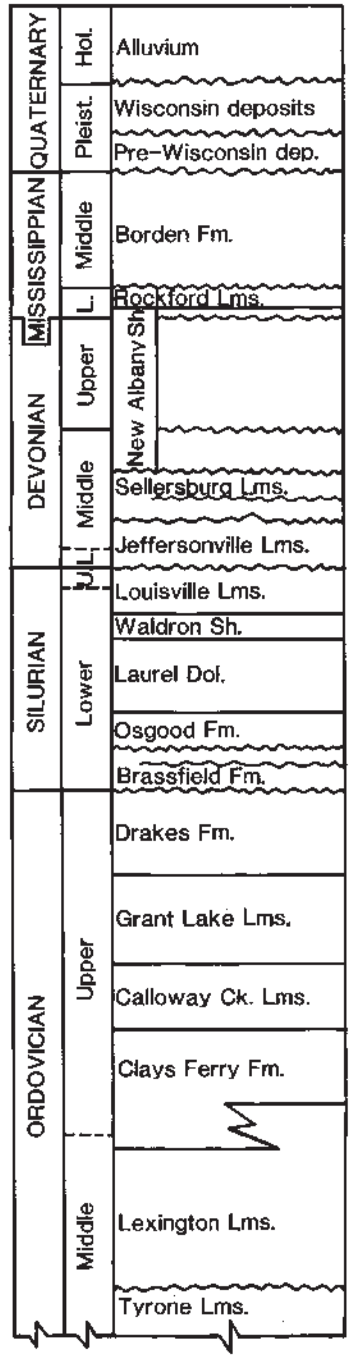

Figure 2. Generalized stratigraphy along the field trip route.

small-scale farming. Outside the Eden Belt is another belt called the Outer Bluegrass proper, or in this area, the Western Bluegrass. It is developed on Upper Ordovician limestones and interbedded shales of the Calloway Creek, Grant Lake, and Drakes formations, and on its extreme western margins may include Lower and Middle Silurian carbonates and shales as well as Middle Devonian carbonates (Fig. 2). Because carbonates are more abundant in this part of the section, and because this area was closer to the glacial front where outwash and loess were available to veneer the topography, the topography is not as steep as in the Eden Belt and the soils are more fertile. Hence, the farms are larger, and both cattle grazing and the growth of burley tobacco are major sources of income.

At 6.4 miles west of the Graefenburg exit, an unusually high knob and ridge system known as Jeptha Knob appears on the north side of the highway, with many antennas rising from its top; at about the same point, exposures along the westbound lane show complexly folded and faulted Ordovician rocks. Mapping shows that the folded and faulted area forms a circular structure called the Jeptha Knob cryptovolcanic structure (Cressman, 1975a, b), although Seeger (1968) has interpreted an origin by meteorite impact. The structure consists of an uplifted and topographically high central area composed of the Clays Ferry Formation, surrounded by a complexly faulted and folded marginal depression containing younger Upper Ordovician rocks (Cressman, 1975a). The youngest rocks involved in the deformation are part of the uppermost Ordovician formation in the area, the Drakes Formation (Fig. 2), and undeformed rocks of Early and Middle Silurian age unconformably overlie deformed Ordovician rocks (Cressman, 1975a). These stratigraphic relationships indicate that the impact was of Latest Ordovician or Earliest Silurian age and occurred during development of the regional Ordovician-Silurian unconformity. The preserved structure is approximately 3.2 miles in diameter, and the highway crosses the extreme southern edge of the marginal depression.

The Outer Bluegrass proper continues into the Louisville area, although the degree of dissection is greatly moderated by the more resistant Middle Silurian and Lower and Middle Devonian carbonates underlying the area, as well as by a veneer of Pleistocene outwash, eolian, and lacustrine deposits (Fig. 2). The city itself owes its presence to the Falls of the Ohio, a series of rapids created by a resistant, biostromal accumulation in the Lower to Middle Devonian Jeffersonville Limestone (Fig. 2) in the bed of the river, which will be the subject of stop 1. In the Falls area along a stretch of about 2 miles, the river drops 26 feet, which necessitated the offloading, transportation, and reloading of goods and travelers. At this point, Louisville sprang up to facilitate the servicing of travelers, as well as the transportation, storage, and redistribution of river goods; the city also became a shipping point for agricultural goods from the surrounding region.

Devonian Stratigraphy of the Falls of the Ohio Area

The Devonian rocks exposed in the field trip area include the Jeffersonville Limestone, the North Vernon Limestone, and the New Albany Shale, in ascending order (Droste and Shaver, 1986a–g) (Fig. 3). The Jeffersonville Limestone unconformably overlies Silurian strata, consisting of either the Louisville Limestone or Wabash Formation. The Louisville Limestone and Wabash Formation will not be stressed in this discussion. General stratigraphic information concerning these two units can be found in Shaver and others (1986).

The Jeffersonville Limestone (Emsian and Eifelian) was named by Kindle (1899) for the fossiliferous limestone exposures at the Falls of the Ohio near Jeffersonville, Ind. (stop 1). Since the completion of the dam and locks, however, most of this important outcrop has been permanently flooded. Bedrock is no longer exposed in the river bed at Jeffersonville, and the limestone bedrock ledges that are still accessible are entirely within the cities of Louisville, Ky., and Clarksville, Ind.

Numerous different stratigraphic workers have proposed numerous different zonal divisions of the Jeffersonville Limestone at the Falls of the Ohio (see, for example, Oliver, 1960; Perkins, 1963; Stumm, 1964; Conkin and Conkin, 1972, 1976). Of these, the informal five-fold zonation of Perkins (1963) remains the most widely used, paleontologically accurate, and sedimentologically meaningful.

Stratigraphic nomenclature for the Jeffersonville Limestone is complicated by some workers using the various fossil zones in combination with or in place of properly defined lithostratigraphic units such as the Vernon Fork and Geneva Dolomite Members. In most cases, the fossil zones were never intended to be used as formal stratigraphic units, and are not suggested to be so in this dis-

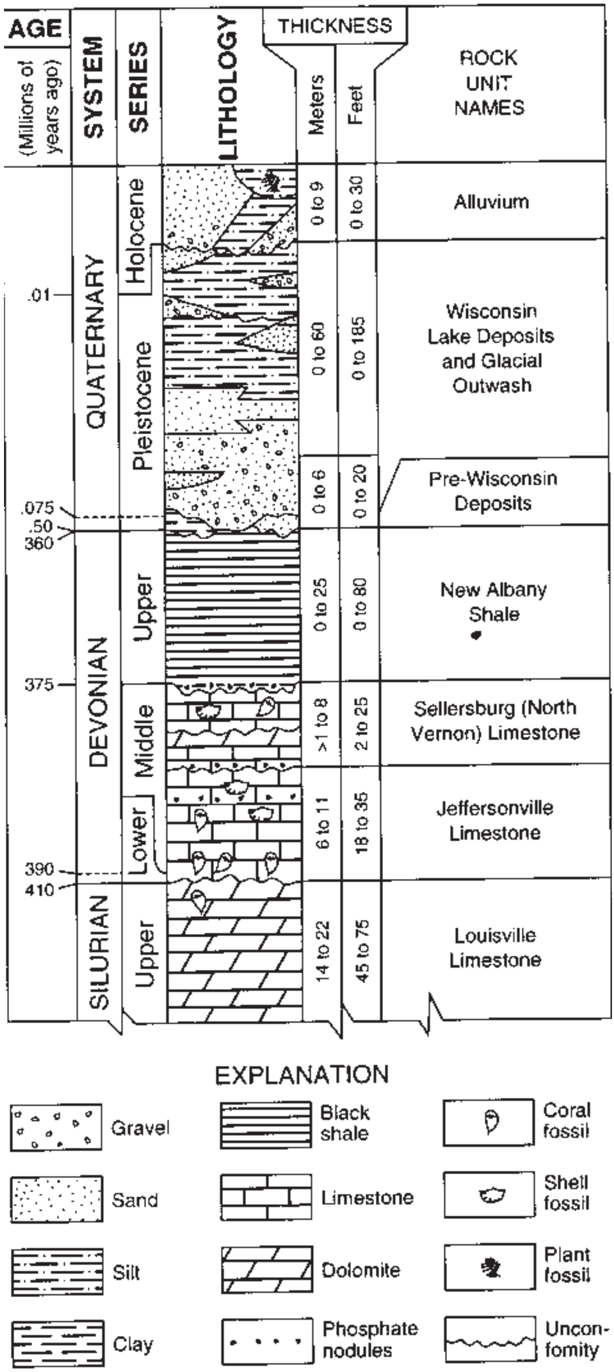

Figure 3. Stratigraphic column of rock units cropping out in the area of the Falls of the Ohio. From Greb and others (1993).

cussion. In fact, fossil zones cannot, by definition, be formal lithostratigraphic units. Formations and members are defined on the basis of distinctive lithologies, not faunal constituents. Therefore, the use of any of the various biozones of the Jeffersonville Limestone to delineate particular rock units should be abandoned, and lithostratigraphic members should be named. This action is yet to be taken, however. Therefore, Perkins' (1963) zonation of the Jeffersonville Limestone will reluctantly be used in this report.

