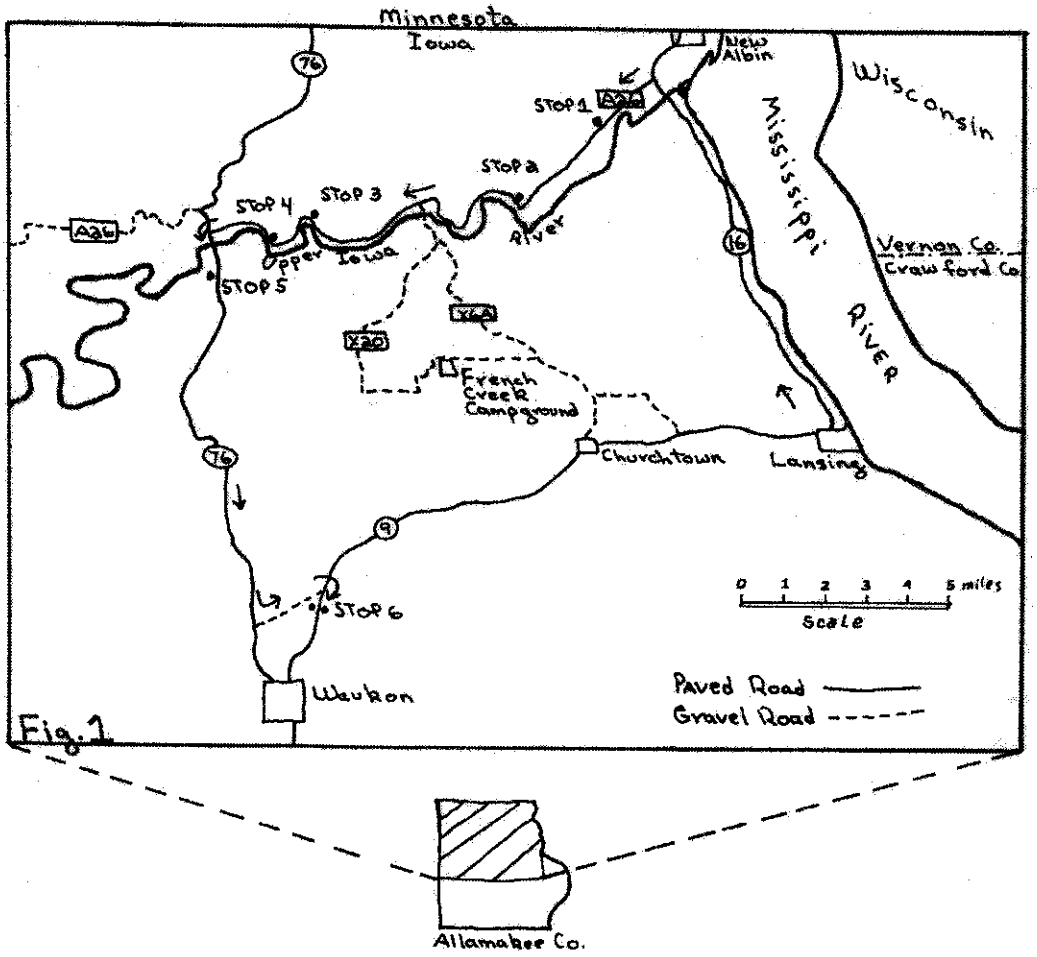
FIELD TRIP GUIDEBOOK TO THE CAMBRIAN STRATIGRAPHY OF ALLAMAKEE COUNTY

October 20, 1979

Sponsored by the **Geological Society of Iowa**
In cooperation with the **Iowa Geological Survey**



GEOLOGICAL SOCIETY OF IOWA
GUIDEBOOK 32

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PREVIOUS STUDIES

The Upper Mississippi Valley is the type area for the Upper Cambrian (Croixan Series). The Cambrian sequence consists of alternating clastic and carbonate rocks with a total average thickness of 1200 feet.

