IOWA GEOLOGICAL SURVEY
IOWA CITY, IOWA
H. GARLAND HERSHEY, Director and State Geologist

REPORT OF INVESTIGATIONS 9

THE YELLOW SPRING GROUP of the Upper Devonian in Iowa

by

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ILLUSTRATIONS

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ABSTRACT

A new group name, the Yellow Spring Group, is designated for those formations herein removed from the Kinderhook Series and assigned as the uppermost unit in the Upper Devonian Series. The formations comprising the Yellow Spring Group are, in descending order, the English River Formation, the Maple Mill Shale, the Aplington Formation and the Sheffield Formation. In spite of the gradational English River - Maple Mill contact in southeastern Iowa, and the local absence of English River and Maple Mill in north-central Iowa, these formations have significant lithologic features in common that justify their recognition as a rock-stratigraphic unit with group status.

Recent work by paleontologists has resulted in raising the Devonian-Mississippian boundary from its previous position at the top of the Lime Creek to its presently designated position at the base of the North Hill Group.

INTRODUCTION

Purpose

The major objective of this report is to name a new rock-stratigraphic unit – the Yellow Spring Group – as the uppermost part of the Upper Devonian in Iowa. This unit encompasses, in descending order, 1) English River Formation, 2) Maple Mill Shale, 3) Aplington Formation, and 4) Sheffield Formation, that have been removed from the Kinderhook Series and placed in the Upper Devonian Series as shown in figure 1. The group is mappable both at the surface and in subsurface. The proposed group name is taken from Yellow Spring Township, Des Moines County, Iowa.

A group name is desirable because: (1) the comprising formations are dominantly clastic; (2) in large areas one or more of the for-

mations are absent; and (3) in some cases, particularly in the subsurface, it is difficult to differentiate the formations that are present. The latter is particularly applicable where the English River - Maple Mill contact is gradational or where the Aplington is absent and the Maple Mill - Sheffield contact is not clearly defined. Consequently, for mapping and subsurface correlation purposes a group name is applied to the formations involved.

Establishing the Yellow Spring Group as uppermost Devonian raises the Devonian - Mississippian boundary from the top of the Lime Creek Formation, where it formerly had been placed, to the base of the North Hill Group (fig. 1).

Acknowledgments

This investigation has been conducted as part of the work of the Iowa Geological Survey under the direction of H. Garland Hershey, Director and State Geologist.

Natural Gas Pipeline Company of America and Northern Natural Gas Company made cores and geophysical logs available. The United States Gypsum Company allowed the Iowa Geological Survey to collect samples during the driving of their mine shaft near Sperry, Iowa. Joseph Kulik, University of Iowa, separated and identified conodonts from the lithologic samples collected at two-foot intervals during the driving of this shaft. Gilbert Klapper, University of Iowa, and Willi Ziegler, University of Marburg, Germany, were consulted regarding the conodonts recovered from these samples. William M. Furnish and Brian F. Glenister, University of Iowa, and Walter L. Steinhilber, U. S. Geological Survey, have been helpful advisors.

Procedure

The conclusions presented in this report are based upon studies of drill cuttings, extensive examination of exposures, and data presented in the literature. Data from drill cuttings are referenced to Iowa Geological Survey file numbers (e.g. W-8000). For conodont data the authors have depended on the work of others but have made their own stratigraphic interpretations based more on lithology than on paleontology. Although the authors worked cooperatively on field and office phases of this study, Parker concentrated on the construction of maps, Koch on restudy of critical drill cuttings, and Dorheim on the review of literature and on construction of the panel diagram.