In northern Kentucky and southern Indiana, the Jeffersonville Limestone includes a southern limestone facies and a northern dolostone and dolomitic limestone facies. The southern limestone facies comprises the five biozones of Perkins (1963) exposed at the Falls of the Ohio. These are the coral, *Amphipora ramosa*, *Brevispirifer gregarius*, fenestrate bryozoan-brachiopod, and *Paraspirifer acuminatus* zones, in ascending order. The northern dolomitic facies of the Jeffersonville Limestone includes the Geneva Dolomite Member, an unnamed member of dolostone and dolomitic limestone (approximately equivalent to the *Amphipora ramosa* zone), the Vernon Fork Member, and an upper cherty, fossiliferous limestone (the *Paraspirifer acuminatus* zone).

Coral zone strata are typically medium to dark gray and grayish-brown, abundantly fossiliferous limestones (Plate 2–Fig. 1). Packstones, grainstones, and rudstones are the predominant limestone textures. Solitary and colonial corals, mound-shaped stromatoporoids, and pelmatozoan debris are common to very abundant. Mat-shaped stromatoporoids, brachiopods, and bryozoans are much less common than in overlying zones.

The coral zone can be traced from outcrops a few miles south of Louisville northward to southern Jennings, Jackson, and Lawrence Counties in Indiana (Perkins, 1963). North of the outcrop area of rocks of the coral zone, the stratigraphic position between the Silurian Louisville and Wabash carbonates and the *Amphipora ramosa* zone of the Jeffersonville Limestone is occupied by the Geneva Dolomite Member.

At the Falls of the Ohio, *Amphipora ramosa*–zone rocks include abundantly fossiliferous, medium gray limestones; skeletal packstones and grainstones are the predominant textural types. The small, branching, cylindrical stromatoporoid *Amphipora ramosa* (Plate 5–Fig. 1), is common to abundant in these rocks, but recognition of the taxon is best accomplished in thin-section study. Although solitary and colonial corals are common in the *Amphipora* *ramosa* zone, such fossils are considerably less abundant than in the underlying coral zone. Mat-shaped, encrusting stromatoporoids abound, and probably acted locally as sediment-binding agents.

Amphipora ramosa–zone rocks are present throughout the southern Indiana area. North of the Falls of the Ohio, in Jennings County, Ind., diagenetically altered *Amphipora ramosa*–zone rocks overlie the Geneva Dolomite Member. Such strata commonly include light to medium grayish-brown, fossiliferous, partially sucrosic dolomitic limestones and calcareous dolostones. Packstones and wackestones are probably the dominant sedimentary textures, although recrystallization has obscured many fossils.

Brevispirifer gregarius–zone lithologies include medium gray, abundantly fossiliferous limestones (packstones and grainstones). In addition to containing vast numbers of the small spiriferid that gives the unit its name (Plate 8–Fig. 5), the *Brevispirifer gregarius* zone also contains abundant pelmatozoan debris, charophyte oogonia, and large snails. Corals are generally smaller and much less abundant than in the coral and *Amphipora ramosa* zones. Chert is a minor constituent in the *Brevispirifer gregarius* zone in southern Indiana, but to the north, in Scott County, Ind., the unit is quite cherty and argillaceous. The *Brevispirifer gregarius* zone pinches out rapidly north of Scottsburg, and its position is occupied by the lower part of the Vernon Fork Member.

Overlying the *Brevispirifer gregarius* zone, the fenestrate bryozoan–brachiopod zone comprises light grayish-brown, abundantly fossiliferous, carbonate packstones and grainstones with nodules and stringers of white chert near the base of the unit. Crinoids, blastoids, bryozoans, brachiopods, and corals are the predominant fossil constituents (Plates 9–10); *Atrypa*, strophomenids, and small spiriferids abound, but *Brevispirifer* and *Paraspirifer* are absent. The fenestrate bryozoan–brachiopod zone can be traced from the Falls of the Ohio north to Jennings County, Ind., where the unit is absent and its stratigraphic position is occupied by the upper part of the Vernon Fork Member of the Jeffersonville Limestone.

The *Paraspirifer acuminatus* zone was characterized by Perkins (1963) as being faunally and lithologically similar to the underlying fenestrate bryozoan-brachiopod zone, but with the addition of the large spiriferid *Paraspirifer acuminatus* (Plate 10–Figs. 3A, B). Like the latter unit, the former includes light grayish to yellowish-brown, fossiliferous bryozoan- and pelmatozoan-rich limestones. The *Paraspirifer acuminatus* zone is the most widespread of all the

Jeffersonville Limestone biozones recognized at the Falls of the Ohio, with similar lithologies present everywhere in the region.

The Geneva Dolomite was named by Collett (1882) as the Geneva Limestone for exposures along the Flatrock River near Geneva, Ind. Droste and Shaver (1975) concluded that the Geneva Dolomite is a northern facies of the lower Jeffersonville exposed at the Falls of the Ohio, and subsequently lowered the Geneva from formation to member rank, assigning the member to the Jeffersonville Limestone.

The Geneva Dolomite Member includes light grayish-brown to chocolate-brown (often laminated and banded dark brown), finely to moderately crystalline, porous, variably fossiliferous dolostones. Original depositional textures are generally obscured by diagenesis. Beds are generally massive in the lower part of the Geneva and thinner bedded in the upper part. Fossils in the area are common to abundant, but are preserved as internal casts and molds. Often, recrystallization has further obscured morphological features. Thus, taxonomically important characteristics are typically absent. Fossils include abundant solitary and colonial corals and stromatoporoids. White to light yellowish-brown calcite masses and crystals commonly fill vugs and fossil molds. Bands and nodules of light-colored chert are present in Jennings County, Ind.; fossil preservation is typically better in the cherts than in the dolostones.

The dark brown color, laminations, and color banding of the Geneva Dolomite are the result of the presence of heavy hydrocarbons (Leninger, 1955). In fresh exposures, the Geneva is typically dark chocolate brown, but the organic residue rapidly oxidizes, and weathered outcrops are light yellowish-brown, light gray, or white.

Texturally, the Geneva Dolomite resembles the Jeffersonville Limestone coral zone exposed at the Falls of the Ohio. Both units include dark brown, carbonaceous lithologies with abundant corals and stromatoporoids. Fossils in these units are quite similar, although specific identification of Geneva corals and stromatoporoids is complicated by the lack of internal structures. The rostroconch *Hippocardia cunea* (Plate 5–Figs. 3A, B) is common at the Falls of the Ohio, and is the most easily recognized fossil in the Geneva Dolomite Member. Furthermore, moldic specimens of *Amphipora ramosa* are abundant in the uppermost bed of the Geneva Dolomite Member at North Vernon. This bed is immediately subjacent to the lighter-colored dolomitic limestone identified as the *Amphipora ramosa* zone by Perkins (1963) and Droste and Shaver (1975).