David Dale Owen (1853), was the first of a large number of geologists to study the Cambrian rocks in this area. Subsequent to Owen and up to the present time, the vast majority of paleontologic, stratigraphic, and petrologic studies of the Cambrian have focused attention on the excellent exposures in western Wisconsin and eastern Minnesota. Major revisions in the stratigraphy and generalized concepts of the depositional environments were outlined by Berg, Nelson and Bell (1956). Their environmental interpretations recognized the basal Mt. Simon sandstone through Galesville sandstone as a transgressive-regressive sedimentation cycle, and the Ironton through Jordan/Oneota as a continuous transgressive phase of sedimentation. In the mid 60's and early 70's Ostrom (1964, 1970, 1978) outlined the cyclic nature of the Cambrian through Lower Ordovician rocks as representing distinct transgressive-regressive sedimentation cycles in which, for the most part, the regressive deposits had been removed by erosion prior to deposition of the next transgressive phase. Ostrom (1978) cites four major lithostromes that developed during each transgression. These are: (1) thick-bedded, medium to coarse grained, well sorted, and cross-bedded quartzose sandstone; (2) medium to thin bedded, reworked quartzose sandstone characterized by alternating poorly sorted sandstone which is commonly burrowed, calcareous, slightly glauconitic or shaley and by well-sorted, medium to coarse grained sandstone; (3) shale, or argillaceous thin bedded sandstone that is fine-grained, feldspathic, glauconitic, or shaley, with minor carbonate; and (4) carbonate or sandy or silty carbonate or calcareous (dolomitic) siltstone. Ostrom compares these lithostromes to sediment types and lithotopes which are present on the recent marine shelf of the Northwest Gulf of Mexico.

INTRODUCTION TO CAMBRIAN STRATIGRAPHY OF ALLAMAKEE COUNTY

Cambrian strata in Iowa crop out along the Mississippi River and its eastward flowing tributaries in the northern and eastern halves of Allamakee Co., and the northeastern extremity of Clayton County. This field trip will visit exposures of the Wonewoc, Lone Rock, St. Lawrence and Jordan Formations along the Upper Iowa River, and the Iron Hill Member of the Cretaceous Windrow Formation on Lansing Ridge (fig. 1).

In northeast Iowa the Iowa Geological Survey presently uses stratigraphic terminology developed in southeastern Minnesota and southwestern Wisconsin (figs. 2 and 3). STOP 1 will visit the Ironton Member of the Wonewoc Formation (fig. 2). This is the lowest exposed formation in the state. It is a cross bedded fine to coarse grained fossilliferous sandstone, in places containing abundant trilobite fragments of Camaraspis and Elvinia and the inarticulate brachiopod Dicellomus. Towards the top it becomes calcareous and glauconitic. Above the Ironton is the Lone Rock Formation of which we will see only the upper part of the uppermost Reno member (fig. 2). The Reno consists of thinly interbedded glauconitic to

very glauconitic, horizontal to cross bedded, ripple marked, burrowed, shaley and silty feldspathic sands to very fine feldspathic sands. In places Reno beds consist almost wholly of randomly oriented shale clasts within a very fine to fine sandy matrix. These beds have previously been termed "wormstone" and their origin attributed to bioturbation. Odum (1978) suggested soft sediment deformation caused by dewatering of the shales during early compaction as an alternative origin for these beds. The Reno is within the Ptychaspis and Prosaukia subzones; unfortunately we have not found any occurrence of these faunas at STOP 2. Odum (op. cit.) interprets the Birkmose and Reno Members of the Lone Rock as areas immediately seaward of the littoral zone, where slow deposition, organic material and favorable Eh conditions permitted the development of abundant glauconite. The Reno is gradational with the overlying Lodi Member of the St. Lawrence Formation. Unfortunately, this transition zone at STOP 2 is covered, but immediately above it is exposed 1.4 feet of fine to coarse crystalline, glauconitic dolomite of the Black Earth Member of the St. Lawrence Formation. This is the only Black Earth that we will see on the field trip although it is exposed at other localities in the county. The Black Earth Member in extreme northeast Iowa is a dolomite wedge within Lodi siltstone that thickens dramatically to the south and west where the Lodi thins and eventually disappears.

Overlying the Reno Member is the St. Lawrence Formation. At STOP 3 we will see the Lodi Member which encompasses the upper two-thirds of the St. Lawrence Formation. The Lodi, commonly referred to as the Lodi Siltstone, is a burrowed, ripple marked, dolomitic siltstone to silty and fine sandy dolomite with irregular to wavy thin argillaceous and shaley partings. Horizontal burrows within shaley partings are abundant on many bedding planes at STOP 3. Note the draping of shale over rippled siltstone. Dikelocephalus is the predominant trilobite of the Lodi, but again, the collecting seems to be poor in all the Iowa exposures investigated. According to Ostrom (op. cit.) the St. Lawrence represents a restricted, rather dirty, shallow water carbonate shelf which was the clearest water deposit of a transgressing sea.

