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STATE OF ARKANSAS

ARKANSAS GEOLOGICAL COMMISSION

Norman F. Williams, State Geologist

A GUIDEBOOK TO THE POST-ST. PETER ORDOVICIAN AND THE SILURIAN AND DEVONIAN ROCKS OF NORTH-CENTRAL ARKANSAS

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William W. Craig, Orville Wise, and

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Prepared for

the Second Annual Field Trip of the Midcontinent Section of the

Society of Economic Paleontologist and Mineralogists

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Copies of guidebook available from the Arkansas Geological Commission, Little Rock.

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PREFACE

This guidebook has been prepared for the Second Annual Field Trip of the Midcontinent Section of the Society of Economic Paleontologists and Mineralogists. The field trip route extends from Batesville, Independence County, to Mt. View, Stone County. The stops, shown in Figure 1, have been chosen to illustrate the stratigraphy and depositional environments of the post-St. Peter Ordovician and the Silurian rocks of north central Arkansas. Some Devonian and Mississippian stratigraphy is incidently included in the scheduled stops, and time permitting a short visit will be made to a section of Sylamore Sandstone and Chattanooga Shale (Alternate Stop C). The stratigraphic column for north central Arkansas is given in Figure 2.

Although the units to be examined continue far to the west of the field trip area, most of their important features are displayed at the guidebook stops. Many of these features are controversial and discussion is encouraged. Summary articles on the stratigraphy have been included to help orient the trip participants with the rocks and their problems.

We are gratefully indebted to Mr. Mike Low, President and General Manager of the Midwest Lime Company Quarry, for the opportunity to visit the company's quarry at Batesville; and to Mr. F. B. Harris, Superintendent of the Love Hollow Limestone Quarry, for permission to view the section at Love Hollow.

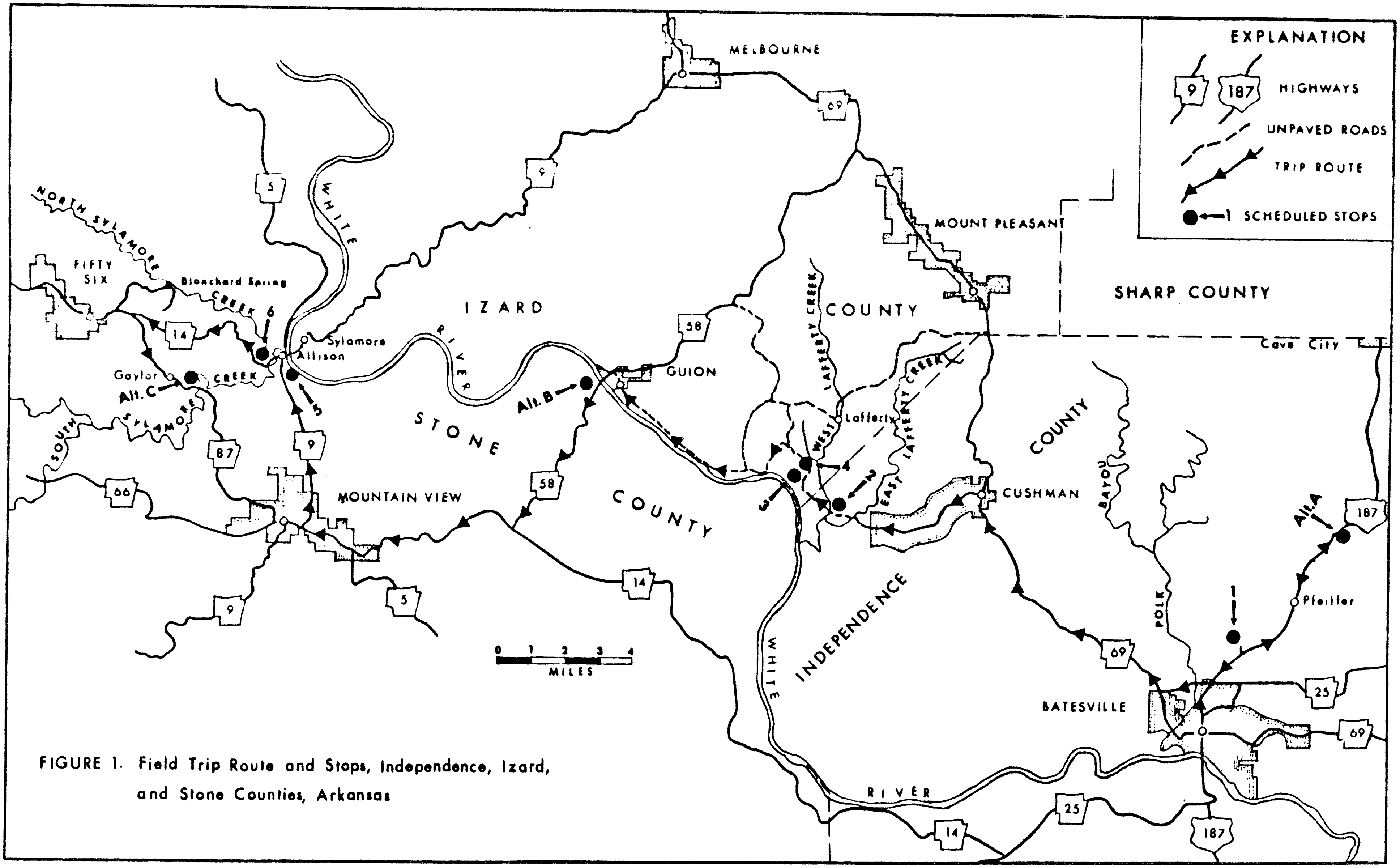

FIGURE 1. Field Trip Route and Stops, Independence, Izard, and Stone Counties, Arkansas

AGE		NORTH CENTRAL ARKANSAS
PENNSYLVANIAN	ATOKA	ATOKA FORMATION
	MORROW	BLOYD FORMATION
		HALE FORMATION: PRAIRIE GROVE MEMBER; CANE HILL MEMBER
		? ——— ?
MISSISSIPPIAN	UPPER	PITKIN LIMESTONE
		FAYETTEVILLE SHALE
		BATESVILLE SANDSTONE
		MOOREFIELD FORMATION
	LOWER	BOONE FORMATION; ST. JOE LIMESTONE MEMBER
		"BASAL MISSISSIPPIAN SANDSTONE"
DEVONIAN	UPPER	CHATTANOOGA SHALE; SYLAMORE SS MEMBER
	MIDDLE	CLIFTY FORMATION
	LOWER	PENTERS CHERT
SILURIAN	UPPER	LAFFERTY LIMESTONE
	MIDDLE	ST. CLAIR LIMESTONE
		CASON "BUTTON SHALE"
	LOWER	BRASSFIELD LIMESTONE
ORDOVICIAN	UPPER	"CASON" PHOSPHATE BEDS
		FERNVALE LIMESTONE
	MIDDLE	KIMMSWICK LIMESTONE
		PLATTIN LIMESTONE
		JOACHIM LIMESTONE
		ST. PETER SANDSTONE
		EVERTON FORMATION
	LOWER	POWELL DOLOMITE
		COTTER DOLOMITE

FIGURE 2. STRATIGRAPHIC COLUMN, NORTHERN ARKANSAS (modified after McFarland and others, 1976).

STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENTS OF THE POST-ST. PETER ORDOVICIAN, NORTH-CENTRAL ARKANSAS

The dominantly carbonate post-St. Peter Ordovician succession of the Arkansas Ozarks consists of, in ascending order, the Joachim Dolomite, the Plattin, Kimmswick, and Fernvale Limestones, and the Cason Shale. The succession crops out in a narrow east-west belt from near Ponca, Newton County, on the west, to Independence County on the east (Fig. 3), where Paleozoic rocks go beneath the younger deposits of the Mississippian Embayment. Between Ponca and eastern Oklahoma, post-St. Peter rocks are covered by Carboniferous strata.

The cumulative thickness of these rocks is slightly in excess of 550 feet; however, in no one locality is this maximum attained. The sequence, as well as its individual units, attains near-maximum thickness in the vicinity of Batesville in the east, but thins markedly westward through the thinning and disappearance of individual units. In the westernmost extent of the outcrop belt, the entire post-St. Peter carbonate succession is comprised of an unevenly distributed Fernvale Limestone that varies in thickness from 0 to 25 feet, as well as a few widely scattered thin exposures of Plattin. Ages of the different units are given in Figure 2.

The carbonate units of the post-St. Peter Ordovician succession are interpreted as peritidal deposits that record an overall increase in water depth up section. Although there is relatively little disagreement on the interpretation of the environments of deposition of the units, geologists have been divided on the historical meaning of their contacts. This controversy, which involves the question of whether or not the contacts of the units are conformable or unconformable, has found forum in the literature in a series of articles (Freeman, 1966a, 1966b, 1972; Young and others, 1972a, 1972b). Craig (1975a) reviews the controversy in a summary of the history of investigations on the post-St. Peter rocks of the Arkansas Ozarks.

Interpretation of conformability of the contacts is appealing because the deepening-upward succession of what seem to be related lithic types suggests a superposition that resulted from a landward migration through time of coexisting adjacent lithotopes. Support for periods of erosion between deposition of the units comes from small-scale truncation features at their contacts, angular relationships at some localities, unpredictable variations in unit thicknesses over short distances, and the thinning and disappearance of units from the succession in western sections of the outcrop belt.

Joachim Dolomite and Plattin Limestone

The bulk of both the Joachim and Plattin collected in a tidal flat environment and the two units possess many similarities. In spite of this, they are unlike in important respects, suggesting the presence of fundamental differences in the details of the environments in which each accumulated. Studies that address the depositional environments of the Joachim and Plattin have been carried out by Freeman (1966b) and Young and others (1972a). Rives (1977) conducted a detailed investigation on the Joachim, and Jee (1981) and Deliz (1984) have studied geographically restricted portions of the Plattin.

The Joachim, which ranges in thickness from 0 to 150 feet in north central Arkansas, is characterized by sequences of faintly laminated, but otherwise structureless dolomicrite; prominently mudcracked layers of laminated dolomicrite; and sandy intraclastic "trash" zones, the base of which contain rip-up clasts from the mudcracked layers below (Figs. 17 and 18). The mudcracked dolomicrite is interbedded with intraclastic-pelloidal wackestone/packstone/grainstone and contains abundant laminoid and irregular fenestrae (birdseye structure) and calcite pseudomorphs after halite. That the laminations in this mudcracked dolomicrite are algal in origin is apparent because similarly structured layers occur as well-formed stromatolite heads (LLH-C type) at different stratigraphic levels within the Joachim (Fig. 19). Relative percentages of mudcracked dolomicrite and pelloidal-intraclastic wackestone/packstone/grainstone vary in different intervals. The Joachim also contains beds of mottled (burrowed), fossiliferous and unfossiliferous dolomicrite, particularly in its basal portion. The fossils, which include pelecypods, gastropods, ostracodes, bryozoans, trilobites, brachiopods, and calcareous algae, occur disseminated through the rock or as laminae of sandy, skeletal pelloidal-intraclastic packstone/grainstone. Prominent blebs of calcite spar in this burrowed rock apparently represent fillings of voids created by burrowing.

The greater part of the Joachim is interpreted as a product of the intertidal zone. The couplet of faintly laminated dolomicrite followed by prominently mudcracked laminated dolomicrite is believed to represent a shallowing-upward cycle that started in the low to middle intertidal range and terminated with accumulation of intertidal to supratidal sediment. The sandy, intraclastic rock probably represents a return to higher energy conditions of the lower intertidal zone. The well-developed stromatolite heads grew in the high energy zone near mean low tide, and as indicated by their mudcracked tops, built-up into the upper reaches of the intertidal zone. Burrowed rock in the Joachim most likely collected in the low intertidal and shallow subtidal zones.

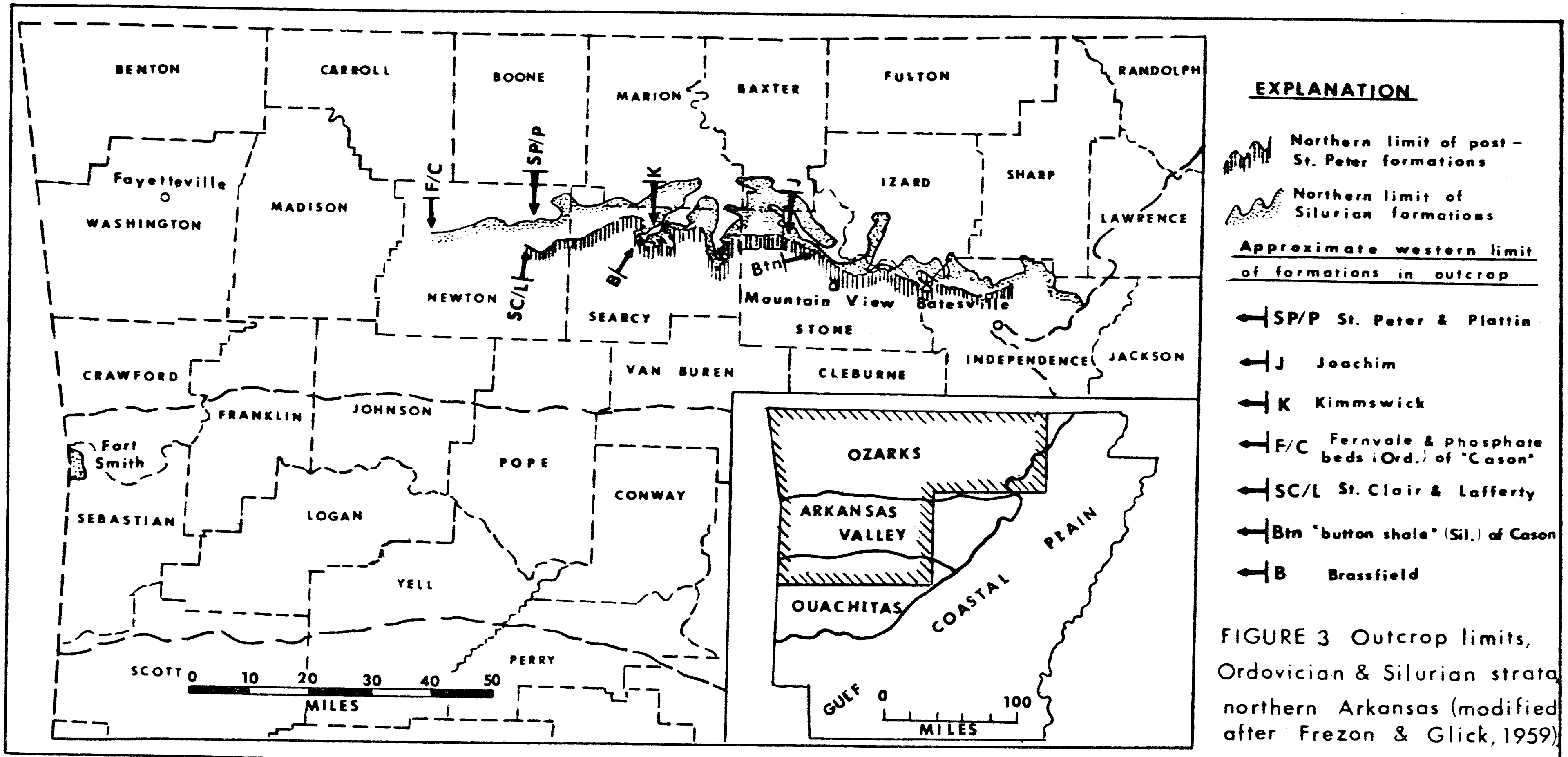

FIGURE 3 Outcrop limits, Ordovician & Silurian strata, northern Arkansas (modified after Frezon & Glick, 1959)

The base of the Plattin is picked at the first occurrence of micritic limestone. The formation ranges in thickness from 0 to 250 feet in north central Arkansas. In contrast with the dominantly thick- to medium-bedded Joachim, the Plattin characteristically exhibits thin to slabby bedding at different stratigraphic levels. This bedding resulted from the influx at different times of detrital mud into the carbonate depositional environment of the Plattin. At certain levels, this influx was abundant enough to produce shale breaks of a few inches thick.