The faunal and lithologic evidence supports the view of a Geneva-Jeffersonville facies relationship. Moreover, the lithologic differences between the Geneva and lower Jeffersonville rocks at the Falls of the Ohio are rooted predominantly in diagenetic processes rather than depositional or temporal variations.

The Vernon Fork Member of the Jeffersonville Limestone was named by Droste and Shaver (1975) for exposures in the area of the Vernon Fork of the Muscatatuck River near North Vernon, Ind. Prior to that time, the unit was generally called the "laminated beds" of the Jeffersonville Limestone. The Berry Materials Quarry at North Vernon was named the principal reference section for the Vernon Fork Member. In this section, Vernon Fork rocks overlie the *Amphipora ramosa* zone and underlie the *Paraspirifer acuminatus* zone. Detailed sedimentology and petrography of the "laminated beds" were done by Perkins (1963).

Vernon Fork lithologies include laminated, commonly brecciated, unfossiliferous dolomitic mudstones with mudcracks, flat pebble conglomerates, and relict evaporites. Unfossiliferous, bioturbated, dolomitic mudstones are also present.

Perkins (1963) noted a rough correlation between the distribution of the Vernon Fork Member ("laminated beds") and the Geneva Dolomite in Indiana, which he attributed to shallower water having been present over the preexisting "Geneva Platform." Later, Droste and Shaver (1975) recognized the correlation of the Geneva Dolomite and lower Jeffersonville Limestone, and stated that Geneva sediments were most likely dolomitized by hypersaline fluids during deposition of the Vernon Fork Member. The presence of relict evaporites in the Vernon Fork Member strengthens this interpretation, because evaporite precipitation follows dolomite formation in modern Persian Gulf sabkhas (Muller and others, 1990).

The Vernon Fork Member is laterally continuous with part or all of the *Amphipora ramosa, Brevispirifer gregarius,* and fenestrate bryozoan–brachiopod zones at the Falls of the Ohio. The Vernon Fork Member is present north of southern Jennings County, Ind. For a more complete discussion of Vernon Fork and Jeffersonville lithologies, see Droste and Shaver (1975) and Perkins (1963).

The North Vernon Limestone (Eifelian and Givetian) was named by Borden (1876) for blue and gray limestones exposed between the "Corniferous" (Jeffersonville) Limestone and the New Albany

Shale near North Vernon, Ind. The North Vernon Limestone is synonymous with the Sellersburg Limestone of Kentucky usage, and comprises the Speed, Silver Creek, and Beechwood Members. In the area, the North Vernon Limestone unconformably overlies the Jeffersonville Limestone and is unconformably overlain by the New Albany Shale. The Beechwood Member itself unconformably overlies the other North Vernon rocks in the area.

The Speed Member (Eifelian) of the North Vernon Limestone was first named the “Speeds Limestone” by Sutton and Sutton (1937) for exposures in Speed’s Quarry near Sellersburg, Ind. Speed lithologies include thin-bedded, argillaceous, bioclastic, crinoid-, brachiopod-, and bryozoan-rich limestone, predominantly of packstone texture. The Speed is not present at the Falls of the Ohio, presumably because of nondeposition of the Speed lithology (Droste and Shaver, 1986f). In the region, the unit is generally less than 5 feet thick.

The Silver Creek Limestone (Eifelian) was named by Siebenthal (1901) for exposures along Silver Creek near the Falls of the Ohio. The Silver Creek Member possesses two basic lithologies: a lower, massive, bioturbated, variably fossiliferous, argillaceous, dolomitic lime mudstone with wackestone and packstone layers, and an upper unit that closely resembles the lower lithology, but with the addition of abundant chert nodules and stringers. Fossils include locally abundant brachiopods, corals, and trilobites. The Silver Creek and Speed Members possess a facies relationship and are gradational and conformable where both are seen in the same exposure (Droste and Shaver, 1986e). The Silver Creek is thickest in central Clark County, Indiana, where sections as thick as 26 feet are present (Whitlatch and Huddle, 1932). The unit thins to the north as the Speed Member thickens, and no significant thickness of Silver Creek is present north of southern Scott County, Indiana. However, lithologically similar beds are present in the Speed Member (Droste and Shaver, 1986e).

The Beechwood Member (Givetian) (Butts, 1915) was named for outcrops in the area of Beechwood Station in Jefferson County, Ky. The Beechwood unconformably overlies various older rocks. Regionally, these include only the Silver Creek and Speed Members of the North Vernon Limestone. The Beechwood is typically an abundantly fossiliferous, usually light-colored, bioclastic (crinoidal) limestone, although glauconitic lithologies exist. The base of the Beechwood is commonly marked by a prominent lag zone with quartz sand, phosphatic nodules, and fish bone fragments (Plate 12–Fig. 5). Fossils include abundant pelmatozoan debris, corals, bryozoans, and trilobites. Some small-scale crossbedding is present in the Scott County Stone Company Quarry. The Beechwood Member is the most widespread Devonian carbonate unit in southeastern Indiana and adjacent Kentucky, nearly everywhere underlying the New Albany Shale.

Stop 1: Falls of the Ohio

Stop Description

Nowhere on earth are fossiliferous rocks of Middle Devonian age as well exposed and as easily accessed as at the Falls of the Ohio. For nearly two centuries, this outcrop has been visited by countless professional and amateur paleontologists who have come to observe, collect, and describe the noteworthy fossil communities exposed in the Devonian limestones (Fig. 3) at the Falls.

Since 1820, some 600 species of fossils (including corals, stromatoporoids, brachiopods, crinoids, and other marine invertebrates) have been reported from the Falls. Stumm (1964), in the most thorough study to date of Falls of the Ohio paleontology, determined, however, that approximately two-thirds of the coral species are taxonomically redundant and therefore invalid. Nevertheless, over 200 species of fossils from a single locality is an impressive number.

Although the various fossil species found at the Falls can be found in many areas of North America, nowhere is their vertical and lateral context in the rock layers as easily observed. The vast area of the Falls and the predominantly bedding-plane exposures allow the observation of millions of individual fossil specimens. The fossil communities at the Falls are preserved virtually in situ, allowing rare insights into the paleoecological interactions of the residents of Devonian seas (see Kissling and Lineback, 1967). Cumulatively, these factors make the Falls of the Ohio a paleoecological resource that remains largely untapped.

Origin of the Falls of the Ohio

The Falls of the Ohio is not actually a waterfall as the name implies, but a limestone bedrock ridge that extends across the channel of the Ohio River between Louisville, Ky., and Clarksville and Jeffersonville, Ind. This bedrock ridge formed a series of natural rapids across the river channel prior to the completion of McAlpine Dam and Locks. For many years, the rapids at the Falls of the Ohio were the only natural barrier to navigation along the entire 981-mile route of the Ohio River. In fact, the principal reason the Louisville area was initially settled was because the rapids at the Falls forced boats to unload cargo and passengers. In modern times, the completion of the canal and locks has allowed more cargo to pass through McAlpine Dam than through the Panama Canal (Powell, 1970).

During the Pleistocene, intense floods of glacial meltwater repeatedly scoured the Ohio River Valley and subsequently filled it with glacial outwash and fluvial and lacustrine deposits. Time and again, the river meandered in its valley, cutting new channels while eroding preexisting sediments and bedrock. The limestone bedrock ridge that now forms the rapids at the Falls of the Ohio was probably created by these episodes of meltwater erosion, valley filling, and river meandering.

At the end of the Wisconsinan glacial interval, the limestone bedrock ridge at the Falls was buried by unconsolidated sediments (predominantly glacial outwash). The Ohio River later meandered to a position overlying the ridge. In time, the river cut through the unconsolidated sediments, exhuming the limestone bedrock ridge and its remarkable fossils.

Since the Ohio River began cutting a new channel overlying the limestone bedrock ridge at the Falls, approximately 50 feet of unconsolidated sediment and from 10 to 20 feet of bedrock has been removed (Powell, 1970). In fact, the erosional processes that first formed the Falls of the Ohio are continuously contributing to its destruction.