Above and gradational with the Lodi Member is the Jordan Formation. The Jordan Formation consists upward of Norwalk, Van Oser, Waukon and Coon Valley Members. The Norwalk Member is a very fine to fine grained, burrowed, argillaceous, in part trough cross-stratified, sandstone which grades upward into the medium to coarse grained, clean, cross-stratified Van Oser Member. Some weathered blocks of Van Oser may contain Skolithos burrows. Separating the Van Oser into an upper and lower portion is the newly established Waukon Member (Odum 1978). The Waukon is similar in texture and composition to the Norwalk Member but is not as well cross-stratified. Both the Norwalk and Waukon Members are interpreted by Odum (1978) to represent dominantly subtidal lagoonal deposits while the Van Oser was deposited as a tidally reworked littoral bar complex.

The youngest rock unit we will visit on the Cambrian portion of this field trip is the Coon Valley Member of the Jordan Formation. We will see the Coon Valley towards the top of STOP 4 and in a roadcut at STOP 5. The Coon Valley Member is composed of lithologies transitional to those of the underlying Van Oser Member and the overlying Oneota dolostone. Dolomitic sandstones, sandy dolostones, intraclast conglomerates, sand cored oolites and thin algal beds are characteristic Coon Valley lithologies, which are

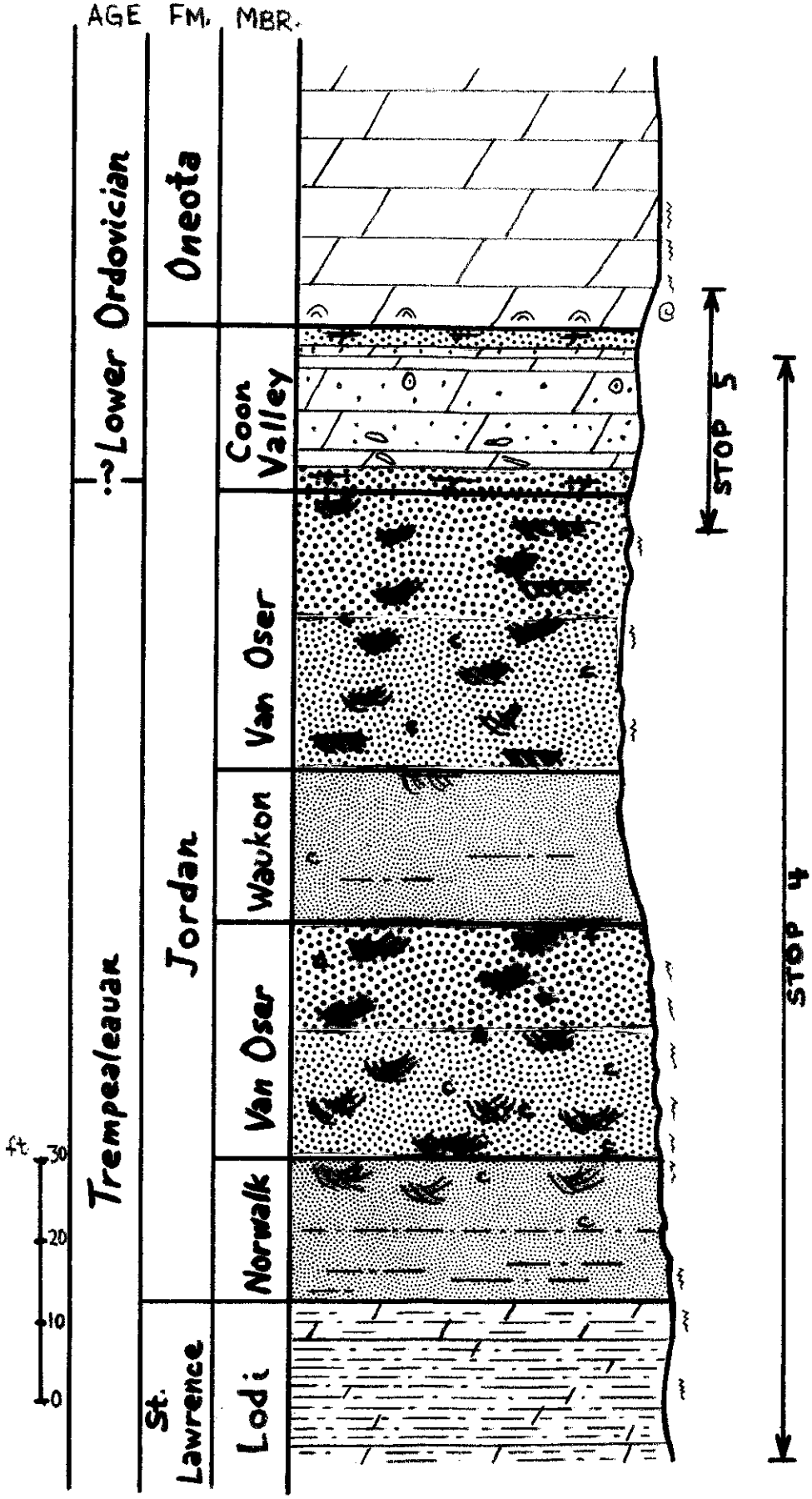
AGE
FM.
MBR.
Lower Ordovician
Trempealeauan
Oneota
Jordan
St. Lawrence
Coon Valley
Van Oser
Waukon
Van Oser
Norwalk
Lodi
STOP 5
STOP 4
ft
30
20
10
0