The Plattin is dominated by randomly stacked beds of finely interlaminated lime mudstone and densely-packed peloidal packstone/grainstone, intraclastic-peloidal packstone/grainstone, and cryptalgal fenestral-laminated lime mudstone. The lime mudstone contains fine spar-filled mudcracks (polygons visible on some bedding soles) and sheet cracks, calcite pseudomorphs after halite, and a variety of fenestral fabrics. Layers of faintly laminated, mudcracked dolomicrite and peloidal-intraclastic dolomitic packstone/grainstone occur at different stratigraphic positions within the dominantly micritic sequence. This association of textural types is interpreted as the product of deposition under the influence of blue-green algal mats in a number of subenvironments within the intertidal and supratidal zones. Stromatolite heads, although not common, also occur in the Plattin (Alternate Stop B). In addition, the Plattin contains several layers of fossiliferous mudstone and wackestone that can occur at any stratigraphic level, but are most common in the base and top of the unit. These beds can contain a diversity of fauna and are commonly burrowed. They are interpreted as sediment of intertidal and protected subtidal origin. A coralline (Tetradium) wackestone, with some colonies in growth position, is present at the top of the unit in the eastern and central portion of the outcrop belt (Fig. 21).

Jee (1981) was able to subdivide the Plattin into five parts in Independence and Izard Counties.. He interpreted these as recording the following sequence of events: a basal subtidal to intertidal transgression; a progradation of intertidal and supratidal mudflats; and a trangression that brought with it both protected and open subtidal environments, including a coral-algae wave-baffle structure. To the west in western Searcy and Newton Counties, where the Plattin is much thinner, the variety of lithic types is much reduced and no subdivision of the unit is possible (Deliz, 1984). No subtidal deposits are recognized in this region.

Although the majority of both the Joachim and Plattin accumulated under the influence of tidal flat conditions, a number of significant differences between the two can be itemized:

1) The Joachim is dominantly dolomite and the Plattin is limestone with subordinate dolomite.

2) The Plattin is more texturally varied and thinly laminated than the Joachim.

3) The superposition of Plattin rock types seems to be random. Neither Jee (1981) nor Deliz (1984) were able to identify preferred sequences of textural types within the formation. This is in contrast with the mudcracked sequences of the Joachim.

4) The Plattin is considerably more fossiliferous than the Joachim.

5) The Plattin contains many levels that received a substantial influx of detrital mud, a feature not characteristic of the Joachim.

The reason for these differences is unclear. A tentative conclusion is that the Plattin tidal flat contained a more varied hydrology than that of the Joachim, with a complex of subtidal, intertidal, and supratidal subenvironments associated with the tidal flat proper, tidal channels and their levees, and tidal ponds. Deliz (1984) has identified channel structures several feet across in the region of Gilbert, Searcy County, to the west of the field trip area. Lateral migration of these subenvironments would produce the randomly stacked, varied textures characteristic of Plattin. The greater amounts of water on the Plattin tidal flat, as compared to that of the Joachim, could have resulted from a more humid climate during Plattin deposition, a conclusion somewhat supported by the zones of detrital mud (delivered by runoff from exposed areas to the north); or the zone of Plattin accumulation could have been at the seaward margin of that geographic region between low and high tide. Located in this position the flat would be more continuously flooded by lunar (?) and storm tides. The greater abundance of stenohaline marine fossils associated with the Plattin would be explained by such a difference in the positions of the Plattin and Joachim tidal flats.

Kimmswick and Fernvale Limestones

Recent studies of the Kimmswick and Fernvale have been undertaken by Freeman (1966a,b), Young and others (1972a) and Craig (1975b). The Kimmswick, which ranges in thickness from 0 to 55 feet in north central Arkansas, is a fine- to coarse-grained bioclastic limestone and contains the most diversified fauna of the post-St. Peter Ordovician units. Fossils include representatives of all major Paleozoic groups. The Kimmswick is comprised of interbedded skeletal wackestone, packstone, and poorly washed grainstone. The wackestone and packstone show evidence of prolific burrowing. Some layers of crinozoan grainstone, which can be cross bedded, are also present. This latter rock is texturally similar to the overlying Fernvale Limestone.

The upper part of the Kimmswick is skeletal wackestone (matrix of microspar and micrite), a texture that contrasts sharply with the overlying coarse grainstone of the Fernvale.

The Kimmswick accumulated in a protected subtidal environment. Protection was probably provided by shoals of crinozoan sands that existed to the south of the outcrop belt and whose presence is suggested by the occurrence of the subordinate coarse-grained crinozoan grainstone interbedded with the common skeletal wackestone and packstone of the unit.

The Fernvale ranges in thickness from 0 to about 100 feet in north central Arkansas. It is comprised almost entirely of thick-bedded calcirudite and calcarenite crinozoan grainstone. Calcirudite layers are commonly cross-bedded and contain few fossils other than fragmented crinozoans. Calcarenite layers tend to be planar bedded and contain a slightly more diversified fauna. Whole, reasonably well-preserved brachiopods can be collected from the base, and in thicker sections, from the top of the unit.

The Fernvale collected in an open subtidal environment as shifting subaqueous dunes and in slightly lower-energy areas between the dunes. The present outcrop belt of the Fernvale would appear to represent the zone where wave and tidal currents dissipated their energies against the substrate, washing away fine grains and leaving coarser grains to accumulate.

Interpretation of Contacts

Young and others (1972a,b) have interpreted the superposition of the carbonate units just discussed as the result of "shifts in laterally adjacent, coexisting facies." In their model, the Joachim and Plattin represent intertidal and supratidal deposition, the Kimmswick protected subtidal deposition, and the Fernvale open subtidal deposition. They conclude that the contacts between the units might "represent geologically brief periods of subaerial exposure, semilithification, and reworking; but there is no need to invoke prolonged exposure or extensive removals of parts of the rock record to explain their presence."

In his classic report on the manganese deposits of the Batesville district, Miser (1922) placed unconformities between each of the units even though their planes of separation appeared "even" to him. Miser's conclusions, which were followed by most later geologists, were based primarily on E. O. Ulrich's determinations of missing faunal zones at the contacts of the limestones. Such contacts qualify as paraconformities. Freeman (1966a,b) has argued that each of Ulrich's paraconformities in this carbonate succession involves lithification and erosion of the rock below prior to deposition of the rock above, and thus truly represent disconformities. Evidence for erosion comes from the truncation of small-scale features, such as shells, burrows, and stylolites, in the rock below by the rock above, and from angular relationships where it can be demonstrated that several feet of rock has been removed prior to the deposition of the overlying unit.

The Plattin-Kimmswick and Kimmswick-Fernvale contacts are commonly "welded"; that is, they occur within the same bed with no separation across a bedding plane (Figs. 23, 24). They are universally sharp, show small-scale truncation features at the contact, and can show small-scale scalloping of the upper surface of the underlying unit. In addition to the truncation features, patches and zones of the overlying rock generally occur within the underlying rock up to several inches below the contact. Freeman (1966a) interpreted the scalloping and patches as products of the infilling by the sediment of the overlying rock of a "micro-karst" surface developed on the lithified, eroded surface of the underlying unit. Young and others (1972a,b) concluded that the sharp contacts are "facies unconformities" that resulted from the transgression or progradation of laterally coexisting lithotopes over one another. These authors interpreted Freeman's "micro-karst" as a gradational or intercalated passage from one unit to another, or as mixing due to burrowing.

The St. Peter-Joachim contact appears conformable (Fig. 16). The Joachim-Plattin contact is not sharp in most exposures and does not exhibit the "micro-karst" characters of the other two contacts in the sequence. In places it appears to be gradational from dolomite to limestone over an interval of a foot or two, as at Allison West, Stop 6. In other places, the passage from the Joachim into the Plattin is through a disturbed interval of a few feet (Fig. 20). Such is the situation at Allison South, Stop 5, where a five foot interval between obvious Joachim and obvious Plattin contains an enigmatic mixture of sandy dolomite, dolomitic limestone, and limestone. Pieces of limestone isolated by solution joints occur surrounded by dolomite, and layers of sandy dolomite drape over truncated edges of beds in the interval. Some beds with the interval appear to be at an angle to normal bedding.

An angular relationship is known to occur between the Joachim and Plattin, the Plattin and Kimmswick (Stop 2, Figs. 9, 10), and where the Kimmswick is absent, between the Plattin and Fernvale. Although each of the relationships cited above is known from only a single locality, the divergence of beds is only a few degrees and is probably not discernible in most natural exposures where it might exist. At the known localities, the removal of several feet of rock can be demonstrated. The preponderance of evidence at the contacts of the post-St. Peter carbonate succession weighs in favor of placing an unconformity between each component unit even though these units form a reasonable group of related facies. At most exposures, the contacts are not gradational or intercalated in a normal fashion.

They do physically resemble the scalloped/planar erosional surfaces interpreted by Read and Glover (1977) as products of a prograded, early-cemented tidal flat or tidal rock platform. However, the ability to demonstrate the removal of several feet of rock at places cautions against the full application of the Read-Glover model to the northern Arkansas surfaces. Nor can the Read-Glover surfaces explain the contact between the Kimmswick and Fernvale, both subtidal in origin, without intervening regression. Jee (1981) has recognized truncation surfaces within the Plattin that well might be similar in origin to the surfaces reported by Read and Glover.

The regional distribution of the units also supports the conclusion that they are separated by periods of erosion. Thicknesses vary significantly over short distances. These variations bear no apparent pattern to facies relationships. On a regional scale, all units thin to the west and, except for the Fernvale, eventually disappear from the sequence (Fig. 3) . The Joachim is the first to disappear, not extending beyond western Stone County. The last patches of Kimmswick are in eastern Searcy County, where the sequence commonly is St. Peter, Plattin, and Fernvale. The Plattin extends as isolated outcrops as far west as west-central Newton County, west of which only the Fernvale remains to represent the interval. Because the St. Peter also disappears in central Newton County, the Fernvale in the west rests directly on the Everton Formation. It is interesting to note that the Everton-Fernvale contact, which certainly must be unconformable, is "welded" in many places and exhibits the same features as the "welded" contacts to the east where all the post-St. Peter carbonate units are present. The disappearance of units to the west is almost certainly the result of erosion between them and not the consequence of onlap in this direction. The occurrence of units is sporadic where they are thin. That is, small thicknesses of them (a few inches to a few feet) are present in some sections, with the unit altogether absent in others. These occurrences are best interpreted as outliers separated by erosion from the main body of the unit. To interpret the westward thinning of the units as depositional pinchout seems unreasonable in light of the distribution pattern of their distal edges.

It is probable that the unconformities separating these units in their outcrop belt disappear to the south, at which place the model proposed by Young and others would be fully applicable. The exclusive separation (both lithically and faunally) of the facies observed in outcrop is best explained by regression, which resulted from epeirogenic uplift, followed by erosion during which some rock was removed. Erosion on the broad, gentle folds formed during uplift thinned units across structural highs and produced the variable and unpredictable thicknesses now observed in outcrop. Because no distinct, sustained regressive sequences are preserved in any of the units, it is apparent that regressions were of short duration, a supposition substantiated by the slight faunal discontinuities present at the contacts. Regressions were followed by rapid transgressions that shifted facies tracts somewhat to the north of the position they occupied before regression, thus bringing basinward facies on top of landward ones without development of intercalated or gradational contacts. Uplift was consistently greater to the west as evidenced by the thinning and disappearance of units in this direction. The patchy distribution of units at their distal margins probably can be accounted for by preservation in structural lows. There is no indication that significant topography was present on these northern Arkansas erosional surfaces.

Cason Shale

The uppermost rocks of Ordovician age in north central Arkansas are assigned to the Cason Shale. The Cason was named by H. S. Williams in 1894 for an exposure of phosphatic red and green shale containing abundant algal "buttons" (oncolites) at the Cason (manganese) Mine just north of Batesville, Independence County (Stop 1; Fig. 4). Because the type Cason occurs between the Fernvale and St. Clair Limestones, the name Cason came to be applied to a rather heterogeneous group of rocks, mostly detrital, occupying this stratigraphic interval. Miser (1922) assigned the Cason to the Upper Ordovician based on the paleontology of E. O. Ulrich. It is now known that the interval contains a second group of phosphatic detrital rocks that are distinct from, and stratigraphically below, the type Cason. Furthermore, the correct stratigraphic position of the Lower Silurian Brassfield Limestone is between these two detrital units (Wise and Caplan, 1967; Amsden, 1968; Craig, 1969). Thus only the lower phosphatic beds of the "Cason interval" are Ordovician in age. The remainder of the interval, which includes the Brassfield and the type Cason, is Silurian and will be discussed in the next article. Details of the history of this stratigraphic problem and its eventual solution are given by Craig (1975a, and in press). Lemastus (1979) has studied the petrology and stratigraphy of the entire interval.

The Ordovician portion of the Cason changes in lithic character across the state. In the vicinity of Batesville, in the eastern part of the outcrop belt, the unit ranges in thickness from 0 to 15 feet and is comprised of phosphatic sandstone and shale, with sandstone more prevalent in its lower half. The sandstone, which rests unconformably on the underlying Fernvale, consists of subequal amounts of phosphate and quartz sand/silt with subordinate glauconite. The phosphate consists of highly polished phosphatized carbonate grains that include lithoclasts and fossils of many kinds. Fragments of phosphatic brachiopods are also prominent.

Occurring stratigraphically above the phosphate beds, and apparently conformable with them, is a carbonate unit that begins as a crinozoan grainstone and grades up into an oolitic-intraclastic grainstone and fenestral (algal) lime mudstone.

The limestone has been almost completely removed from the Batesville district by pre-Brassfield erosion. In the mid-1960's about 5 feet of it was present between the phosphate beds and Brassfield Limestone at Love Hollow Quarry on the White River (Stop 3; Fig. 11). Both the "Cason" oolitic limestone and Brassfield apparently were present at the Love Hollow Quarry as isolated erosional remnants because they since have disappeared through continued quarrying. At present, the quarry face shows the lower phosphate beds overlain directly by the Silurian algal "button" shale. The only presently known locality in the Batesville district for this limestone is near St. Clair Spring north of Batesville (Alternate Stop A; Fig. 7). Here the phosphate beds are absent and 9 feet of the limestone, exhibiting all of its textural variations, occurs between the Fernvale and Brassfield.

The phosphate beds are interpreted as a basal detrital phase of a transgression that produced the overlying shallow subtidal to intertidal limestone, the record of which has been mostly removed from the outcrop belt. The phosphate grains are almost certainly reworked from below and represent a lag deposit. The underlying Fernvale contains phosphatized patches as well as abundant phosphatized small clams and shales. This phosphate, which remains in acetic acid residues of the limestone, is unpolished. Detrital material was not abundant enough during the transgression to completely cover the erosional surface. Thus the phosphate rock does not occur everywhere beneath the limestone.