Strata in northwestern Kentucky and adjacent Indiana generally dip a few feet per mile to the west. Strata in the northwestern part of the Falls of the Ohio (downstream from the mouth of Cane Run Creek) dip to the northwest, however, while strata in the eastern part of the Falls (adjacent to the Pennsylvania Railroad Bridge) dip to the southeast. For this reason, Kepferle (1974) mapped an anticline in the Ohio River at the Falls (see Fig. 4). Because of this structure, the Louisville Limestone (the lowest strata exposed at the Falls at low water) can be seen only in the central area of the fossil beds at the Falls of the Ohio.

The bedrock exposed at the Falls of the Ohio (including the outcrop just west of the mouth of Cane Run Creek) encompass-

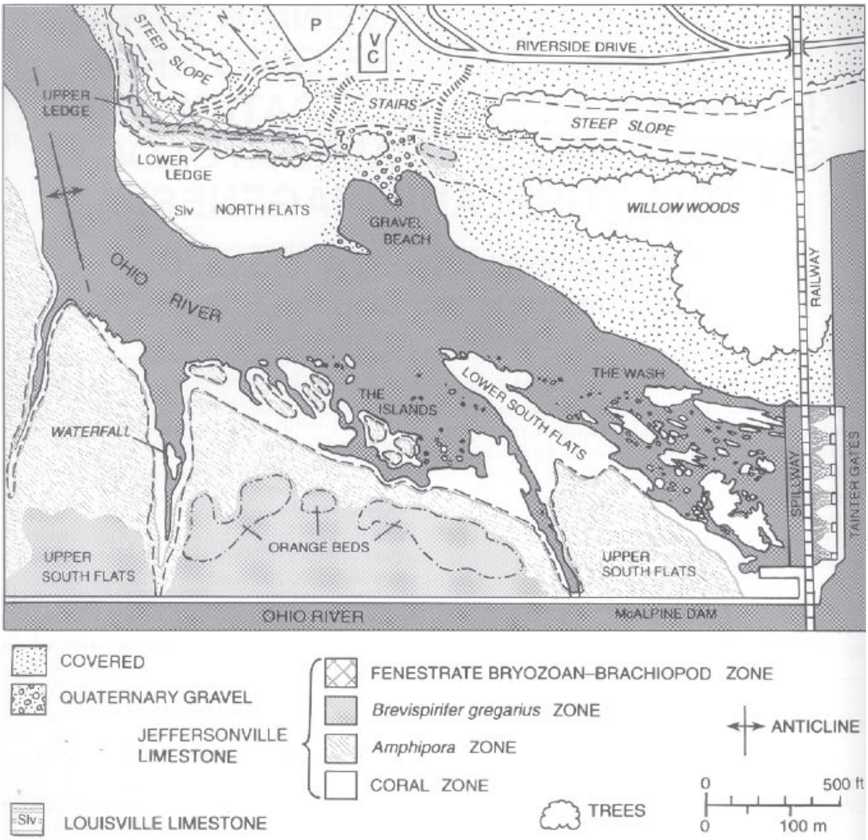

Figure 4. Geologic map of the Falls of the Ohio showing the areas of outcrop of the various rock units described in the text. From Greb and others (1993).

es approximately 1 foot of Louisville Limestone, a complete (35 feet thick) section of Jeffersonville Limestone, and a thin, largely covered section of the Silver Creek Member of the North Vernon Limestone. Unconsolidated sand, silt, and gravel (predominantly Quaternary outwash and alluvial sediments) are also present at the Falls. The Upper Jeffersonville *(Paraspirifer acuminatus* zone) and Silver Creek Member are exposed only along the bluff overlooking the Ohio River downstream from the mouth of Cane Run Creek. Because of limited accessibility, the Cane Run exposures will not be visited.

The Louisville Limestone is exposed at the Falls of the Ohio only during periods of low water, usually during the summer and fall. Generally, the Louisville is best exposed along the northwestern margin of the North Flats (see Fig. 4). In the fall of 1988, the upper foot of the Louisville was well exposed in the river bed downstream from the mouth of Cane Run Creek. Fossils common in the Louisville at the Falls of the Ohio include chain corals *(Halysites, Cystihatysites,* and *Quepora),* tabulate corals *(Helioiites),* and small mound-shaped stromatoporoids.

The coral zone of the Jeffersonville Limestone (9.9 feet thick) unconformably overlies the Louisville Limestone at the Falls. Coral-zone faunas are dominated by abundant and diverse solitary and colonial corals and mat- and mound-shaped stromatoporoids (Plates 2–4).

Numerous workers (e.g., Conkin and Conkin, 1980) have termed the fossil beds in the Jeffersonville at the Falls of the Ohio a fossil coral reef. No organically bound, wave-resistant, topographically significant composite fossil structure has been reported in the bedrock at the Falls or anywhere else in Jeffersonville exposures, however. (A few small bioherms, predominantly *Emmonsia* coral colonies, up to 10 feet in diameter and from 4 to 5 feet in height, are present at the Falls and in quarries to the north.) Sediment binding, with consequent biostrome formation, was accomplished to some degree by mat-shaped stromatoporoids, but no wave-resistant structures resulted. Coral zone communities are more accurately described as representing coral-stromatoporoid level-bottom fossil communities.

Solitary corals are most abundant in the upper part of the coral zone at the Falls. In the North Flats and Lower South Flats (Fig. 2), the upper coral zone is a dark, carbonaceous rudstone (Plate 2–Fig. 1) with many large rugose corals. Among these is *Siphonophrentis elongata* (also called *S. gigantea),* which attains lengths of 4 feet (Perkins, 1963). Many of the larger rugosans in the Jeffersonville assumed a curved growth habit. We presume the coral attached itself to an object such as a shell or another coral as a juvenile and later toppled over when it had outgrown its base. The animal was then forced to grow upward, forming a curved corallum (Thompson, 1982).

The *Amphipora ramosa* zone contains abundant small, branching stromatoporoids *(Amphipora),* mat-shaped stromatoporoids, mound-shaped and branching colonial corals, and rugose corals (Plate 5). The *Amphipora ramosa* zone is best exposed in the Lower Ledge in the northern fossil beds and in the Upper South Flats and Islands areas in the southern fossil beds (Fig. 4). Solution cavities have developed in the Islands area of the Lower South Flats, and silicified corals and stromatoporoids stand in relief on the walls.

The *Brevispirifer gregarius* zone (4.5 feet thick) contains very abundant *Brevispirifer*, large snails *(Turbonopsis shumardi),* colonial corals *(Favosites*, *Prismatophyllum),* solitary corals *(Zaphrenthis*, *Heterophrentis),* charophyte oogonia, and crinoid debris (Plates 6–8).

Hundreds of large *Turbonopsis* snails are preserved in the *Brevispirifer* zone; specimens are abundant in the silicified Orange Beds at the southern Falls (Fig. 4). Often, silicified specimens are preserved as internal molds encrusted by quartz. Other specimens of *Turbonopsis* are found encrusted by stromatoporoids (Plate 7–Figs. 2A–B); usually, the entire upper surface of the snail shell was covered, but the aperture of the shell was not. This association may have occurred while the snail was living, and perhaps offered protective camouflage for the gastropod.

The uppermost Jeffersonville zone we will see at the main body of the Falls of the Ohio is the fenestrate bryozoan–brachiopod zone (6.3 feet thick). The unit is best exposed in the wooded area of the Upper Ledge (Fig. 4). Layers of white chert mark the base of the unit. Predominant faunal elements include pelmatozoans, fenestrate bryozoans, and brachiopods (mostly *Atrypa,* spiriferids, and strophomenids) (Plates 9–10). Large colonies of the rugose coral *Eridophyllum* are present in this unit. Such colonies are asymmetrical, and individual corallites tend to lean to the south (Plate 10–Fig. 1). The predominant current or wave direction during Jeffersonville deposition is presumed to be from south to north (Perkins, 1963). The south-facing corallites were better oriented to catch prey brought in by tides from the open seas to the south. *Brevispirifer gregarius*–zone and fenestrate bryozoan-brachiopod–zone rocks grade northward into the laminated, mudcracked dolostones of the Vernon Fork Member, indicating that tidal flats and possibly even sabkhas were several tens of miles to the north. More open-marine conditions probably prevailed south and west of the Falls.