Fig. 2

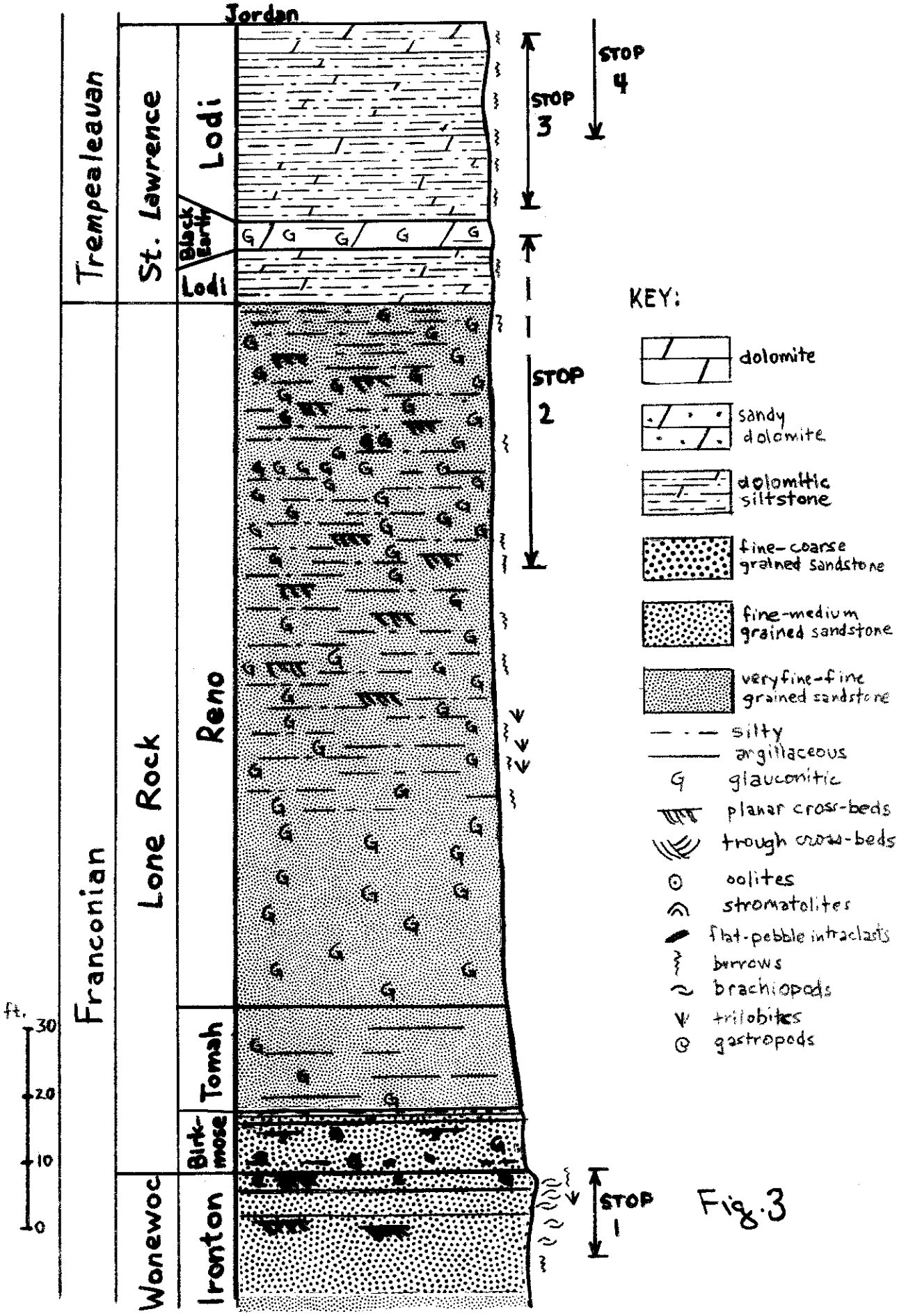
Jordan
Trempealeauan
St. Lawrence
Lodi
Black Earth
Lodi
Franconian
Lone Rock
Reno
Tomah
Birk-mose
Wanewoc
Ironton
ft.
30
20
10
0
STOP 4
STOP 3
STOP 2
STOP 1
KEY:
dolomite
sandy dolomite
dolomitic siltstone
fine-coarse grained sandstone
fine-medium grained sandstone
very fine-fine grained sandstone
silty
argillaceous
glauconitic
planar cross-beds
trough cross-beds
oolites
stromatolites
flat-pebble intraclasts
burrows
brachiopods
trilobites
gastropods