To the west of the Batesville district the phosphate content of Ordovician Cason decreases significantly. In the Allison area (Stop 6; Figs. 15, 22) the unit is a green silty shale and clayey siltstone with thin phosphatic sandstone layers and disseminated phosphate sand. Wise and Caplan (1967, 1979) record the oolitic limestone from above the shale in the Blanchard Spring Recreation Area a short distance from Allison. Farther west, in Searcy and Newton Counties, the unit generally has a sandy, phosphatic base that grades upward into a green silty dolomitic shale which bears some resemblance to the Sylvan Shale of Oklahoma. At certain localities in the west, the lower phosphatic portion of the unit contains stringers of phosphatic ooids. These stringers are judged to be equivalent to the oolitic limestone to the east. Its phosphatic composition records a second episode of phosphate replacement during the Late Ordovician. Horner and Craig (1984) discuss the occurrence of phosphate in the Lower Paleozoic rocks of north central Arkansas.

The Cason to the west varies from 0 to 20 feet in thickness and has a very irregular distribution. It appears to be preserved in structural lows that escaped pre-Boone erosion. Just such an occurrence of 20 feet of the shale was reported by Purdue and Miser (1916) just north of Jasper, Newton County, Arkansas .

STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENTS OF SILURIAN STRATA, NORTH CENTRAL ARKANSAS

Rocks of Silurian age in north central Arkansas have been assigned to four lithostratigraphic units. From oldest to youngest, these are: the Brassfield Limestone, the Cason Shale, and the St. Clair and Lafferty Limestones. Until relatively recently, detrital rock assigned to the Cason was considered to be wholly Ordovician in age. It is now known that the type Cason (Stop 1) is Silurian (Late Llandoverian-Early Wenlockian) and represents a basal detrital phase of the transgression that resulted in the deposition of the St. Clair and Lafferty Limestones. The correct stratigraphic position of the oncolite-bearing shale ("button" shale of authors) that forms the type Cason is above the Lower Silurian Brassfield Limestone, which in turn overlies an Upper Ordovician unit of phosphatic sandstone and shale (Stop 3) that traditionally also has been assigned to the Cason Shale. References that address this problem are given in the discussion on the post-St. Peter Ordovician rocks in this guidebook.

Silurian strata crop out discontinuously in a belt that extends from their easternmost exposures in the Batesville district, Independence Country, to just west of the Searcy-Newton County line (Fig. 3). These strata have a maximum cummulative thickness of about 155 feet, but this maximum is not present at any one locality. Silurian rocks are absent at many places, their presence apparently controlled by preservation in structural lows that escaped erosion. McKnight (1935) has identified such structurally controlled occurrences for the St. Clair in the western part of the outcrop belt. Ages of the individual units are given in Figure 2.

The Silurian strata in north-central Arkansas unconformably overlie the Upper Ordovician phosphatic sandstone and shale traditionally assigned to the Cason, or where these strata are absent, the Fernvale Limestone. They are unconformably overlain almost everywhere by the Boone Formation, but in a few areas of limited extent the Penters Chert (Lower Devonian) or the Sylamore Member of the Chattanooga Shale (Upper Devonian) is the unconformable superjacent unit. These latter two relationships are present at Stops 1 (Fig. 4) and Alternate C, (Fig. 25) respectively. A comprehensive report on the Silurian stratigraphy of the Arkansas Ozarks is given by Craig (1984).

Brassfield Limestone

The Brassfield is presently known from only one locality in the Batesville district, Alternate Stop A, where it is 19 feet thick. In the 1960's, 5 feet of Brassfield was present at Love Hollow Quarry (Stop 3) between the Upper Ordovician phosphate beds (traditionally Cason) and the oncolite-bearing shale equivalent to the type Cason (Wise and Caplan, 1967; Amsden 1968; Craig, 1969). It is probable that other remnants of the unit are present along the bluffs of the White River in the vicinity of the Love Hollow Quarry. Reports (Miser, 1941) of a manganese carbonate up to 3 feet thick within the Cason Shale of this general region are probably records of the Brassfield between the Ordovician phosphate beds and the oncolite-bearing shale at the base of the St. Clair Limestone.

The best and thickest exposures of the Brassfield are in the vicinity of Gilbert, Searcy County, to the west of the field trip area, where it ranges in thickness from 0 to nearly 40 feet. These occurrences have been mapped by McKnight (1935), Maher and Lantz (1953), and Glick and Frezon (1965).

At all known localities the Brassfield unconformably overlies the upper Ordovician shale and associated lithologies traditionally assigned to the Cason. It is unconformably overlain by the oncolite-bearing shale of the type Cason, or where this rock is absent, by the St. Clair Limestone. The contact with both of these latter units is welded in places and shows many of the same features as the welded contacts between the post-St. Peter Ordovician units of north central Arkansas (see previous article in this guidebook). These contacts are illustrated by Craig (1984).

The Brassfield is dominantly a bioclastic limestone of variable texture. Its chief constituent is fragmented crinozoans, but it also contains abundant debris of other common Paleozoic fossil groups. The limestone has an important constituent of lime mud as discontinuous stringers or layers, as mud resting on shell surfaces that floor interstices, and as irregular patches that resulted from burrowing. These patches, which are dark red from the admixture of detrital mud, give the Brassfield a characteristic mottled aspect.

The lithic and faunal characteristics of the Brassfield suggest that the limestone collected under restricted subtidal conditions where wave energy was not consistently strong enough to remove all the lime mud present. These conditions developed the Brassfield's most dominant texture, which is a skeletal wackestone/packstone. Interbedded with the mud-bearing limestone is a significant, but subordinate amount of subequigranular crinozoan grainstone and poorly washed grainstone. These latter textures are characteristic of the Brassfield in the Batesville district. The grainstone probably formed in wave-dominated shoal zones and was introduced into the semi-protected area of major Brassfield accumulation during periods of higher energy, possibly storms.

"Button Shale" of the Cason

The major occurrence of the oncolite-bearing "button" shale of the Cason is in the Batesville district, where it ranges in thickness from 0 to about 20 feet. West of the district, it is known from only one locality within the Blanchard Spring Recreation Area. The most notable exposure of the unit is its type section at the old Cason (manganese) Mine and the adjacent Midwest Lime Company Quarry (Stop 1). About 16 feet of the shale, which contains abundant oncolites flattened in the plane of bedding, is exposed in the mine face and floor. The unit thins rapidly eastward into the quarry. In the western face of the quarry the "button" shale is in distinct erosional contact with the Fernvale, its material filling fractures and irregularities in the upper portion of the limestone (Fig. 5). The shale, which is only about 6.5 feet thick here, grades upward into the base of the St. Clair by a decrease in detrital material and an increase in carbonate. Abundant spherical oncolites occur in the basal St. Clair. North along the quarry face the "button" shale and overlying St. Clair climb onto an expanded Fernvale section, the St. Clair eventually onlapping the shale to come to rest directly on the Fernvale (Fig. 6). This relationship shows that the "button" shale is a basal detrital phase of the St. Clair transgression. Some topography apparently existed, at least locally, on the Fernvale erosional surface, and deposition of detrital material, which was in short supply, was restricted to topographic lows. This depositional pattern explains the inconsistent occurrence of the "button" shale at the base of the St. Clair throughout north central Arkansas. An indication of the topography present at the Midwest Lime Quarry is seen in the variation in the thickness of the Fernvale, which is about 80 feet in the north face of the quarry, but only 15 to 20 feet thick in the west face. The topography here probably developed on the upthrown side of a fault system directly to the south. The faulting was active during this time as evidenced by an angularity between the Fernvale and St. Clair.

The shale at the mine is difficult to decipher petrographically because of heavy manganese and iron mineralization. It is a silty to fine-sandy, calcareous, red to red and green mottled clay shale. Dolomite rhombs occur scattered throughout. In addition to algal buttons, other fossils include fragmented ostracodes, crinozoans, trilobites, and calcareous and phosphatic brachiopods. Calcareous cement increases upward toward the St. Clair, with the upper few feet calcareous enough to dissolve in acetic acid. Acid residues produce _Ammodiscus_- and _Psammosphaera_-type agglutinated foraminifers. Also present are conodonts characteristic of the basal St. Clair, which corroborates the conclusion (from brachiopods) of H. S. Williams (1900) that the Cason at the mine contains the beginning of the St. Clair fauna.

Phosphate pebbles occur in the shale, but not in the abundance that they appear in the Ordovician phosphate beds. However, the presence of phosphate in the "button" shale provides a certain similarity between it and the Ordovician phosphate beds that no doubt has helped obscure the distinction between the two units. Phosphate can be present in any one of several Ozark Paleozoic units (Horner and Craig, 1984) and is not a good criterion for distinction between the "button" shale and the underlying Ordovician phosphatic sandstone and shale. The lower phosphatic beds of the Batesville district differ from the "button" shale in that they are distinctly interbedded hard sandstone and shale in which all fossil debris is phosphatic. They do not contain oncolites or calcareous shells, nor are they characteristically calcareous or dolomitic.

A clean exposure of the "button" shale occurs at the Love Hollow Quarry (Stop 3). The unit at the quarry averages about 3 feet in thickness and has a slightly scoured erosional contact with the rocks below. The contact is sharp and distinct when the Brassfield is the underlying unit. It is more subtle when the Ordovician phosphate beds are the underlying unit, as has been the case for the past few years. The basal 6 inches of the "button" shale at the quarry is dark-red, quartz-sandy siltstone with pebbles of phosphate and chert and fragmented crinozoan parts. This basal conglomeratic unit grades up into 2 feet of silty, pyritic, calcareous red to gray-green clay shale with scattered dolomite rhombs and abundant flattened oncolite "buttons"; sparse, fragmented ostracodes, brachiopods, trilobites, and crinozoans occur along with abundant aggluitinated foraminifers. Through a decrease in detrital material and increase in carbonate, the shale passes gradationally into an ostracode wackestone with scattered oncolites in the base of the St. Clair Limestone (Fig. 13).

<u>St. Clair and Lafferty Limestones</u>

The St. Clair Limestone is the most widespread and continuous of the Silurian units. The Limestone is best developed in the Batesville district, where it ranges in thickness from 0 to 100 feet. It is thickest in the eastern part of the district, but occurs at only isolated localities, its distribution apparently controlled by a combination of topography on the underlying erosional surface and preservation in structural downwarps that were protected from post-St. Clair erosion. In the western part of the district, the unit is more continuous, but averages only about 15 feet in thickness.

The St. Clair is of irregular occurrence in the Blanchard Spring area. The best exposure is along the north bank of South Sylamore Creek just downstream from Gaylor Crossing (Alternate Stop C). To the west, in Searcy County, the St. Clair ranges from 0 to 35 feet in thickness.

The spectrum of St. Clair textures parallels that of the Brassfield. Both are dominantly bioclastic limestones charac terized by fragmented crinozoans and with abundant lime mud matrix. The St. Clair is somewhat coarser grained than the Brassfield and lacks the Brassfield's distinctive dark-red mottling.

Vertical trends, not identified in the Brassfield, are present in the St. Clair. These trends are significant in the interpretation of the depositional history of the formation, particularly when considered in conjunction with the conformably overlying Lafferty Limestone. In the Batesville district, the St. Clair is a pinkish-gray to light-gray, coarse-grained crinozoan packstone/grainstone. Some layers, especially at the base and top of the unit, are poorly washed and contain a matrix of gray-green lime mud. In all sections where the base of the St. Clair is exposed, the lower 2 to 5 feet is a pyritic, gray-green or red ostracode wackestone that contains angular to subrounded quartz silt, conodonts, abundant aggluntinated foraminifers, minor amounts of fragmented crinozoans, corals, brachiopods and trilobites, and large, well-formed dolomite rhombs. The overlying main body of crinozoan-rich St. Clair is dominated by wackestone and packstone in its upper and lower layers and by grainstone and poorly washed grainstone in its middle layers. The wackestone and packstone contain abundant whole skeletons of brachiopods, ostracodes, cephalopods, and well-preserved pygidia and cephala of trilobites. Holloway (1980, 1981) has recently reported on the St. Clair trilobites and Amsden (1968) has described the brachiopods. The middle grainstone is dominated by crinozoan calcarenite and calcirudite containing fragmented skeletal material of other fossil groups. This superposition is well displayed at the now abandoned Batesville Stone Quarry (Stop 1; Fig. 4) and the type section near St. Clair Spring (Alternate Stop A). It is less well developed in the thinner section at Love Hollow Quarry (Stop 3; Fig. 11).

In the western part of its outcrop, in Searcy County, the St. Clair contains a greater percentage of lime mud. Grainstone, although present in some layers, is not as characteristic of the unit as in the Batesville district, and layers of skeletal wackestone are common throughout the limestone.

The Lafferty Limestone ranges in thickness from 0 to a maximum of over 80 feet near its type section (Stop 4). The Lafferty is lithically similar to the ostracode wackestone at the base of the St. Clair. Detrital quartz silt and clay and agglutinated foraminifers, rare in the allochem-rich rock of the main body of the St. Clair, are prominent constituents of the Lafferty. Depending on the investigator, the St. Clair-Lafferty contact is placed either above the last occurrence of abundant coarse-grained bioclastic allochems or within the body of the overlying fine-grained limestone at a level exhibiting a noticeable increase in detrital constituents.. The change from St. Clair to Lafferty results from a decrease in the percentage of allochems and an increase in lime mud and detrital clay and silt. The change in depositional environment was apparently rapid because the contact is relatively sharp in most places. There is an increase in detrital mud and decrease in carbonate, including fossil remains, upward in the unit. This is best seen in the thicker sections, such as at Stop 4 and Alternate Stop C, where the upper part of the unit is a sparsely fossiliferous, clayey lime mudstone. With the addition of clay, the unit becomes characteristically slabby bedded (Fig. 14).

The "button-shale" is the basal unit of a transgressive-regressive cycle of sedimentation that includes the overlying St. Clair and Lafferty Limestones. The shale represents terrigenous sediment that accumulated in a near-shore subtidal environment containing oncolites, aggutinated foraminifers, and ostracodes. Seaward, lime mud was collecting in a protected subtidal lagoonal environment that abounded in agglutinated foraminifers and ostracodes. This sediment is now represented by the basal ostracode wackestone of the St. Clair. Protection was afforded by a crinozoan shoal zone now represented by the coarse-grained St. Clair. On the lee side of this shoal, marine invertebrate life abounded on a substrate composed of intermixed lime mud and skeletons. The fossiliferous wackestone/packstone occurring above the basal St. Clair ostracode wackestone records this semi-protected subtidal environment behind the crinozoan-sand shoal. Above this, the more clastic crinozoan grainstone and poorly washed grainstone is interpreted as encroachment into the semi-protected back-shoal region by the higher energy sediment of the shoal. That some of this bioclastic debris of the shoal was delivered to back-shoal areas by storm washover is seen at the Love Hollow Quarry (Stop 3), where crinozoan grainstone of the middle St. Clair distinctly scours subjacent wackestones (Fig. 12). The poorly washed upper layers of the St. Clair represent the recurrence during the regressive phase of the conditions on the protected side of the shoal. The ostracode wackestone of the Lafferty records the return of the lagoonal environment that produced the similar rock of the basal St. Clair. As regression continued, land-derived detrital grains were delivered to this environment in greater abundance as recorded by the clayey lime mudstone of the higher layers of the Lafferty. It is significant to note that where the St. Clair is exceptionally thick, the Lafferty is exceptionally thin (e.g., Stop 1; Fig. 4), and vice versa (e.g., Stop 3; Fig. 11)). These contrasts no doubt reflect the proximity of the crinozoan shoal.