Overlying the bedrock in the Falls area is some 50 feet of unconsolidated sand, silt, and gravel. These sediments are principally glacial outwash and alluvial deposits (Powell, 1970; Kepferle, 1974). Large erratics, some up to 5 feet across, are found at the Falls of the Ohio (Fig. 5). Several sand and gravel pits operate in the area, and numerous bones of Pleistocene vertebrates, including mammoths, have been unearthed in such pits (Fig. 6).

Figure 5. Large sandstone erratic at the Falls of the Ohio. Hammer for scale.

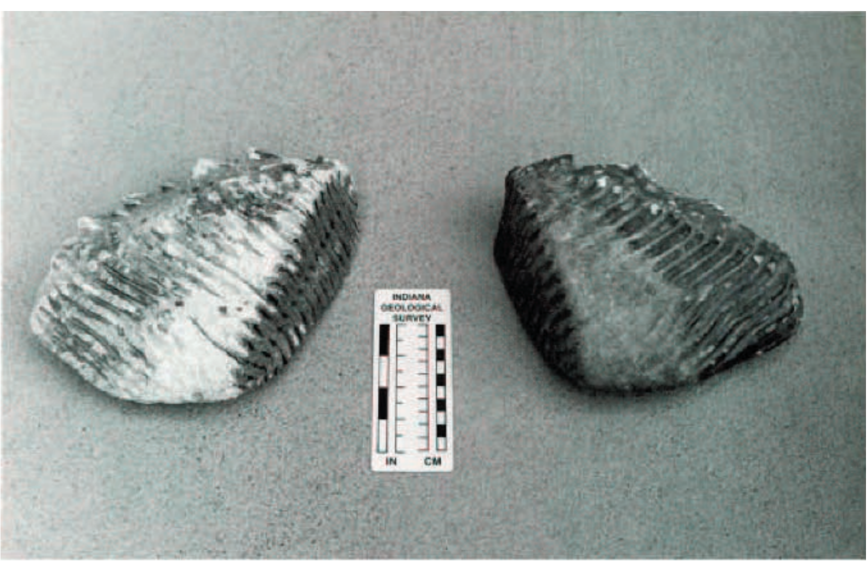

Figure 6. Mammoth teeth unearthed from Pleistocene deposits by quarrymen in Utica, Ind.

Acknowledgements

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Plate 1

Representative fossils of the Louisville Limestone and Wabash Formation (all figures X 0.65 unless otherwise noted).

Figure

1. *Entelophyllum eruciforme.* Side view of silicified colony acidized from matrix. Riprap along floodwall. Louisville Limestone or Wabash Formation. Clarksville, Ind.
2. *Arachnophyllum striatum.* Top view of part of a large colony. Louisville Limestone. Charlestown, Ind.
3. *Heliolites spongiosus.* Top view of colony. Louisville Limestone. Falls of the Ohio.
4. *Quepora huronensis.* Top view of silicified colony, acidized from matrix. Differs from other common genera, *Halysites* and *Cystihalysites* (also found in the Falls of the Ohio area), in lacking mesocorallites and septal spines. Louisville Limestone. Falls of the Ohio.
5. *Astylospongia* sp. (A) Side and (B) top views. Louisville Limestone. Falls of the Ohio.

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PLATE 1

Plate 2

Representative fossils of the Jeffersonville Limestone coral zone (all figures X 0.65 unless otherwise noted).

Figure

1. Sawed slab of carbonaceous limestone containing various rugose and tabulate corals, including *Cystiphylloides* and *Thamnopora.* Upper part of coral zone. Jeffersonville, Ind.
2. *Thamnopora limitaris.* In bedrock. Lower foot of coral zone, in bed of Ohio River, downstream from Cane Run Creek. Clarksville, Ind.
3. *Siphonophrentis elongata.* Side view of large corallum (X 0.39). Specimens of this species up to 4 feet in length and 4 inches in diameter are exposed at the Falls of the Ohio. Lower foot of coral zone, Falls of the Ohio.
4. *Thamnopora limitaris.* Silicified specimen acidized from matrix. Lower foot of coral zone, in bed of Ohio River, downstream from Cane Run Creek. Clarksville, Ind.

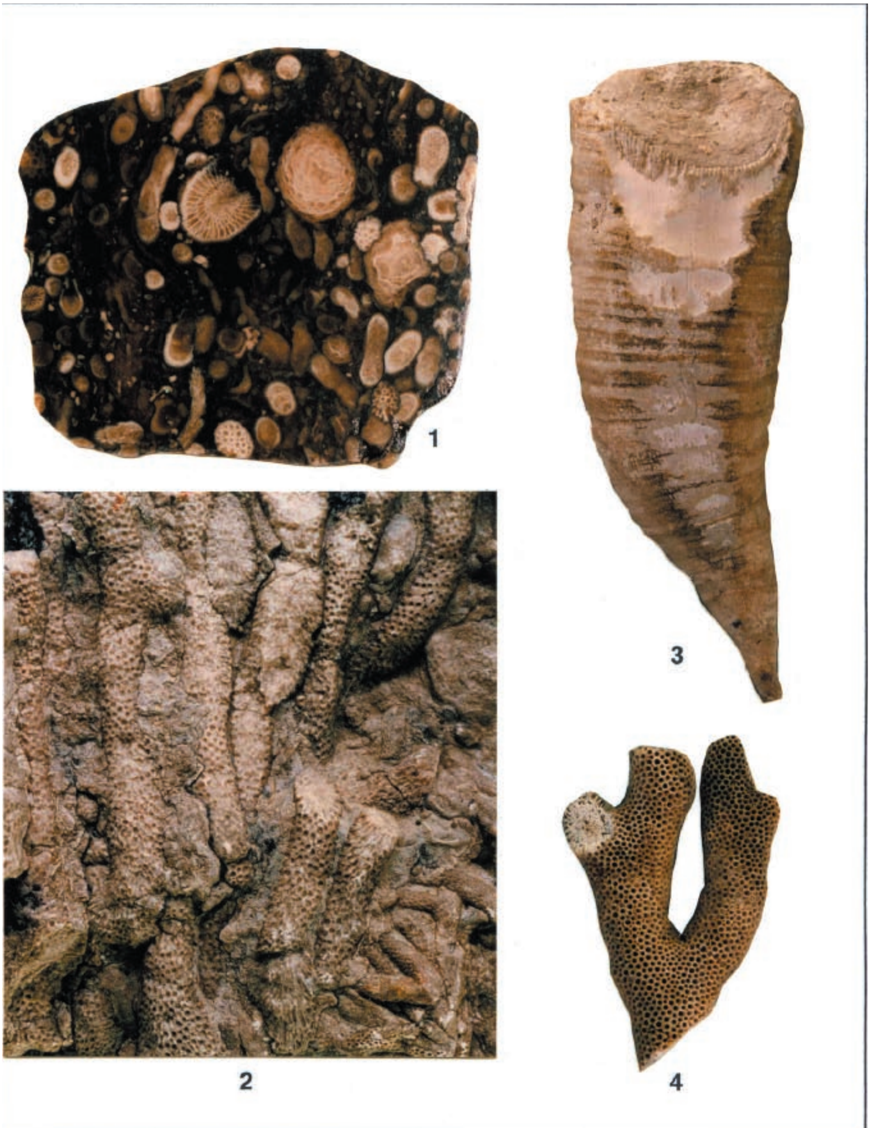

PLATE 2

Plate 3

Representative fossils of the Jeffersonville Limestone coral zone (all figures X 0.65 unless otherwise noted).

Figure

1. *Aulacophyllum perlamellosum.* (A) Top and (B) side views. Lower foot of coral zone, in bed of Ohio River, downstream from Cane Run Creek. Clarksville, Ind.
2. *Heterophrentis* sp.(?). Side view of silicified specimen. Lower foot of coral zone, in bed of Ohio River, downstream from Cane Run Creek. Clarksville, Ind.
3. *Scenophyllum conigerum.* Side view. Lower foot of coral zone, in bed of Ohio River, downstream from Cane Run Creek. Clarksville, Ind.
4. *Acrophyllum* sp. Side view. Lower foot of coral zone, in bed of Ohio River, downstream from Cane Run Creek. Clarksville, Ind.