Fig. 3

believed to represent the northward transgressing edge of an extensive carbonate platform during Early Ordovician time.

The last stop of the day (STOP 6) is an exposure of the Iron Hill (Andrews, 1958), the lowest member of the Windrow Foramtion (Thwaites and Twenhofel, 1921). The unit has been dated as Cretaceous in age based on plant fossils found in the overlying East Bluff Member and lithologic similarities to the Ostrander Member of the Dakota Formation, although it has been found to overlie rocks ranging in age from Precambrian to Devonian. The Iron Hill is an iron deposit composed primarily of limonite ($Fe_2O_3 \cdot 3/2H_2O$) but also contains goethite ($Fe_2O_3 \cdot H_2O$), turgite ($Fe_2O_3 \cdot \frac{1}{2}H_2O$) and hematite ($Fe_2O_3$). Details of the origin of the deposit is unclear, however, suggestions include bay deposits, replacement of limestone by iron-rich solutions, and secular decay creating residual deposits. No one of these, however, is sufficient to completely explain the origin of the Iron Hill Member. Coarse, angular quartz and chert grains can be found in upper portions of the sections, while silicified fossils derived from the underlying Galena Formation can be found encased in the iron oxides near its base.

Iron Hill represents the high point in North East Iowa (1,345 feet) as well as the type section for the member. The Iron Hill Member averages over 20 feet in thickness (maximum 135 feet) and covers an area over 200 acres. It has been estimated (Beyer, 1901) that over 12,000,000 tons of potential iron ore is included in this member. The ore was mined here from 1899 through 1918 with concentrate shipped to Chicago, St. Louis, Milwaukee, and Granite City, Minnesota. The high cost of shipping the ore by rail has presently eliminated the economic viability of the Iron Hill as an iron ore.

CAMBRIAN STRATIGRAPHY OF ALLAMAKEE COUNTY, IOWA

Brian Witzke, Bob McKay, Ray Anderson

Geological Society of Iowa Field Trip
in cooperation with the Iowa Geological Survey
Saturday, October 20, 1979

There are no restroom facilities available at any point along the trip (bushes and woods will suffice). Picnic tables and drinking water will not be available for our lunch stop. Plan on eating your bag lunch whenever you feel the need; Stop 3 will probably be a good place to eat with large blocks of rock serving as suitable chairs and tables. Free camping is available after the trip at French Creek (see map) and at Yellow River State Forest. Both camp areas can be expected to be crowded with weekend campers. The Iowa City crew will be staying at French Creek in small tents surrounding a large tepee, and we will try to occupy a large enough area that additional tent space will probably be available for field trippers. Motel rooms may be available in Lansing, New Albin, or Waukon.

Road Log (in miles)

0	Rendezvous in Lansing, Iowa at ball park south of Mississippi River bridge. Proceed in auto caravan north on Second Street (Highway 26).