SUMMARY OF DEVONIAN STRATIGRAPHY,

NORTH CENTRAL ARKANSAS

Devonian rocks of northern Arkansas have been assigned to three formations, which in ascending order are: the Penters Chert (Lower Devonian), the Clifty Formation (Middle Devonian), and the Chattanooga Shale and its basal Sylamore Sandstone Member (Upper Devonian). The Clifty is confined to northwest Arkansas and will not be included in this discussion. A summary of the Clifty and its occurrence can be found in Hall and Manger (1977).

Both the Penters and the Chattanooga are of sporadic occurrence in north central Arkansas. Of the two, the Chattanooga is more widespread; it occurs in several localities in north central and northwest Arkansas, but does not crop out well. The Penters is confined to the Batesville district where it occurs between the Lafferty and the Chattanooga or Boone. Over much of the district it has been removed by pre-Chattanooga or pre-Boone erosion.

Penters Chert

Miser (1922) named the Penter's for exposures near Penter's Bluff on the White River (just south of Stop 3). Based on its stratigraphic position, he assigned the unit to the Lower Devonian. Kinney (1946) reported a small brachiopod fauna indicting a Lower to Middle Devonian age from the base of the Penters in the vicinity of Stop 1.

The upper part of the unit is excellently exposed along the Missouri Pacific right-of-way just south of Penters Bluff. Most of Miser's understanding of the lithic character of the Penters came from these exposures, which are massive beds of dense, light- to bluish-gray chert with some unsilicified patches of gray, fine-grained limestone. The only other places the Penters is preserved within the district are near Cushman and just north of Batesville (Stop 1 and vicinity). During the time of Miser's work, the latter occurrence was mostly covered by surficial material floating downhill from the overlying Boone. The excellent artificial exposures created by the Batesville Stone Quarry and the Midwest Lime Company Quarry (Stop 1) presently afford the best available view of the entire formation.

Based on his observations along the bluffs of the White River, Miser reported the unit as 20 to 25 feet of dominantly massive chert with only a small amount of limestone. At Stop 1, the unit is about 25 feet thick, but only the upper few feet are massive chert. The lower 15 to 18 feet are fine-grained fossiliferous dolomitic wackestone with some dense chert and zones of partial silicification. It is glauconitic and shaley in places.

The Penters exhibits an irregular contact with the underlying Lafferty at the Batesville Stone Quarry and in the west wall of the Midwest Lime Quarry. In the north and east walls of the Midwest Lime Quarry the Penters rests directly on the Fernvale because of pre-Penters erosion of the Lafferty and St. Clair Limestones. The base of the Penters is marked by a 2 inch glauconitic, dolomitic sandy shale. A thin chert breccia (1 inch) occurs at the top of unit and apparently represents residium on the post-Penters erosional surface. Miser reported 6 to 7 feet of chert breccia in the upper part of the Penters along the White River. The breccia, which is not sharply separated from bedded chert below, contains large blocks and even unbroken beds tilted at angles as high as 40 degrees. Miser interpreted this breccia as the result of subsidence of the Penters into sinks formed in the underlying St. Clair during subaerial exposure. Inasmuch as the overlying Chattanooga and Boone are not affected, this karst development must have occurred prior to their deposition.

An angularity in the beds occurs in the lower limy portion of the Penters at the Batesville Stone Quarry. A clear exposure of the underlying Lafferty and St. Clair Limestones shows this angularity not to be the result of subsidence of Penters into subjacent sinks. The dipping beds are shaley and lie adjacent to massive limestone, which possibly represents some type of bioherm development. The massive limestone is high in the quarry and not accessible for examination by climbing. Interpretation of the depositional environment of the Penters awaits a detailed lithic study.

Chattanooga Shale

The Chattanooga is a black, hard fissile shale with thin lenses of phosphatic sandstone and siltstone. In places phosphatic brachiopods are present. The best exposures of the unit are in northwest Arkansas where it attains a maximum thickness of 25 feet and can contain at its base a 2 foot thick phosphatic sandstone, the Sylamore Sandstone Member.

In northcentral Arkansas the Chattanooga is of sporadic occurrence, and where present is only a few feet thick. More commonly, the stratigraphic interval of the Chattanooga, just below the Boone Formation, is occupied by a sandstone or sandy shale of variable phosphate content that many agree is gradational into the base of the St. Joe Member of the Boone. Geologists who have concerned themselves with the Devonian and Mississippian stratigraphy of the region have been divided as to whether this sandstone is the same as the Sylamore Sandstone Member of northwest Arkansas or whether it is a stratigraphically higher sandstone that represents a basal detrital phase of the Boone. The location of the type Sylamore is not exactly known. It was named for exposures in north central Arkansas along South Sylamore Creek, where up to 25 feet of phosphatic sandstone occurs between the Boone and underlying rock of Ordovician and

Silurian age (Horner and Craig, 1984). The sandstone rests with obvious unconformity on the underlying rock, but exposures are not such to provide information on its relationship with the Boone. Only at one locality along South Sylamore, Alternate Stop C (Fig. 25), is the sandstone associated with Chattanooga Shale. Here approximately 9 feet of fissile, black shale containing thin phosphatic siltstones occurs between a basal 2-foot and an upper 4-foot phosphatic sandstone. McKnight (1935) and Swanson and Landis (1962) have reported other occurrences of fissile, black shale beds and lenses in phosphatic sandstone from isolated localities in north central Arkansas away from the type South Sylamore Creek area.

To add to the confusion over the lithostratigraphy, conodont-based age determinations of both the phosphatic sandstone at the base of the Boone and that associated with black shale have given results ranging from Middle Devonian to Early Mississippian (Maher and Lantz, 1953; Freeman and Schumacher, 1969). Some authors (Maher and Lantz, 1953; Freeman and Schumacher, 1969; Hall and Manger, 1977) have reported the Devonian-Mississippian boundary from within a single, seemingly uninterrupted sandstone unit. One example of this situation is Alternate Stop C, where the systemic boundary occurs 3 feet above the base of the upper sandstone.

The intimate association of sandstone and black shale, the varying age of the sandstone, and the apparent depositional continuity in many places between a sandstone and the overlying St. Joe Member of the Boone led Swanson and Landis (1962) to propose a model that relates all of the interval's rocks to one genetic unit deposited during a single transgression of the sea. In their model, the Chattanooga was deposited as a shelf mud and the phosphatic sandstone represents a shallow-water, near-shore accumulation. Occurrences of shale interbedded with sandstone represent an interfingering of the two lithosomes. The different ages determined for the sandstone result from its being a near-shore deposit in a transgressing sea. Freeman and Schumacher (1969) expanded on the model by constructing a qualitative paleo-physiographic map based on the age of the base of the sandstone in different places. According to the interpretation of both Swanson and Landis and Freeman and Schumacher, the transgression continued across the Devonian-Mississippian boundary without a significant break in deposition, resulting in a conformable contact between the detrital rocks below and the overlying St. Joe Member of the Boone Formation.

Other workers (Thompson and Fellows, 1970; Manger and Shanks, 1976; Hall and Manger, 1977) do not deny the occurrence of interbedded Sylamore-type phosphatic sandstone and Chattanooga Shale for the Devonian portion of stratigraphic interval, but maintain that all Mississippian age phosphatic sandstone records a separate transgression and rests unconformably on the underlying Devonian. Wise and Caplan (1979), in a review of the Devonian stratigraphy of northern Arkansas, also conclude that the sandstone at the base of the Boone is distinct and separate from the Sylamore. The name Bachelor Formation is most commonly applied to this basal Mississippian unit. According to this interpretation, the basal sandstone at Alternate Stop C is assigned to the Sylamore Sandstone Member of the Chattanooga; the lower 3 feet of the upper sandstone is considered an informal member of the Chattanooga and the upper 1 foot is placed in the Bachelor Formation (Hall and Manger, 1977).

Horner and Craig (1984) concluded that the phosphatic sandstone of the interval represents a lag deposit at the base of the transgression that eventually resulted in the deposition of the overlying Boone Formation. They identified two periods of phosphate formation: an older one that affected the Fernvale Limestone and a younger one that affected the oolitic limestone associated with the Ordovician phosphatic beds traditionally assigned to the Cason Shale (see the article on the Post-St. Peter Ordovician in this guidebook). They further conclude that at different times during the Early Paleozoic this phosphate was subaerially exposed and reworked, along with well-rounded, medium-sized sand grains from the St. Peter and sandstones of the Everton Formation, into the base of the overlying transgressive carbonate, imparting a remarkable similarity to the thin detrital units found in the Ordovician, Silurian, and Devonian of the region. Although Horner and Craig accepted the Swanson and Landis model for the Chattanooga and its associated phosphatic sandstone, their work points out that units of distinctly different age can be quite similar in appearance and suggests caution in embracing one side or the other in the controversy over the stratigraphy of these rocks.

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ROAD LOG

Post-St. Peter Ordovician and Silurian and Devonian Rocks

of North-Central Arkansas

First Day - Batesville to Mountain View

Mileage (interval)	cumulative	
	0.0	Intersection 69/167 on north side of Batesville.
(0.6)	0.6	State 69 turns west (left). Continue north on 167.
(1.7)	2.3	Entrance to Midwest Lime Company Quarry on left. Take entrance road to quarry office.
(0.2)	2.5	STOP 1 (Fig. 4). The MIDWEST LIME COMPANY QUARRY and the now abandoned CASON MINE and BATESVILLE STONE QUARRY, both just to the west of the Midwest Lime Quarry on land held by the quarry, afford an excellent view of the stratigraphic section from upper Plattin Limestone into the Boone Formation. Of particular interest here is the facies of the St. Clair and the relationship of the St. Clair to the oncalite-bearing shale ("button" shale) of the Cason, and both units to the underlying Fernvale Limestone (Figs. 5 and 6). The Cason Mine, mined for its manganese content in the early part of this century, is the type section of the Cason. Tailings from the quarry are encroaching on the mine exposure. The manganese occurs as a replacement of the carbonate oncolite growths. The thickest development of the St. Clair in Arkansas is at the Batesville Stone Quarry, from which the limestone was quarried for ornamental stone. The Midwest Lime Company presently quarries Plattin, Kimmswick, Fernvale,

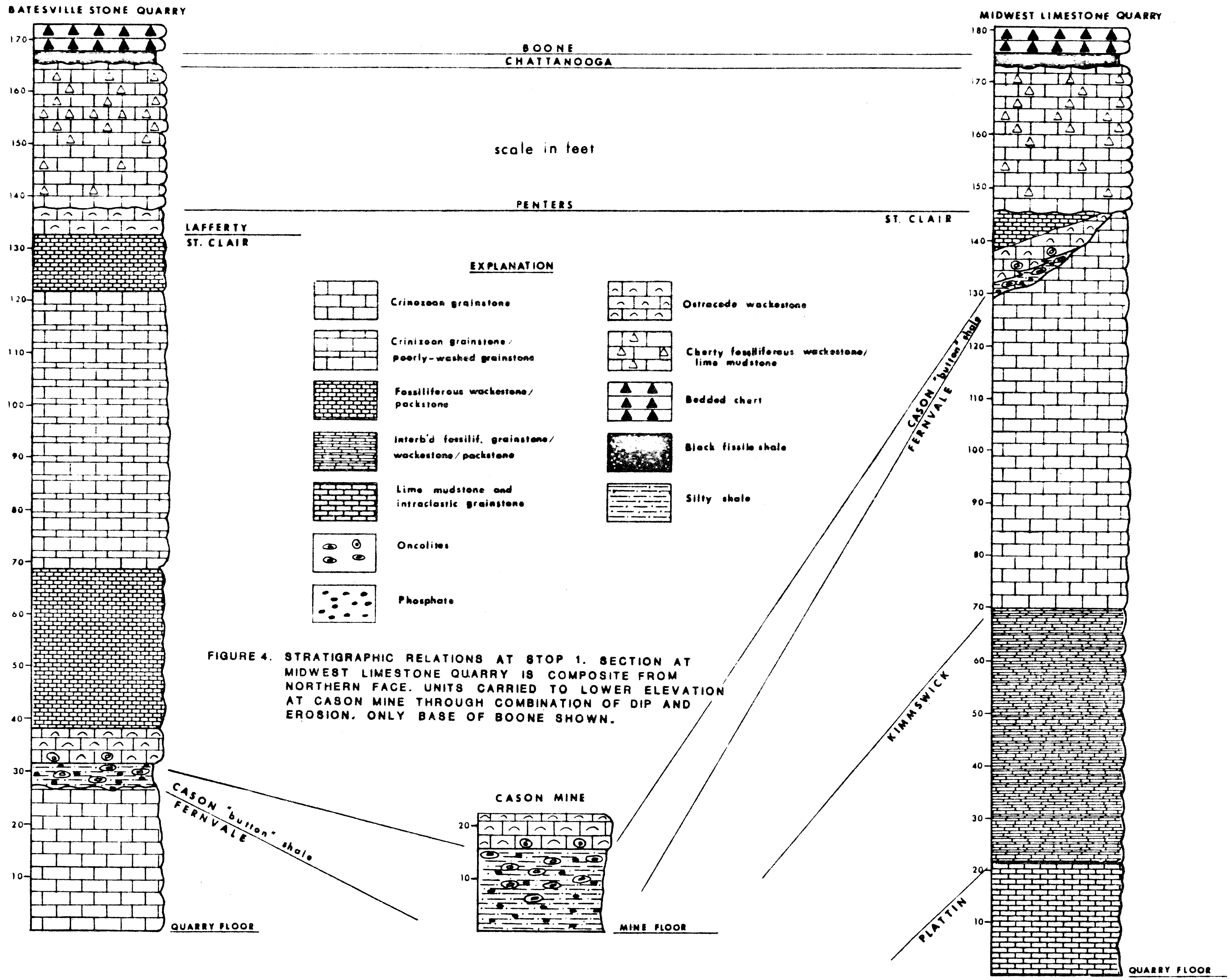


FIGURE 4. STRATIGRAPHIC RELATIONS AT STOP 1. SECTION AT MIDWEST LIMESTONE QUARRY IS COMPOSITE FROM NORTHERN FACE. UNITS CARRIED TO LOWER ELEVATION AT CASON MINE THROUGH COMBINATION OF DIP AND EROSION. ONLY BASE OF BOONE SHOWN.

Figure 5. Stop 1. Cason "button" shale filling fractures and solution passages in top of Fernvale Limestone, west face of Midwest Lime Company Quarry. Fernvale (Of), Cason "button" shale (Sc), St. Clair (Ssc).