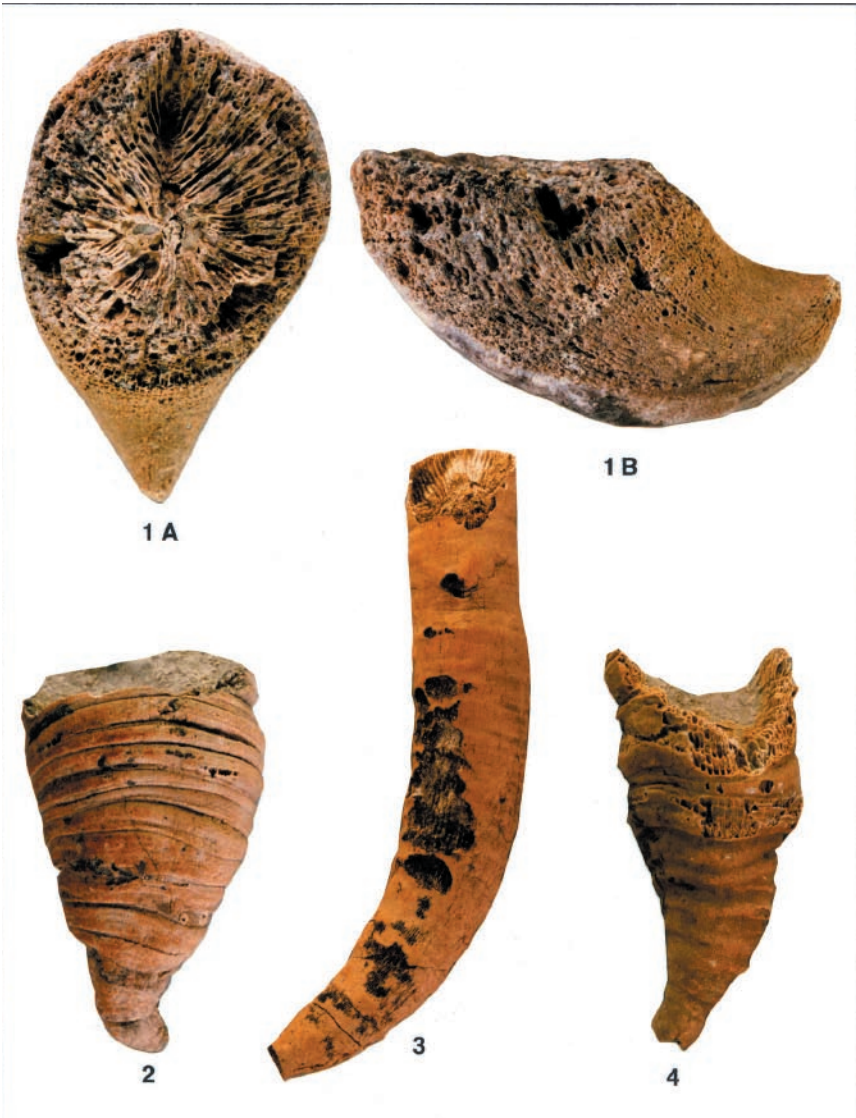

PLATE 3

Plate 4

Representative fossils of the Jeffersonville Limestone coral zone.

Figure

1. *Alveolites winchellana.* (A) Side view of silicified partial colony acidized from matrix (X 0.39). (B) Close-up of surface of colony (X 1.3). Lower foot of coral zone, in bed of Ohio River, downstream from Cane Run Creek. Clarksville, Ind.
2. *Emmonsia tuberosa.* View of specimens in bedrock with silicified rinds and calcareous centers. Lower foot of coral zone. Falls of the Ohio. Scale: 5.75 inches.
3. *Emmonsia emmonsi.* Fragment of broken colony showing prismatic corallites and mural pores (X 0.65). Upper coral zone. Scottsburg, Ind.

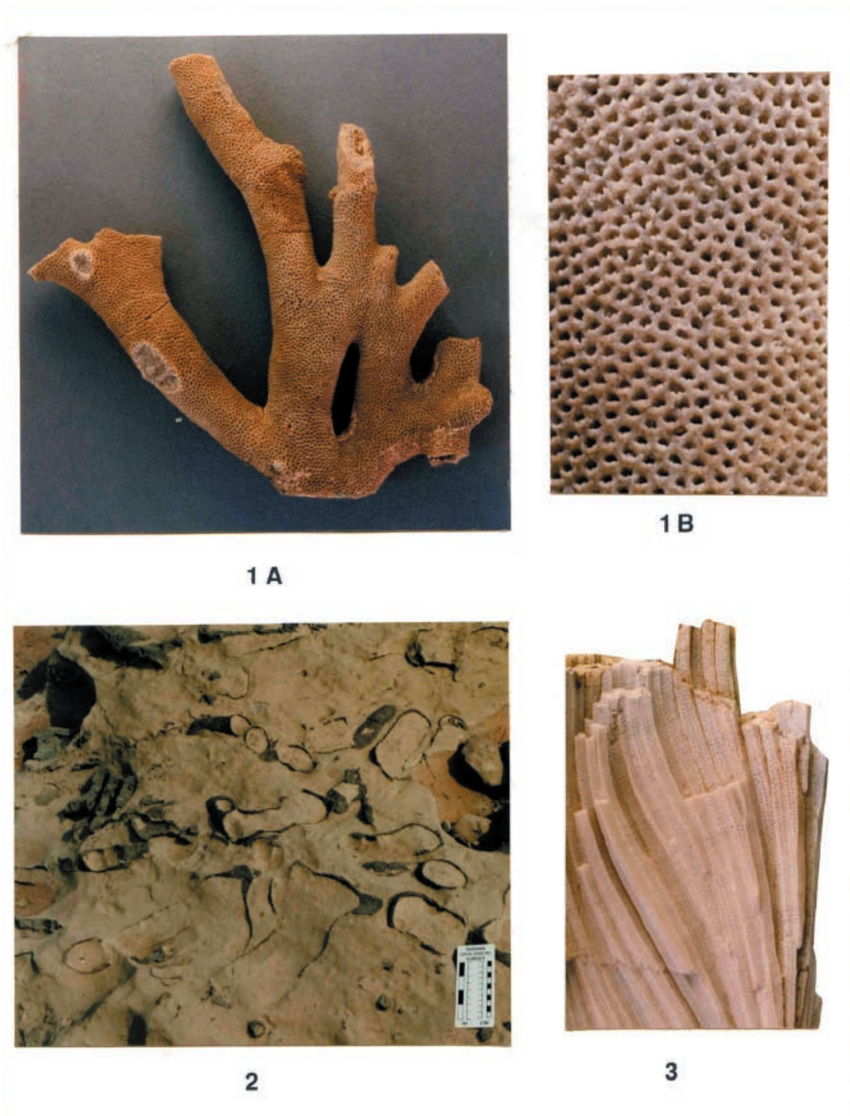

PLATE 4

Plate 5

Representative fossils of the Jeffersonville Limestone *Amphipora ramosa* zone (all figures X 0.65 unless otherwise noted).

Figure

1. *Amphipora ramosa* with branching tabulates in bedrock. Falls of the Ohio.
2. Conical stromatoporoid. Although not as abundant as moundlike or matlike forms, conical stromatoporoids, some up to 1 foot in height, are common in the *Amphipora ramosa* zone. Falls of the Ohio.
3. *Hippocardia cunea.* (A) Top and (B) side views. Commonly identified as *Conocardium,* this rostroconch is present in most Jeffersonville zones. Jeffersonville, Ind.
4. *Pleurodictyum cylindricum.* Top view of weathered colony (X 0.52). Upper *Amphipora ramosa* zone. Falls of the Ohio.

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PLATE 5

Plate 6

Representative fossils of the Jeffersonville Limestone *Brevispirifer gregarius* zone (all figures X 0.65 unless otherwise noted).