0.1	Knopf's Standard Station, 115 N. Second Street. Excellent exposures of Lone Rock Formation sands and green sands are seen here. Do not stop. We will be driving past many Cambrian outcrops during the course of the day, but because of logistical or time limitations we will be restricted to only five Cambrian stops. We encourage participants to examine these additional outcrops after today's trip.
0.4- 0.9	Roadcuts on left include exposures of Lone Rock sands and green sands, and the contact with the overlying St. Lawrence Formation can be seen near the north edge of the roadcuts.
4.1	Bridge crosses small stream. Adjacent to north edge of bridge and continuing west on south bank of stream are natural exposures of the Ironton Member of the Wonewoc Formation. This outcrop reveals the most complete Ironton section in Iowa, and the oldest Paleozoic rocks that presently crop out anywhere in the state are found at the base of this exposure.
4.3	Roadcuts in the Ironton Sandstone.
5.2- 6.1	Bluff exposures of Jordan Sandstone. Note well-drained south-facing Jordan slopes.
7.5	Fish Farm Mounds State Preserve (Indian burial mounds) and Jordan slopes on left.
9.1	Bridge across Upper Iowa River (New Albin Wildlife area).
9.7	Turn left (west) on Highway A26.
10.0	Note flowing well on right (from Mt. Simon Sandstone). The Upper Iowa River floodplain in this area is prime agricultural land, and corn fields cover much of the valley. Large sand terraces line the lower valley walls in this general vicinity.
10.8	Note Jordan Sandstone bluff ahead.
11.3	STOP 1. Turn right onto gravel county trunk road, and park along right edge of road. Exposure of Ironton Sandstone (c SE NW sec. 21, T100N, R4W). 10.7 feet of Ironton exposed here includes fine-medium sandstones, in part cross-bedded. A 3.2 foot zone near the top includes abundant inarticulate brachiopods (Dicellomus) and poorly-preserved trilobite debris (including Elvinia). The uppermost Ironton is calcite-cemented and coarse calcite spar is present.
11.3-13.7	Procede west on gravel road 1.2 miles to T-intersection with Highway A26. Turn right on A26.
16.0	Jordan sandstone crop on right.
16.1	Quarried pit of Lodi Siltstone on right.

16.4 Roadcut in Lodi Siltstone on right.

16.6 Top of Reno Member exposed in roadcut.

16.8 STOP 2. Small quarry in Reno green sands on right edge of road. The quarry can accomodate only about four parked cars. Additional cars will have to park along the right edge of a gravel county road south of the quarry immediately across the bridge over the Upper Iowa River (carefully turn around in farmyards south of parking area when we leave). 32.4 feet of the Reno Member, Lone Rock Formation are exposed here (c SW NW sec. 31, T100N, R4W). Glauconitic silty and very fine to fine sandstones are characteristic of the Reno; cross-bedded and burrowed zones are common, and extremely glauconitic dark green zones are present. A 16 foot covered interval in the upper quarry corresponds to the lower St. Lawrence Formation siltstones. Above the covered interval a zone of glauconitic dolomite (Black Earth Member) is partially exposed. Further up the hill slope are good bluff exposures of the Jordan Sandstone.

17.2-22.1 Numerous road cuts reveal float blocks and blocky talus of Jordan lithologies spalling down the bluff slopes.

18.8 Road cut in Lodi Siltstone.

19.8-20.2 Jordan Sandstone bluff exposures to right.

20.5 Mt. Hope church to right.

22.2 St. Lawrence Formation road cut on right.

23.1 STOP 3. Quarry in Lodi Siltstone. Jordan bluff exposures above (Norwalk Member is slope-former). Turn right and park on right side of gravel county trunk road adjacent to quarry; space cars far enough apart to facilitate Y-turn for departure (those reluctant to Y-turn, procede up gravel road for farmyard turn around). 25.6 feet of St. Lawrence strata (Lodi dolomitic siltstone) are exposed here (c W½ SE SW sec. 32, T100N, R5W). Dolomitic siltstone is the predominant lithology, although green shaley partings and mottlings and silty dolomites are present. Horizontal burrows are conspicuous on some bedding surfaces, and ripple marks are also noted.