Figure 6. Stop 1. Stratigraphic section along west face of Midwest Lime Company Quarry. Note St. Clair onlapping Cason "button" shale dark band between Fernvale and St. Clair) onto Fernvale Limestone. Plattin (Op), Kimmswick (Ok), Fernvale (Of), St. Clair (Ssc).

		and St. Clair for road material and agricultural lime.
(0.2)	2.7	Retrace path to U.S. 167. Turn north (left) toward Alternate Stop A.
(0.9)	3.6	Junction with Arkansas 394. Continue north on U.S. 167.
(1.4)	5.0	Crossroads in Pfeiffer, Arkansas.
(1.5)	6.5	Tom's Auto Salvage on right.
(0.9)	7.4	ALTERNATE STOP A. (Fig. 7). TYPE ST. CLAIR LIMESTONE. Park on shoulder of highway across from stonehouse on left. The section is on the wooded hillside to the east (right) of highway. To reach it, cross the barnyard and pasture behind barn on foot. Ask permission at stone house first. The section exposed here contains the only presently known occurrence in the Batesville district of the Lower Silurian Brassfield Limestone and the oolitic and algal-fenestral limestone belonging to the Ordovician portion of the Cason Shale. These rest on the Fernvale Limestone (a peculiar fine-grained development) which occurs at the base of the hill. The major portion of the hill above the Brassfield is the St. Clair Limestone, with a small amount of Lafferty Limestone on top. The type section at St. Clair Spring is about 450 yards south along the hillside. The exposure at the spring is no longer adequate so the rock at Alternate Stop A is effectively the type St. Clair.
(5.9)	13.3	Retrace path south on U.S. 167 past entrance to the Midwest Lime Company Quarry to junction with Arkansas 69N. Turn west (right) on 69N.
(0.5)	13.8	Bridge over Polk Bayou.
(0.6)	14.4	Batesville city limits.
(0.4)	14.8	Junction Arkansas 69N and 69B. Turn north (right) on 69N.
(2.8)	17.6	Chert beds of Mississippian Boone Formation in roadcut on right and continu-

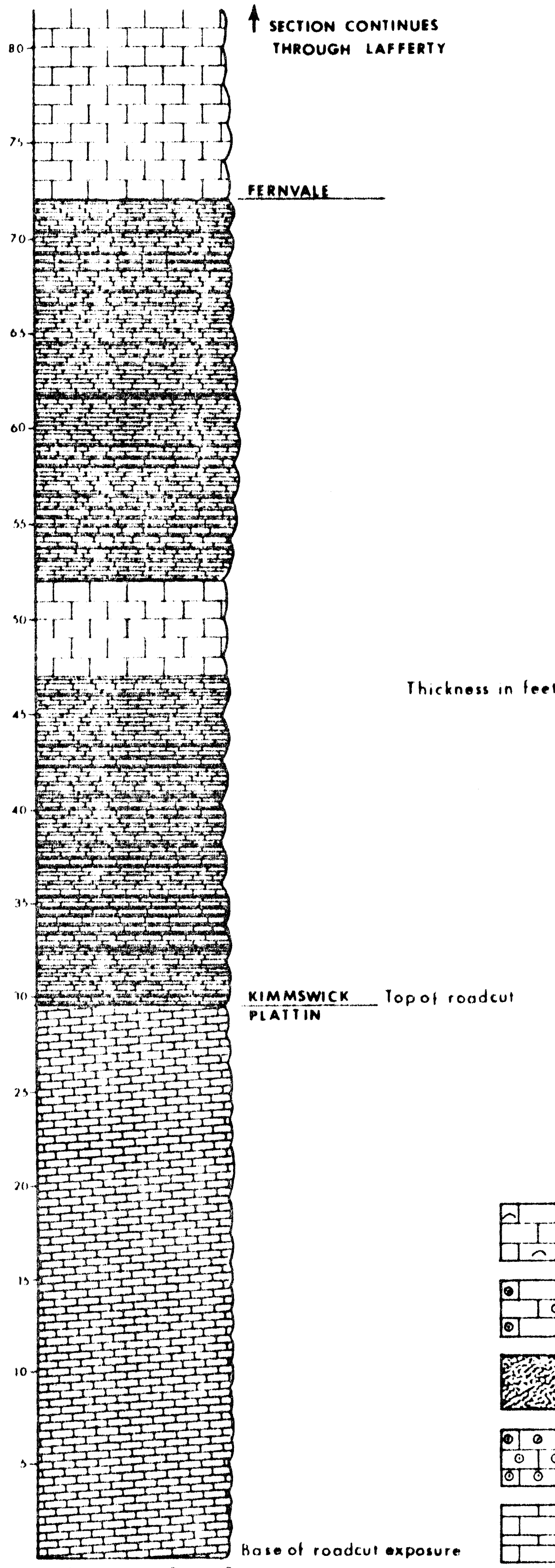


FIGURE 8. Stop 2.
WEST LAFFERTY CREEK

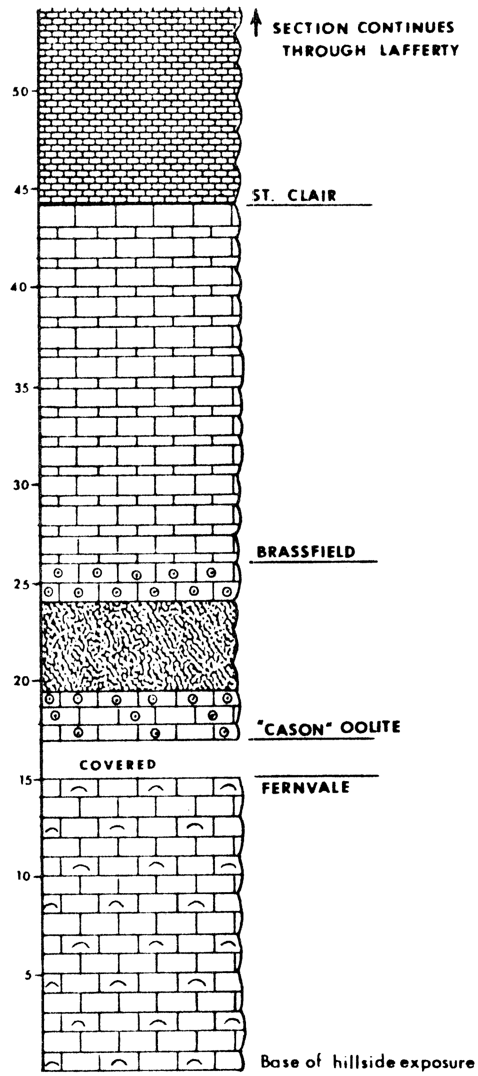
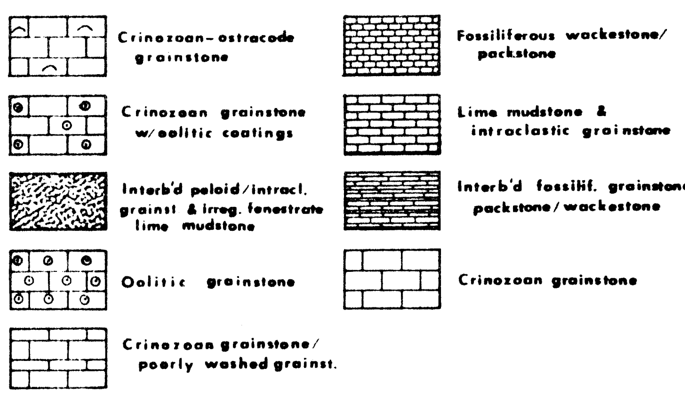


FIGURE 7. Alternate Stop A.
ST. CLAIR SPRING

EXPLANATION: Figures 7 & 8



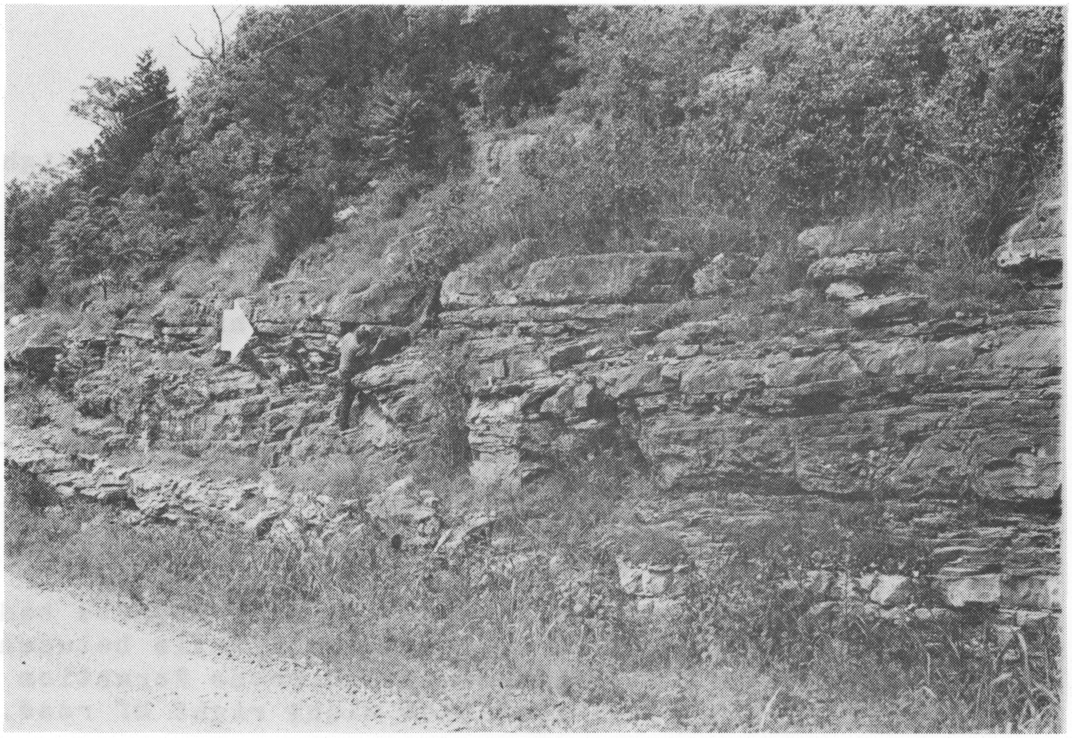


Figure 9. Stop 2. Kimmswick on Plattin, Love Hollow Road at West Lafferty Creek. Geologist's hand is on basal sandy Kimmswick Limestone. Note angularity of Plattin Limestone to basal Kimmswick.

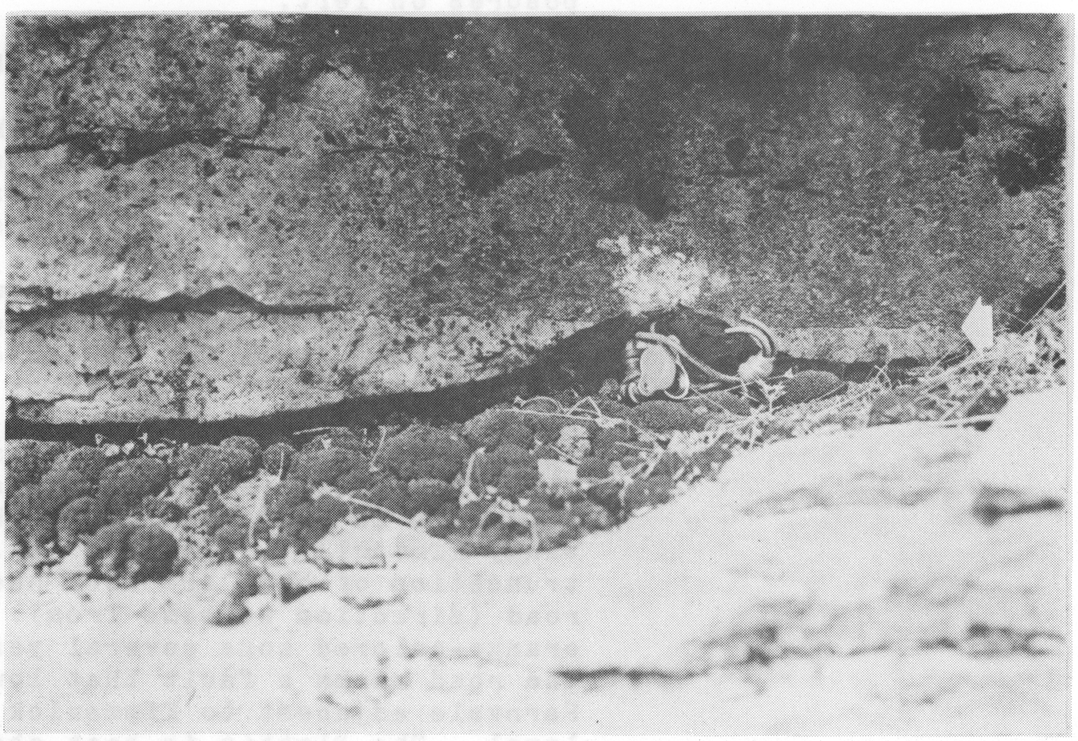


Figure 10. Stop 2. Close up of contact in Figure 9. Note truncation of bed of Plattin (light colored) against basal Kimmswick.

ing down hill.

(0.9)	18.5	Limedale Junction. Swing right on 69N. Roadcuts along highway are in chert beds of Boone Formation.
(1.1)	19.6	Spring Mill. Spring issues from Boone in base of hillside.
(3.7)	23.3	Cushman city limits.
(0.3)	23.6	Cushman General Store. Take first road west (left) beyond store.
(3.5)	27.1	Pavement ends.
(0.6)	27.7	Good exposure of phosphate beds of Ordovician Cason Shale between Fernvale Limestone and Boone Formation in drainage ditch along right of road.
(0.1)	27.8	Fernvale to right and left.
(0.2)	28.0	Contact between Kimmswick (Middle Ordovician) and Fernvale (Upper Ordovician) Limestones in moss-covered exposures on left.
(0.1)	28.1	Bridge over East Lafferty Creek.
(0.6)	28.7	STOP 2 (Fig. 8). WEST LAFFERTY CREEK. The Plattin, Kimmswick, and Fernvale Limestones, the Cason Shale, and the St. Clair Limestone are exposed in the roadcut and up the hillside at this location. The Plattin and Kimmswick are visible from the road. The base of the Fernvale is on the forested slope above. Of particular interest here is the Plattin-Kimmswick contact, which is sharp and "welded" as well as angular. The Plattin occurs in a small synclinal fold that is truncated by the basal sandy Kimmswick (Figs. 9 & 10). The truncation of beds are best seen up the road (direction we came from). An orange-colored zone several yards up the road marks a fault that lowers Fernvale adjacent to Kimmswick at road level. The Plattin is best observed down the road. It exhibits typical birdseye character with spar patches of many shapes and origins. Mudcracks are common and best observed in cross sec-

		tion, although some do show on bedding surfaces. Peloidal and intraclastic layers are also present.
(0.1)	28.8	Bridge over West Lafferty Creek.
(0.3)	29.1	Fault lowers Sylamore and Boone adjacent to Fernvale on right.
(1.5)	30.6	Turn left into entrance of Love Hollow Quarry.
(0.2)	30.8	STOP 3 (Fig. 11). LOVE HOLLOW QUARRY. Park and walk down to upper level of quarry. The upper quarry face contains the phosphate beds of the Ordovician Cason, the oncolite-bearing shale like the type Cason, and the St. Clair and Lafferty Limestones (Fig. 12). The lower quarry face contains the Kimmswick and Fernvale. The contact between the phosphate beds and "button" shale is subtle and occurs where a 6" dark-red phosphatic, conglomeratic siltstone of the basal "button" shale rests on a yellow-green silty shale of the phosphate beds. Of particular interest here is the conformable sequence from the "button" shale into the Lafferty Limestone (Fig. 13) and the scouring of the basal fine-grained St. Clair by the overlying coarse-grained St. Clair (Fig. 12). During the 1960's, the "Cason" oolitic limestone and the Brassfield Limestone occurred between the phosphate beds and "button" shale. The quarry provides Kimmswick and Fernvale to ALCOA as flux for use in sintering of bauxite.
(0.2)	31.0	Retrace route back to quarry entrance and turn left down steep hill.
(0.6)	31.6	STOP 4. NEAR TYPE LAFFERTY LIMESTONE. Miser named the Lafferty for 85 feet of slabby bedded, earthy, gray-green to red, sparsely fossiliferous lime mudstone overlying the St. Clair near this locality (Fig. 14). Beneath the Lafferty, as defined by Miser, is 12.5 feet of ostracode wackestone with scattered pink crinozoan fragments. Some later geologists (Straczek and Kinney, 1950; Craig, 1969 , and in press) have included this fine-grained rock in the