Figure

1. *Favosites turbinatus.* Basal view of colony showing characteristic wrinkled appearance (X 0.39). Upper foot of the *Brevispirifer gregarius* zone. Falls of the Ohio.
2. *Favosites turbinatus.* Side view of small specimen showing turbinate shape. Upper foot of the *Brevispirifer gregarius* zone. Falls of the Ohio.
3. *Zaphrenthis phrygia.* Various views of silicified specimens weathered from matrix. Upper foot of the *Brevispirifer gregarius* zone. Falls of the Ohio.
4. *Favosites turbinatus.* Internal view of weathered specimen showing radiating form of corallites (X 1.3). Upper foot of the *Brevispirifer gregarius* zone. Falls of the Ohio.
5. *Striatopora cavernosa.* Side view of fragment of branch. Upper foot of the *Brevispirifer gregarius* zone. Falls of the Ohio.

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PLATE 6

Plate 7

Representative fossils of the Jeffersonville Limestone *Brevispirifer gregarius* zone (all figures X 0.65 unless otherwise noted).

Figure

1. *Turbonopsis shumardi.* Apical view. Falls of the Ohio.
2. Stromatoporoid encrusting *Turbonopsis shumardi* snail. (A) Top and (B) basal views. Falls of the Ohio.
3. *Chonostegites tabulatus* encrusting *Heterophrentis duplicata.* (A) Side and (B) top views. Falls of the Ohio.
4. Stromatoporoid encrusting *Prismatophyllum* coral. Top view (X 0.39). Falls of the Ohio.

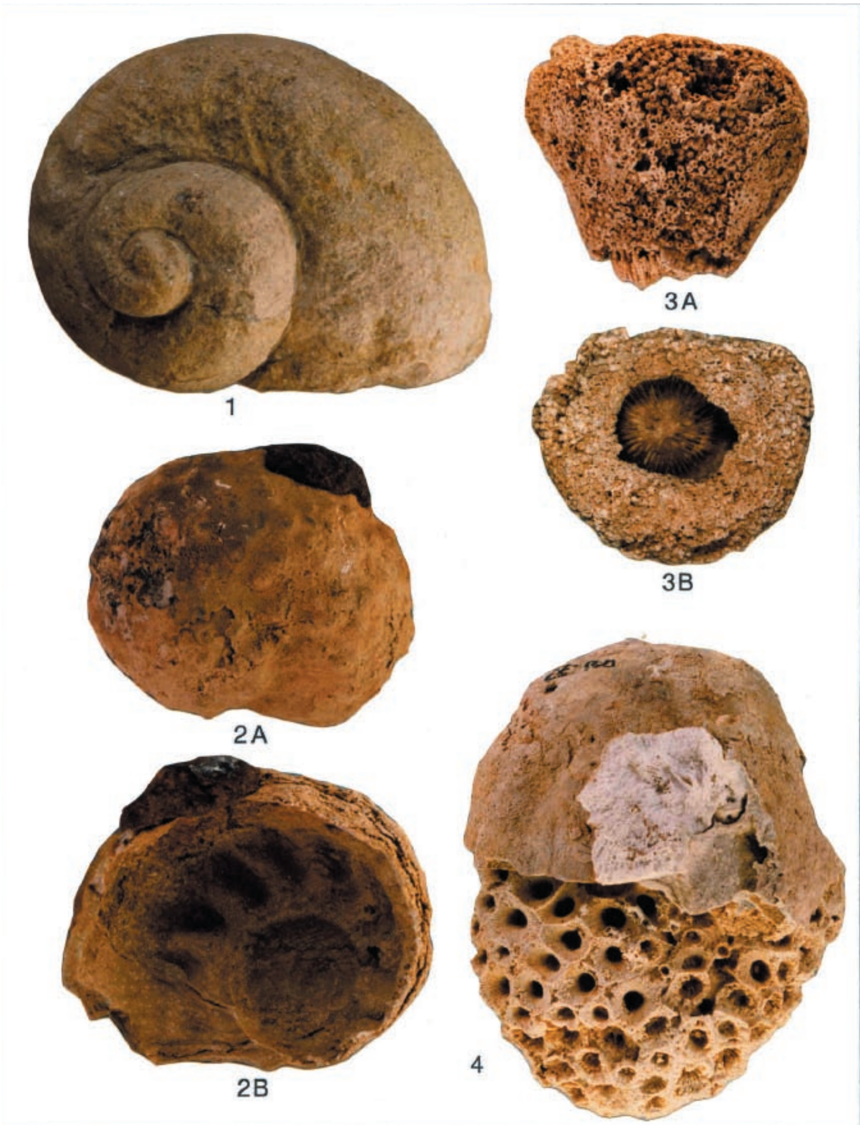

PLATE 7

Plate 8

Representative fossils of the Jeffersonville Limestone *Brevispirifer gregarius* zone (all figures X 0.65 unless otherwise noted).

Figure

1. Crystalline molds of unidentified clams. Upper foot of *Brevispirifer gregarius* zone. Falls of the Ohio. Scale: 5.75 inches.
2. Unidentified crinoid. Middle *Brevispirifer gregarius* zone. Charlestown, Ind.
3. Mound-shaped stromatoporoid. Side view (X 0.52). Upper *Brevispirifer gregarius* zone. Charlestown, Ind.
4. *Stropheodonta* sp. Pedicle view. Upper *Brevispirifer gregarius* zone. Falls of the Ohio.
5. *Brevispirifer gregarius.* Various views. Location uncertain.

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PLATE 8

Plate 9

Representative fossils of the Jeffersonville Limestone fenestrate bryozoan–brachiopod and *Paraspirifer acuminatus* zones (all figures X 0.65 unless otherwise noted).

Figure

1. *Siphonophrentis elongata.* (A) Side and (B) top views of a large broken specimen. Fenestrate bryozoan–brachiopod zone. Falls of the Ohio.
2. Fenestrate bryozoan. Side view of broken colony. Fenestrate bryozoan–brachiopod zone. Falls of the Ohio.
3. *Platyceras dumosum.* Side view. In life, the surface of the snail's shell was covered with hollow spines. Fenestrate bryozoan–brachiopod zone. Falls of the Ohio.
4. *Dolatocrinus lacus.* (A) Top, (B) basal, and (C) side views. Fenestrate bryozoan–brachiopod zone. Falls of the Ohio.
5. *Coronura aspectans.* Ventral view of partial pygidium. Fenestrate bryozoan–brachiopod zone. Falls of the Ohio.
6. *Elaeacrinus verneuili.* Various views of three specimens. Fenestrate bryozoan–brachiopod zone and *Paraspirifer acuminatus* zone. Falls of the Ohio.