23.8 Lodi exposures on right.

24.4 Jordan Sandstone bluff to right.

24.6 Roadcut and bluff exposure of Jordan Sandstone on right. Slow up for left turn ahead.

24.7 STOP 4. Turn left into pasture adjacent to barn across from Alton and Helga Bulman farm house, and park. The Bulmans have kindly allowed us parking space in this area. Please be careful of fences and farm implements. If necessary, overflow parking can be accomodated in the sand pit 0.1 mile further down the road. We will examine both road cuts (east and west of the farm house) and the bluff section above the west road cut. The bluff section is steep and crumbly in places, and those people who feel unsure on steep slopes are encouraged to remain behind for the upper Jordan trek. The St. Lawrence-Jordan contact and a complete Jordan section are accessible at this stop (c NW sec. 6, T99N, R5W). 19 feet of St. Lawrence are exposed in the west road cut and dolomitic siltstones and silty to argillaceous dolomites are included. The contact with the overlying Jordan is marked at the base of the first sandstone bed. The Jordan Sandstone is divisible into four members at this locality; the lowest Norwalk Member (18 feet) is characterized by very fine grained sandstones, often cross-bedded and with vertical burrows (some calcareous siltstone, coarser sand grains, and clay laminae are present). The overlying Van Oser Member is characterized by very fine to coarse grained sandstones; resistant ledges are calcite-cemented. The Van Oser is prominently planar to trough cross-bedded, and zones of "grapeshot"-cemented sand clusters are noteworthy. In Allamakee County the Van Oser Member is split into an upper and lower portion by the intervening Waukon Member. Stop 4 is the type locality of the Waukon Member, where 29 feet of lower Van Oser and 35 feet of upper Van Oser are separated by 19 feet of Waukon. The Waukon Member is a very fine grained sandstone, horizontally laminated and massive, with some cross-bedding near the top. At this stop the upper Van Oser is overlain by 17 feet of sandy dolomite and very dolomitic sandstone assigned to the Coon Valley Member.

26.5 Intersection with Highway 76. Turn left.

30.0 Cross Upper Iowa River.

30.3-30.7 Series of Jordan road cuts on right. Begin slowing up and turn on your left turn signals. We will be crossing the opposing lane of traffic so please be careful.

30.7 STOP 5. Pull onto left shoulder of road behind lead car. Make sure you are out of the opposing lane of traffic. This is a potentially dangerous place to stop our vehicles, and if weather conditions are poor or time is running short this stop will be eliminated. Stop 5 will be brief and will focus on the Van Oser-Coon Valley contact. Friable sandstones are overlain by very dolomitic sandstones and sandy dolomites that include prominent flat-pebble intraclasts. (W½ NW NW sec. 12, T99N, R6W)

31.4 Bridge across stream.

31.5-31.6 Quarry and road cuts on left. Most of the quarry is in the Oneota Formation, a Lower Ordovician dolomite and cherty dolomite sequence. The lower part of these exposures are in the Coon Valley Member of the Jordan, and the transition beds with the Oneota include gastropod-bearing dolomites and stromatolites.

31.8-33.5 Series of road cuts on left through the Oneota Dolomite.

33.6-33.7 Road cuts in the New Richmond Sandstone Member of the Shakopee Formation on the left.

34.5-34.6 Natural exposures and road cuts in the Middle Ordovician St. Peter Sandstone and Platteville Formation on left.

34.85 Small exposure along left edge of road in the Galena Group (Dunleith Formation).

37.1 Galena road cut on left.

40.2 Turn left on gravel county trunk road at top of hill. Road signs indicate "road closed ahead", but we will procede ahead to intersection with Highway 9 (under construction).

41.95 Stop. Turn right on Highway 9.

42.2 STOP 6. We will attempt to stop along the right shoulder of the road, but due to uncertainties in road construction, other parking arrangements may be necessary. Follow the lead car. This stop is at Iron Hill, (c SW sec. 17, T98N, R5W), the type locality of the Iron Hill Member of the Windrow Formation (probable Cretaceous age). Iron Hill is one of the highest points in the Upper Mississippi Valley (1345 feet elevation); it lies along Lansing Ridge, a prominent drainage divide that Highway 9 follows into Lansing. The Iron Hill rests on limestones of the Galena Group (Dunleith Formation); the Galena limestones here are fossiliferous (brachiopods and Receptaculites are noteworthy) and corrosion surfaces are present. The Iron Hill Member is present along the graded slopes on each side of the road, and these exposures are probably short-lived since the Highway Commission plans to cover and seed these slopes. So feel free to collect abundant specimens of the iron ore. The origin of the Iron Hill Member is somewhat enigmatic, although hematite-cemented sands and gravels are present in the part of this exposure that suggest a fluvial channel association. Gravel clasts include abundant quartz pebbles (probably derived from a granitic terrane) and rare Coon Valley lithologies; the source region for these clasts could only be in areas far to the north, possibly south-central Minnesota. For the most part the Iron Hill Member consists of strange masses of hematite and limonite/goethite. Some of the underlying Galena carbonates have also been replaced by hematite.