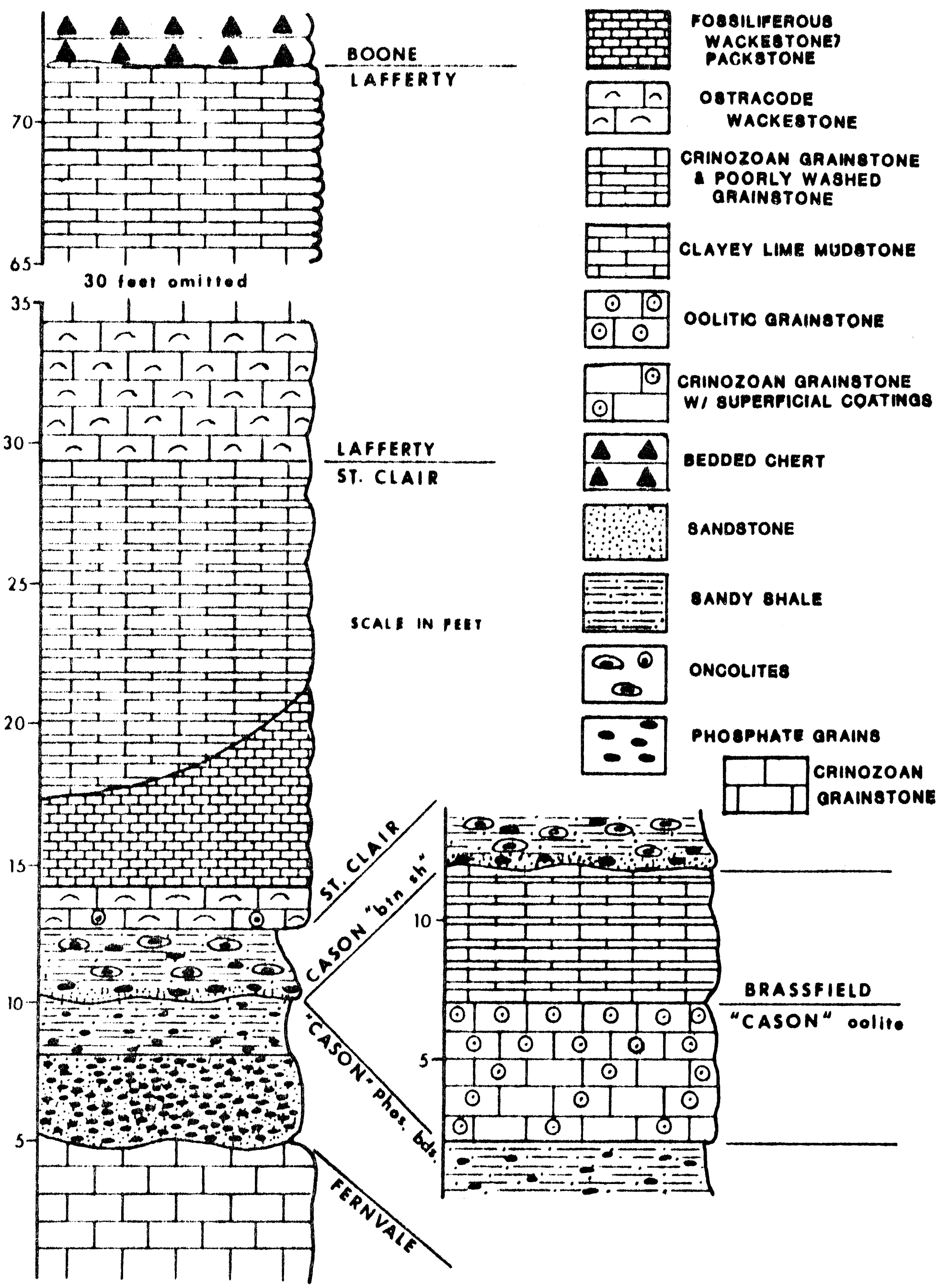


FIGURE 11. STOP 3, LOVE HOLLOW QUARRY(upper level). Short section to right shows units present between "Cason" phosphate beds and Cason"button" shale during 1960's. Lower level of quarry in Kimmswick and Fernvale.

Figure 12. Stop 3. Section in face of upper level of Love Hollow Quarry. Note scouring of basal fine-grained St. Clair by overlying coarse-grained St. Clair. "Cason" phosphate beds (Oc), Cason "button" shale (Sc), St. Clair (Ssc), Lafferty (Sl).

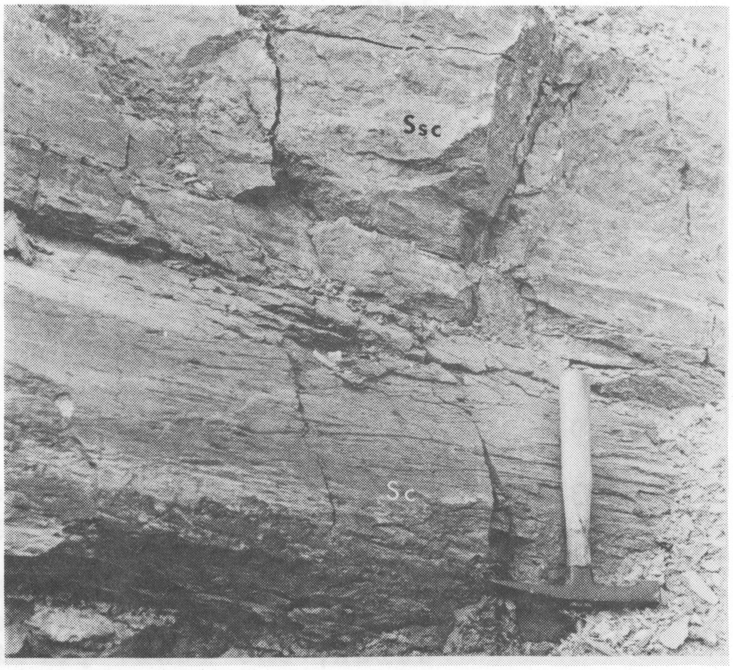


Figure 13. Stop 3. Close up showing gradation of Cason "button" shale into basal ostracode wackestone of St. Clair Limestone. Cason "button" shale (Sc), St. Clair (Ssc).

Lafferty. Others (Wise and Caplan, 1967, 1979) have retained it in the St. Clair. The coarse-grained crinozoan limestone beneath the ostracode wackestone at this locality has been interpreted variously as St. Clair or Brassfield.

(0.3)	31.9	Another entrance into Love Hollow Quarry on left. Keep right.
(0.2)	32.1	Fork in road. Go left downhill. Road descends through section from Boone into Joachim. (Caution: The road from this point to Guion is not passable when wet. In inclement weather, Stop 5 can be reached by retracing the trip route to Cushman and from there taking 69 north to Melbourne and Arkansas 9 to Allison, a travel time of approximately 1 1/2 hours from this point.)
(1.3)	33.4	Go under RR tressle and turn right. The road from here into Guion parallels the Missouri Pacific tracks along the base of the east bluff of the White River valley. The White is to the left.
(0.2)	33.6	The contact between the Joachim Dolomite and the Plattin Limestone is the prominent bedding plane in the railroad cut to the right. The upper Joachim has pieces of lime mud giving it a brecciated appearance.
(0.4)	34.0	Fork in road. Go left.
(0.1)	34.1	Fork in road. Go left.
(0.9)	35.0	Pass under RR tracks.
(0.3)	35.3	Contact of St. Peter Sandstone and Joachim Dolomite to right.
(0.5)	35.8	Dipping contact of St. Peter and Joachim to right. From here into Guion, the lower portion of the White River bluff is formed of St. Peter.
(3.0)	38.8	Right over tracks into Guion, Arkansas. Turn left along main street of Guion. The St. Peter is mined at

Figure 14. Stop 4. Slabby, clayey fossiliferous lime mudstone of Lafferty Limestone, Love Hollow Road near type Lafferty.

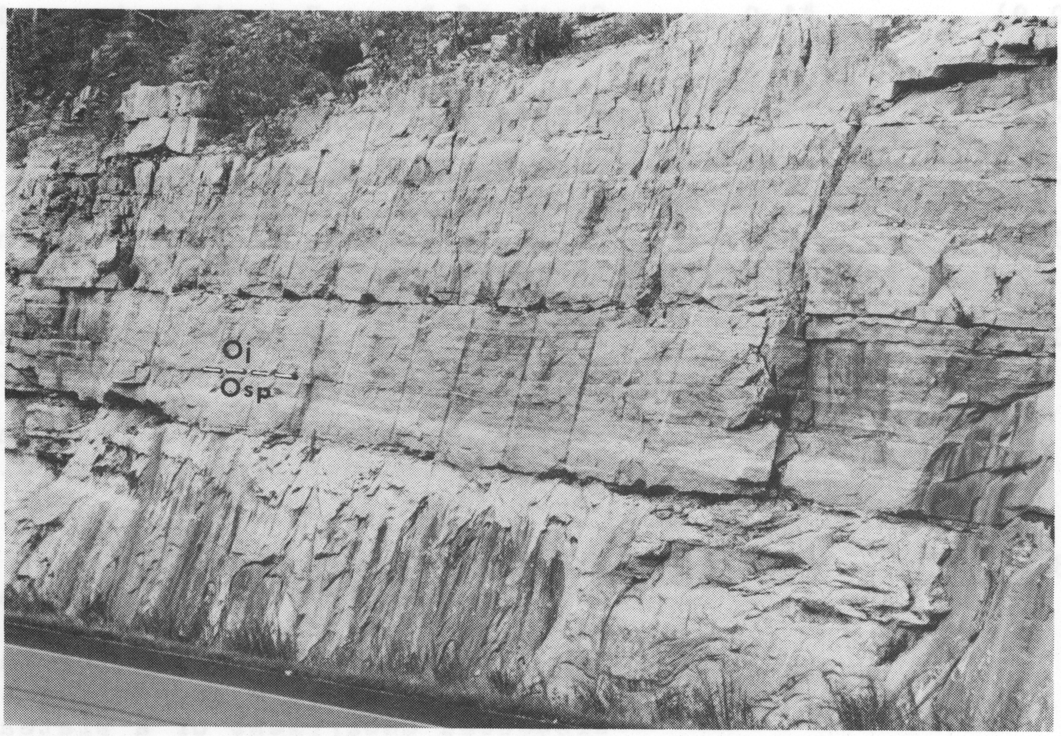


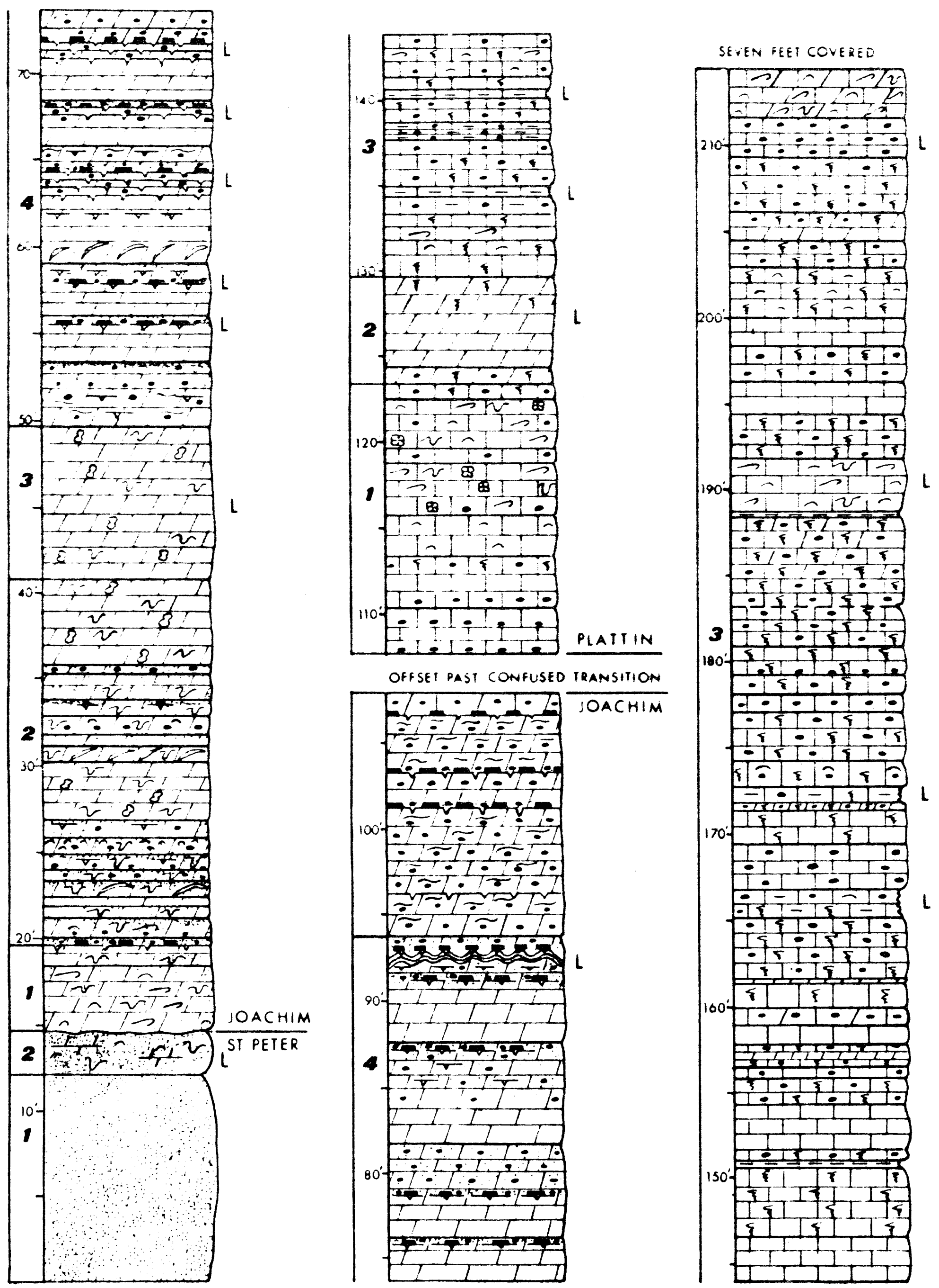
Figure 16. Stop 5. Contact between St. Peter Sandstone and Joachim Dolomite, Allison South. St. Peter (Osp), Joachim (Oj).