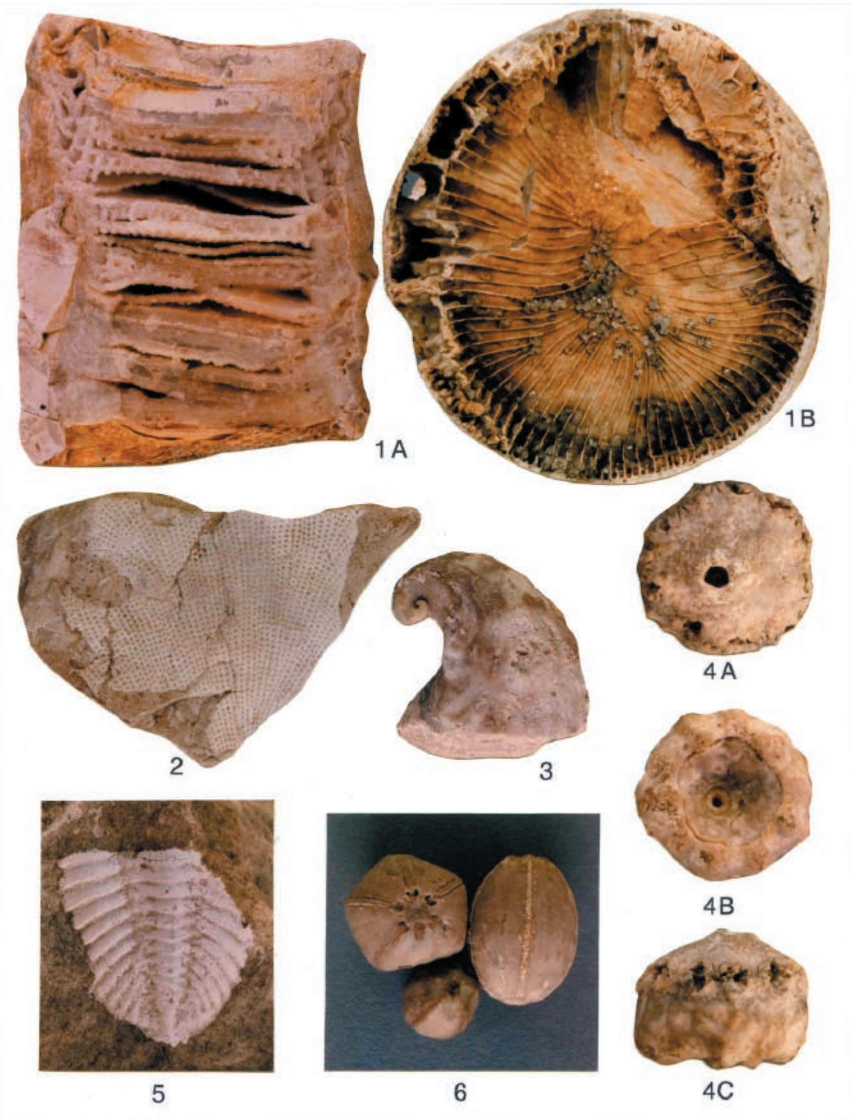

PLATE 9

Plate 10

Representative fossils of the Jeffersonville Limestone fenestrate bryozoan–brachiopod and *Paraspirifer acuminatus* zones (all figures X 0.65 unless otherwise noted).

Figure

1. *Eridophyllum* sp. Colony in bedrock. Pocket knife is 4 inches long. Fenestrate bryozoan–brachiopod zone. Falls of the Ohio.
2. *Stropheodonta* sp. Brachial valve interior. Fenestrate bryozoan–brachiopod zone. Falls of the Ohio.
3. *Paraspirifer acuminatus.* (A) Posterior and (B) anterior views. *Paraspirifer acuminatus* zone. Scottsburg, Ind.

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PLATE 10

Plate 11

Representative fossils of the North Vernon Limestone (all figures X 0.65 unless otherwise noted).

Figure

1. *Spinocyrtia (Platyrachella) oweni.* (A) Pedicle and (B) brachial views. Silver Creek Member. Jeffersonville, Ind.
2. *Spinocyrtia euruteines.* (A) Pedicle and (B) brachial views. Silver Creek Member. Jeffersonville, Ind.
3. *Atrypa* sp. (A) Brachial and (B) pedicle views. Silver Creek Member. Jeffersonville, Ind.
4. *Trachypora* sp. Side view of fragment of colony. Silver Creek Member. Jeffersonville, Ind.
5. *Spinocyrtia (Platyrachella) oweni.* Broken specimen, showing silicified spires. Silver Creek Member. Jeffersonville, Ind.
6. *Paracyclas elliptica.* View of silicified specimen. Silver Creek Member. Jeffersonville, Ind.
7. *Athyris* sp. Brachial view. Speed Member. Sellersburg, Ind.
8. *Phacops rana.* Dorsal view of complete specimen (X 0.78). Speed Member. Sellersburg, Ind.
9. *Phacops rana.* Dorsal view of complete, enrolled, silicified specimen (X 0.78). Silver Creek Member. Jeffersonville, Ind.
10. *Hadrophyllum orbignyi.* Top and bottom views. Speed Member. Charlestown, Ind.

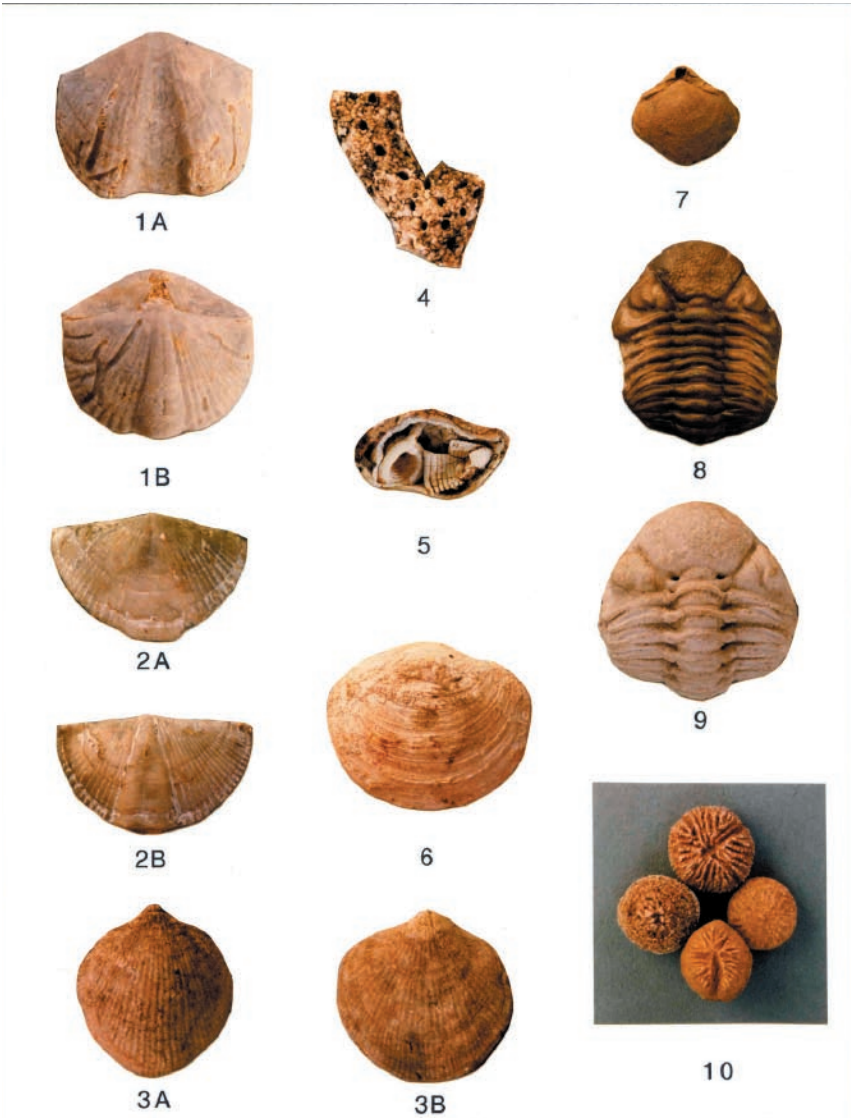

PLATE 11

Plate 12

Representative fossils of the North Vernon Limestone (all figures X 0.65 unless otherwise noted).

Figure

1. Chonetid brachiopods, commonly assigned to the species *C. yandellanus.* Silver Creek Member. Jeffersonville, Ind.
2. *Siphonophrentis halli.* Beechwood Member. Jeffersonville, Ind.
3. *Megistocrinus* sp. (A) Top, (B) basal, and (C) side views. Beechwood Member. Sellersburg, Ind.
4. *Aulocystis* sp. Beechwood Member. Jeffersonville, Ind.
5. Placoderm bone. Beechwood Member. Bardstown, Ky.

PLATE 12

Plate 13

Representative fossils of the New Albany Shale (all figures X 0.65 unless otherwise noted).

Figure

1. Chonetid brachiopods. Blocher Member. North Vernon, Ind.
2. *"Leiorhynchus."* Dozens of specimens on black shale, probably representing an in situ community. Coin for scale. Blocher Member. North Vernon, Ind.
3. *"Leiorhynchus."* Single specimen with a small chonetid. Blocher Member. North Vernon, Ind.
4. Lingulid brachiopods. Blocher Member. New Albany, Ind.

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PLATE 13

Notes

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