END OF SATURDAY TRIP.

For those returning home after this, follow Highway 9 into Waukon. For those staying in Allamakee County tonight, an excellent series of roadcuts can be found along Highway 9 into Lansing. Good fossil collecting in the Middle Ordovician Decorah Formation can be had in the new road cuts at the east edge of Churchtown on Highway 9.

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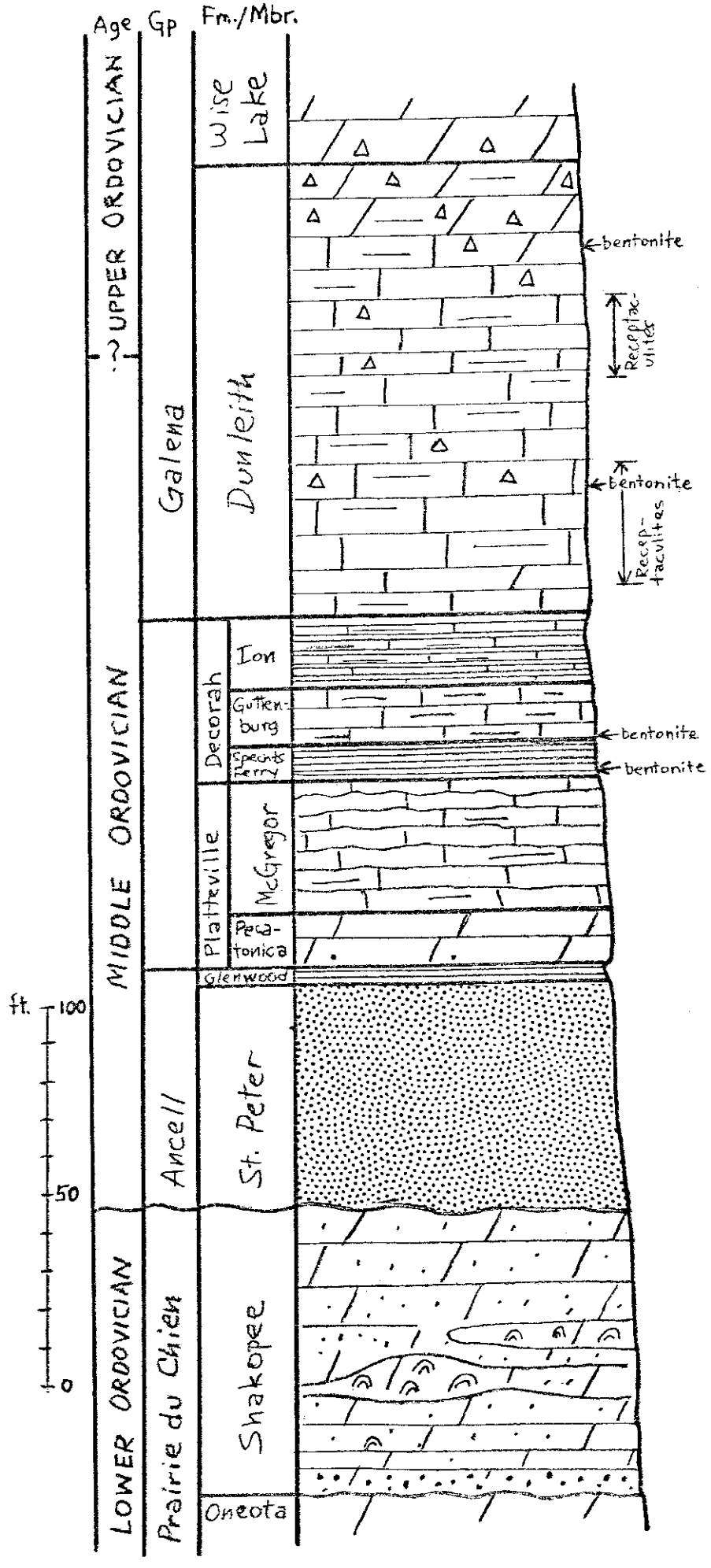
12



SUNDAY STOP

Oct. 27, 1979

Clayton Barge Terminal Rd.

south edge sec. 1 & NW sec. 12, T93N, R2W, Clayton Co.

Generalized Stratigraphic Section

This is one of the most complete Ordovician stratigraphic sections exposed anywhere in the upper Mississippi Valley.