		Guion for use as a glass sand.
(0.6)	39.4	Junction with Arkansas 58. Turn left.
(0.4)	39.8	Guion Ferry. Cross the White River on Arkansas 58 to connect with Arkansas 14 into Mountain View. If ferry is closed, reach Stop 5 by taking 58 to Highway 69, go north on 69 to Melbourne, and south on highway 9 to Allison.
(0.1)	39.9	(Continuing on 58 on west bank of White). St. Peter on right.
(0.2)	40.1	ALTERNATE STOP B. JOACHIM-PLATTIN CONTACT. The change from thick to slabby bedding at prominent bedding plane on right is Joachim-Plattin contact. The lower Plattin in drainage to left of road contains excellent stromatolite "heads". Rock along most of road going up hill is Plattin. The Kimmswick and Fernvale are poorly exposed here.
(0.9)	41.0	Chert of Boone Formation in roadcut on left.
(0.4)	41.4	Fernvale on right.
(0.2)	41.6	Plattin on left.
(0.6)	42.2	Fernvale lowered to road level by dip or fault.
(0.2)	42.4	About 12 feet of Ordovician "Cason" Shale between the Fernvale and the St. Joe Limestone occurs in bank of small stream on right at sharp turn in road. Rock in roadcuts from here to Highway 14 is Boone.
(3.2)	45.6	Junction Highway 14. Turn west (right) toward Mountain View. The route from here into Mountain View travels along the base of the north edge of the Boston Mountains, a name given to the dissected escarpment of a plateau to the south held up by Pennsylvanian strata. Upper Mississippian strata occur in the face of the escarpment, which is readily visible to the south (left) of the highway. The lower level

on which the highway runs is the Springfield Plateau, the surface of which extends to the north (right) of the highway. The Springfield Plateau is held up by the resistant chert of the Boone Formation.

(0.5)	46.1	Batesville Sandstone (Upper Mississippian) along roadside.
(2.0)	48.1	Moorefield Shale (Upper Mississippian) in roadcut.
(0.8)	48.9	Cross Rocky Bayou. The road has descended into the Boone Formation, the weathered products of which occur in the roadcuts.
(1.6)	50.5	City limits of Mountain View. Moorefield ShaleandBatesvilleSandstonein roadcut to left. Mountain View is the home of the Ozark Folk Center and the focus of the music, crafts, and customs of hill folk.
(0.9)	51.4	Junction with Arkansas 5. Continue straight.
(1.7)	53.1	Junction with Arkansas 9. Turn right on combined highways 5, 9, and 14.
(0.7)	53.8	Red Bud Inn on left, our accommodations for the night.

END OF FIRST DAY



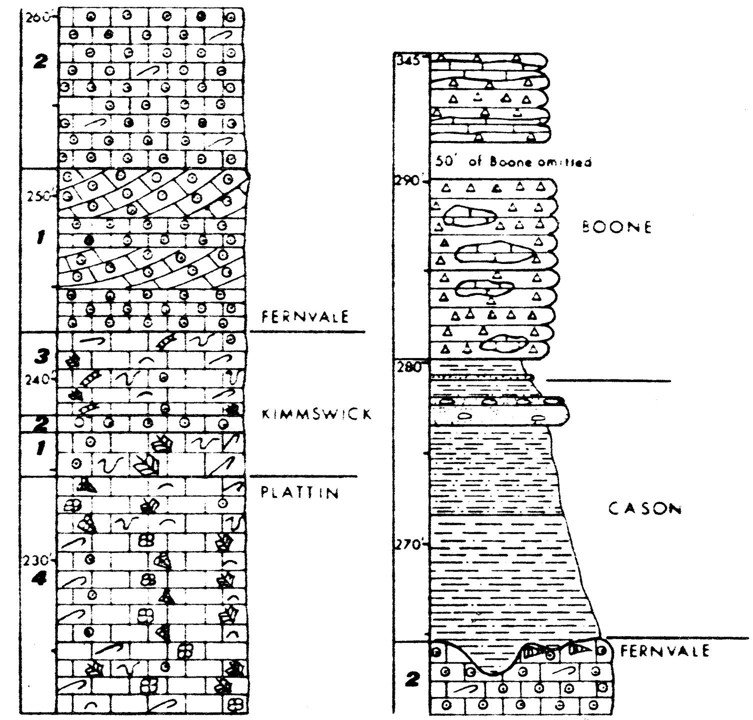
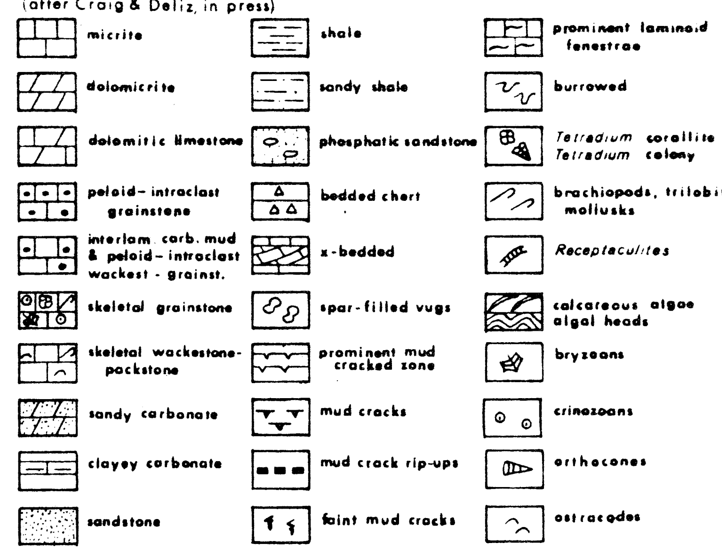


FIG. 15. STOPS 5 & 6. Stratigraphic section at Allison. St Peter–Plattin from Allison South Kimmswick–Boone from Allison West L = locator horizon (after Craig & Deliz, in press)



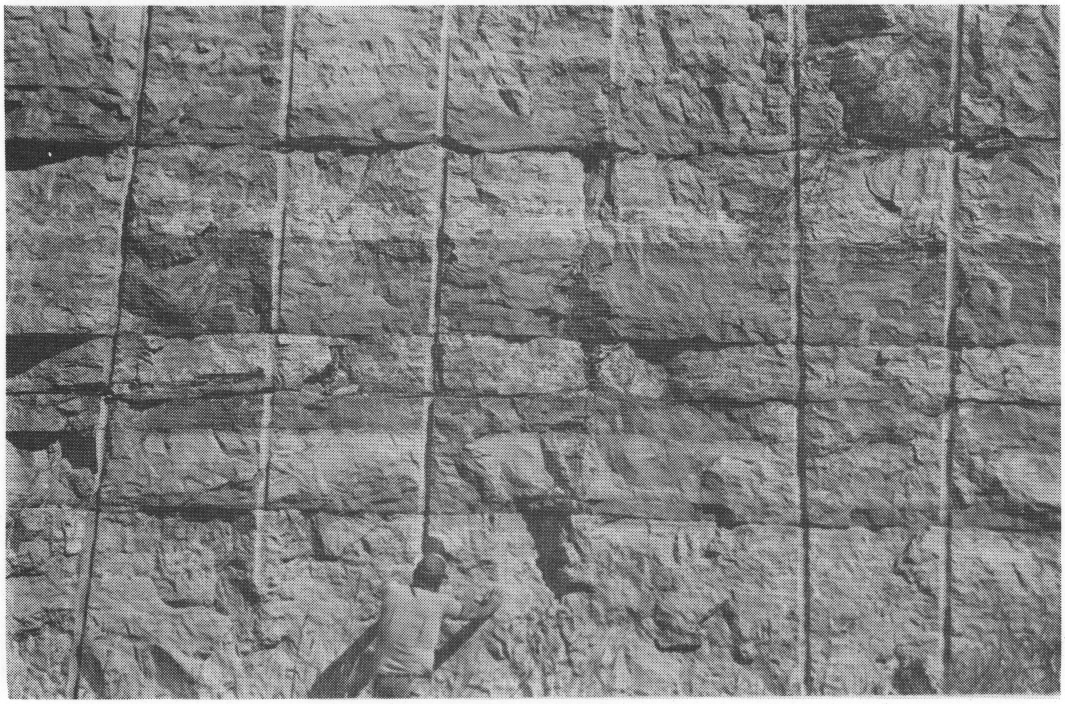


Figure 17. Stop 5. Sequences of laminated dolomicrite (dark layers) and Mudcracked zones (light layers) in Middle Joachim, Allison south.

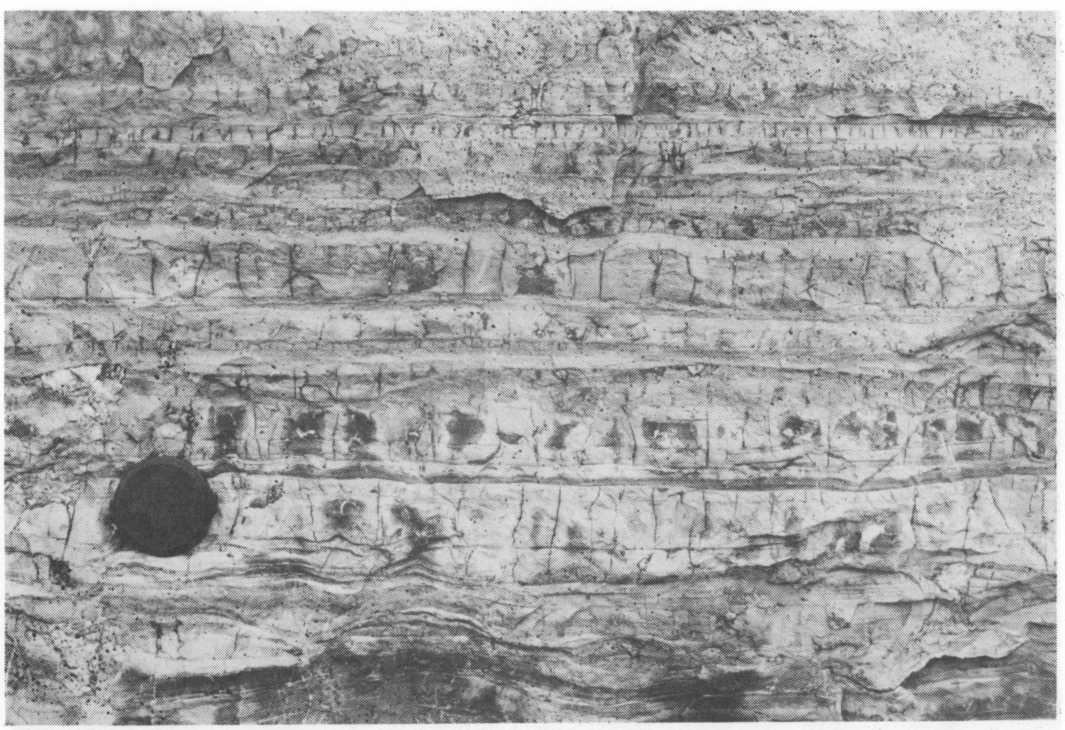


Figure 18. Stop 5. Close up of mudcracked zones in Figure 17 above.

Figure 19. Stop 5. LLH-C algae stromatolites in Joachim Dolomite, Allison South.

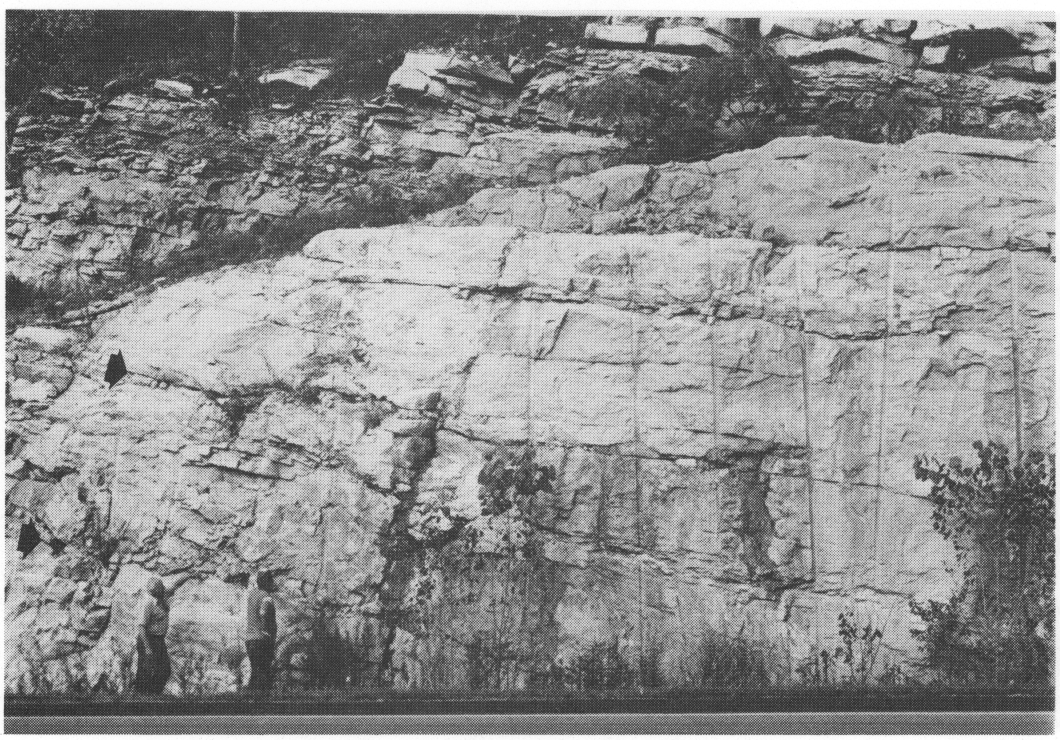


Figure 20. Stop 5. Passage between Joachim Dolomite and Plattin Limestone, Allison South. Arrows mark "disturbed" interval.

SECOND DAY - MOUNTAIN VIEW TO GAYLOR

MILEAGE (interval)	cumulative	
	0.0	Parking lot, Red Bud Inn. Turn north (left) on Arkansas 14, 9, and 5.
(0.6)	0.6	Road to Ozark Folk Center to left. Continue straight.
(3.1)	3.7	Boone in roadcuts.
(0.5)	4.2	Fernvale in roadcuts to left.
(0.4)	4.6	STOP 5 (Fig. 15). ALLISON SOUTH. Park on shoulder of highway opposite roadcut. Excellent and continuous exposure of uppermost St. Peter sandstone through the Joachim Dolomite and Plattin Limestone. The St. Peter-Joachim contact is well exposed and appears conformable (Fig. 16). A fault of small displacement lowers the Joachim adjacent to the St. Peter at the lower end of the exposure. Of particular interest are the mudcracked sequences in the Joachim (Figs. 17,18) and the disturbed passage from Joachim into Plattin (Fig. 20). The textures of the Plattin are easy to observe here. The Plattin-Kimmswick contact occurs up the highway and on the opposite side from the major cut. Both Allison sections (Stops 5 and 6) have been covered in an earlier guidebook (McFarland, et. al., 1979).
(0.3)	4.9	Junction of Arkansas, 5, 9, and 14. Turn west (left) on Highway 14.
(0.2)	5.1	St. Peter on left.
(0.7)	5.8	STOP 6 (Fig. 15). ALLISON WEST. Pull into drive on left and park on the grass. Allison West provides an excellent and continuous exposure from the upper part of the Plattin through the Kimmswick and Fernvale, the Cason (Ordovician only), and into the Boone Formation (Fig. 22). Of particular interest are the sharp, "welded" con-

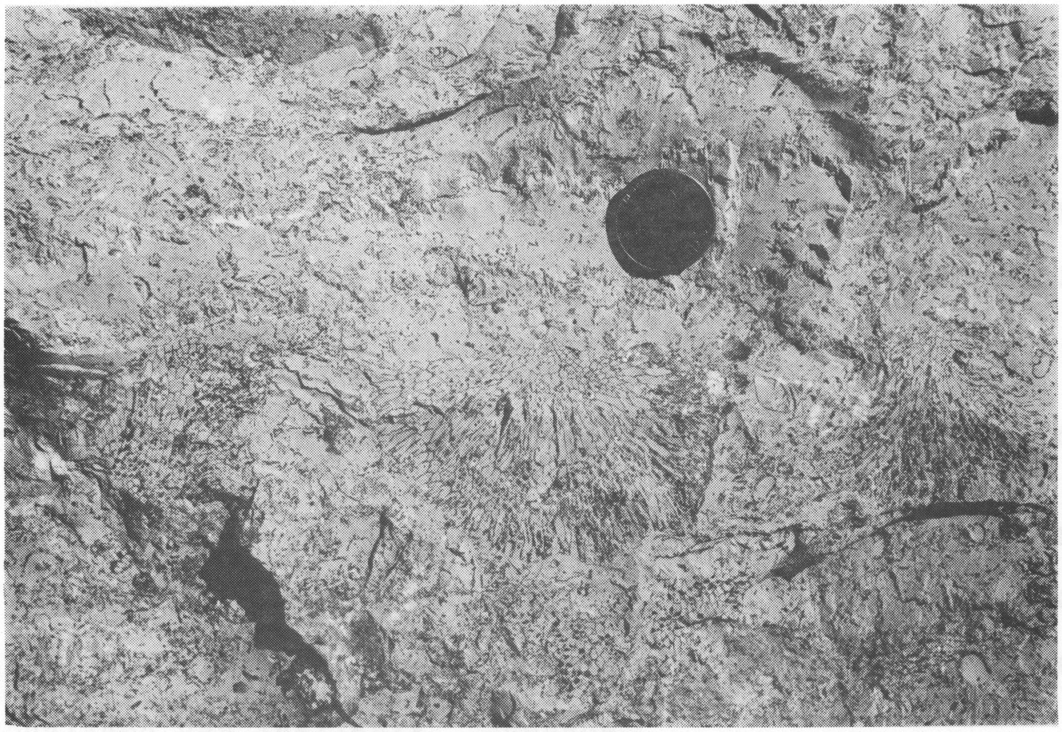


Figure 21. Stop 6. <u>Tetradium</u> wackestone in upper Plattin Limestone, Allison West.

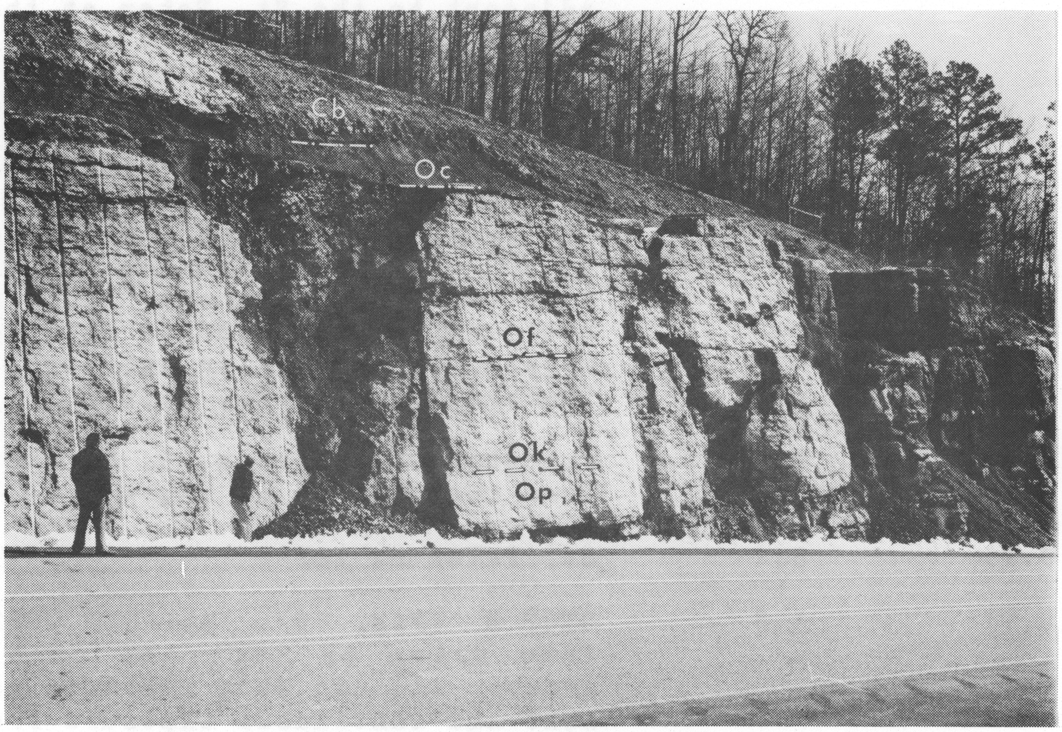


Figure 22. Stop 6. Section at Allison West. Plattin (Op), Kimmswick (Ok), Fernvale (Of), "Cason" phosphate beds (Oc), Boone with basal sand (Mb).

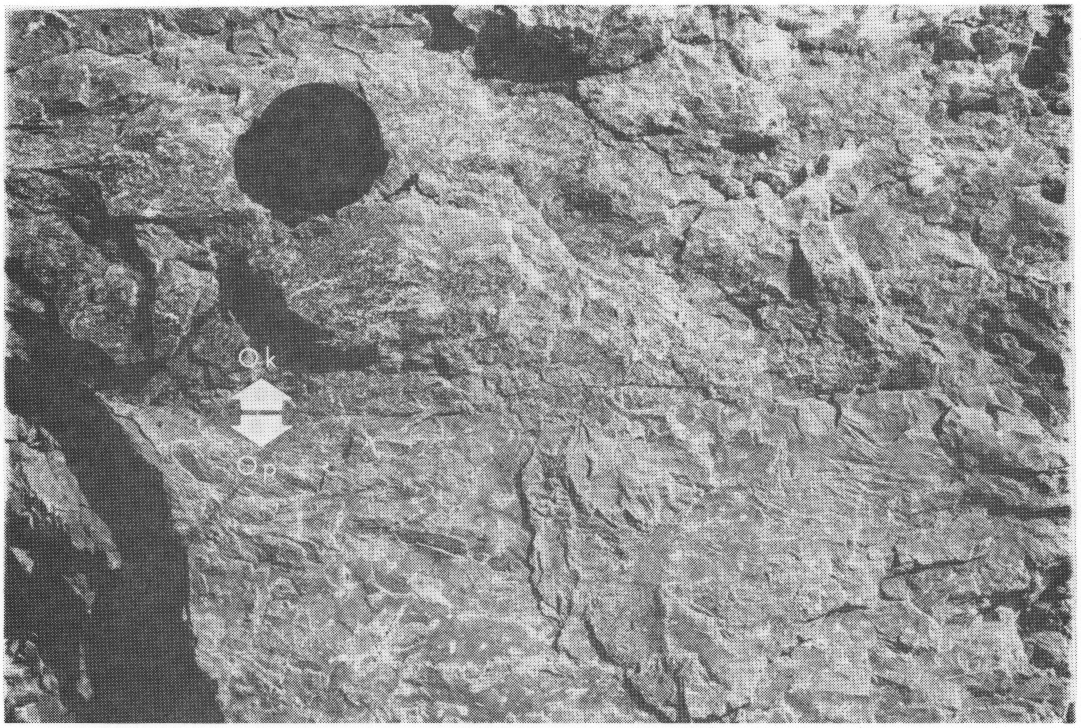


Figure 23. Stop 6. Close up of contact of Plattin (Op) and Kimmswick (Ok) Limestone, Allison West.

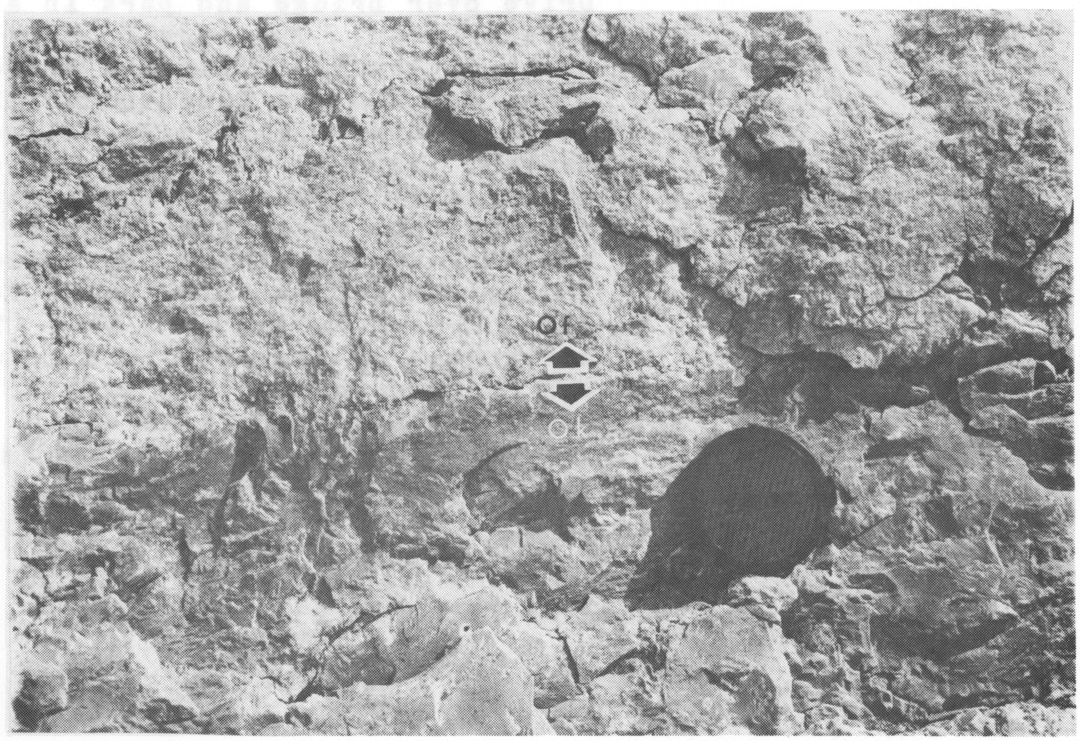


Figure 24. Stop 6. Close up of contact of Kimmswick (Ok) and Fernvale (Of) Limestones, Allison West.

tacts of the Plattin-Kimmswick (Fig. 23) and the Kimmswick-Fernvale (Fig. 24). Also well displayed in the uppermost Plattin is a fossiliferous coralline bed with *in situ Tetradium* heads (Fig. 21). A sharp truncation surface occurs within the Plattin a few inches below the Plattin-Kimmswick contact. The contact between the Joachim and Plattin, visible down the road, is quite different from the one at Allison South.

To reach ALTERNATE STOP C, continue west on Arkansas 14. The route is on the Boone Formation.

(5.5) 11.3 Junction with Arkansas 87. Turn left on 87.

(2.5) 13.8 Townsite of Gaylor.

(1.0) 14.8 ALTERNATE STOP C(Fig.25). GAYLOR CROSSING. Low-water bridge at Gaylor Crossing over South Sylamore Creek. Drive over bridge and park in area to left of road. The section here consists of the St. Clair and Lafferty Limestone and the Chattanooga Shale and its basal Sylamore Sandstone Member. This is the general area of the type Sylamore. A sandstone occurring in this stratigraphic position, but without associated Chattanooga Shale, can get as thick as 25 feet along South Sylamore Creek. The assignment of the sandstone between the Chattanooga and the base of the Boone at this stop is in doubt. The earthy, slabbyupper Lafferty is well displayed here.

END OF FIELD TRIP

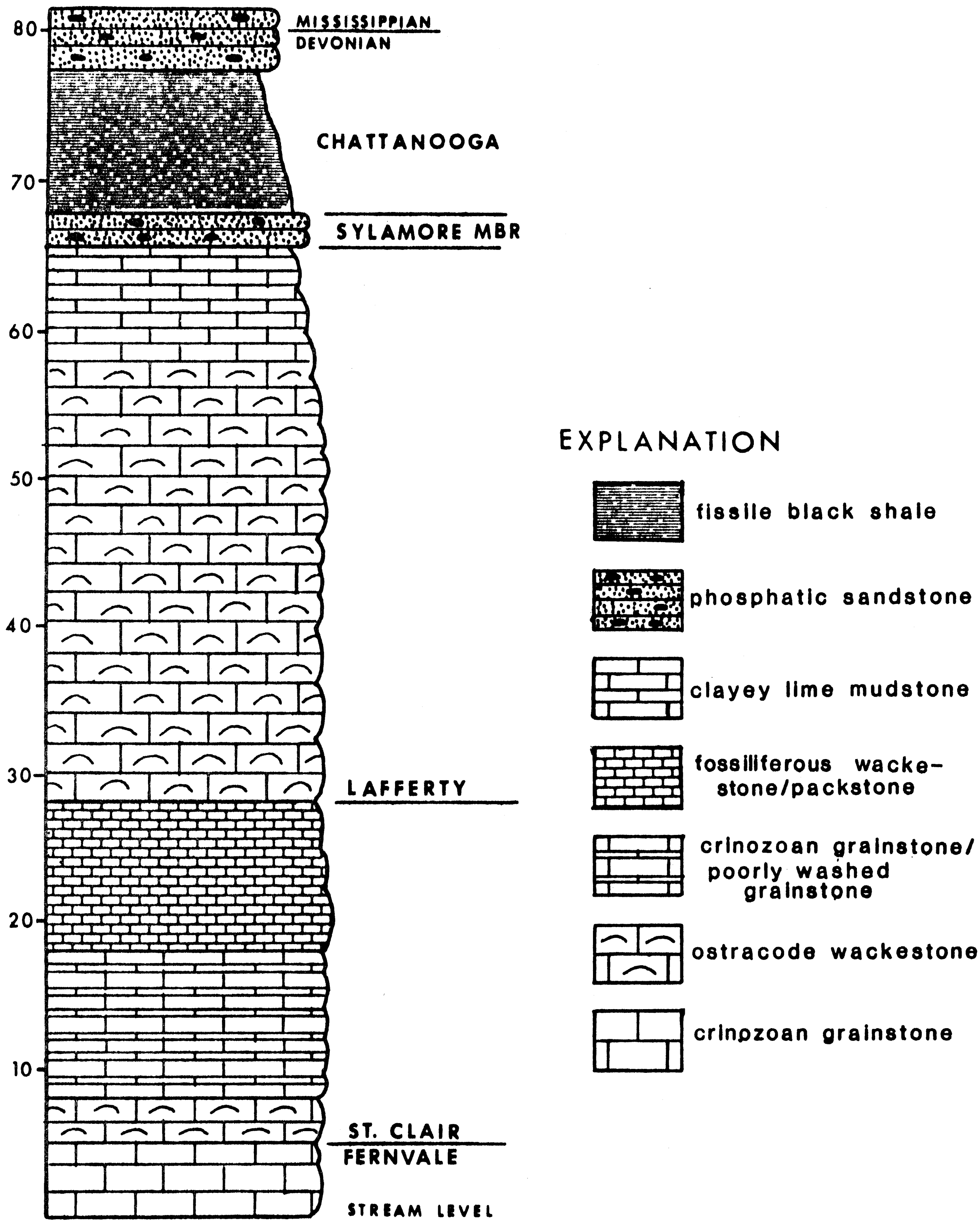


FIGURE 25. STRATIGRAPHIC SECTION ALTERNATE STOP C, GAYLOR CROSSING