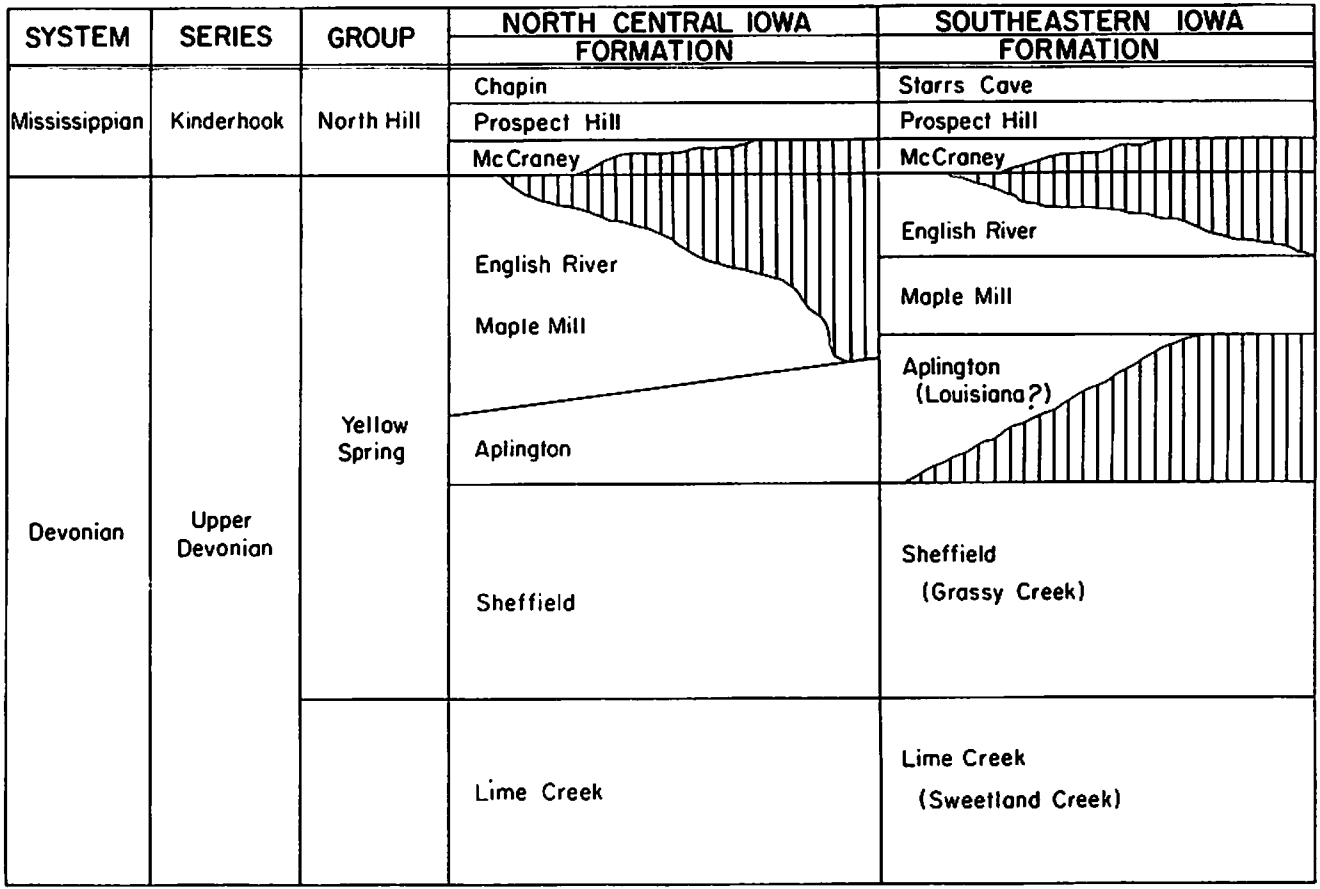


Figure 1. Stratigraphic sequence of the Yellow Spring Group.

YELLOW SPRING GROUP

The name Yellow Spring Group is designated for the formations underlying the North Hill Group (Kinderhook) and overlying the Lime Creek Formation. The formations comprising this group are, in descending order: English River Formation, Maple Mill Shale, Aplington Formation, and the Sheffield Formation.

The entire Yellow Spring Group is not completely exposed in any one locality, but crops out in two widely separated areas, one in north-central and the other in southeastern Iowa. The Aplington and Sheffield are well exposed in north-central Iowa (Butler, Cerro Gordo, and Franklin Counties) and only the English River and the upper part of the Maple Mill are exposed in southeast Iowa (Des Moines and Washington Counties). However, the entire sequence is well known from drill cuttings and cores, although all of the formations are not typically represented in any one drill or core hole.

Type Section Yellow Spring Group

Because no single surface exposure contains all of the formations of the Yellow Spring Group, and because all of the formations are not typically represented in any one drill or core hole, the type section is designated in two wells — a gas storage well and a gas storage stratigraphic test. Detailed lithologic studies have been made of the samples from both holes. In addition, conodont studies were made from the gas storage well (Anderson, 1966). In the stratigraphic test well the Aplington Formation is absent but all other units of the group are typical. The core from the gas storage well contains the Aplington and its upper and lower contacts are typically represented.

The stratigraphic test well (fig. 2) is the Natural Gas Pipeline Company of America No. 1, E. Reed (W-21126), located in the NE¼ NE¼ SW¼ sec. 16, T. 72 N., R. 3 W., Yellow Spring Township (from which the name of the group is taken), Des Moines County, Iowa. The well was drilled in 1968 to a depth of 586 feet. The land surface elevation is 777 feet above sea level. The top of the Yellow Spring Group occurs at a depth of 133 feet, the base at a depth of 426 feet — a thickness of 293 feet. The group is overlain by the North Hill Group (Mississippian-Kinderhook) and underlain by the Lime Creek Formation (Upper Devonian). Although the Aplington Formation is not present in this well, it appears that a full

section occurs which is representative of the group in the type area, as shown by the following description:

	THICKNESS FEET
Mississippian System	
Kinderhook Series	
North Hill Group	
Prospect Hill Formation	
Siltstone, very light olive-gray, medium-to coarse grained, slightly dolomitic, slightly argillaceous	5
McCraney Limestone	
Dolomite, dark yellowish-brown, fine-textured, slightly calcareous, interbedded with pale-orange, sublithographic limestone containing scattered embedded dolomite euhedra - -	6
Devonian System	
Upper Devonian Series	
Yellow Spring Group	
English River Formation	
Siltstone, yellowish-gray, medium-grained, slightly dolomitic, argillaceous in upper part, shaly in lower part, may contain finely disseminated pyrite; sharp upper contact, gradational lower contact - - - - - - - - -	23
Maple Mill Shale	
Shale, greenish-gray, laminated, slightly dolomitic; pyritized plant (?) tubes and nodular pyrite in upper part; lower 50 feet interlaminated greenish-gray and olive-gray shale containing scattered crushed spore carps; gradational upper contact, sharp lower contact - -	138
Sheffield Formation	
Shale, top 16 feet is dark olive-gray to dusky yellowish-brown, laminated, very hard and contains abundant crushed spore carps; next 95 feet is a uniform very light olive-gray, soft, flaky, unctuous shale with slightly crushed spore carps in the upper portion; lower 21 feet is interlaminated olive-gray and dark olive-gray shale; sharp upper and lower contact - - -	132
Base of Yellow Spring Group	

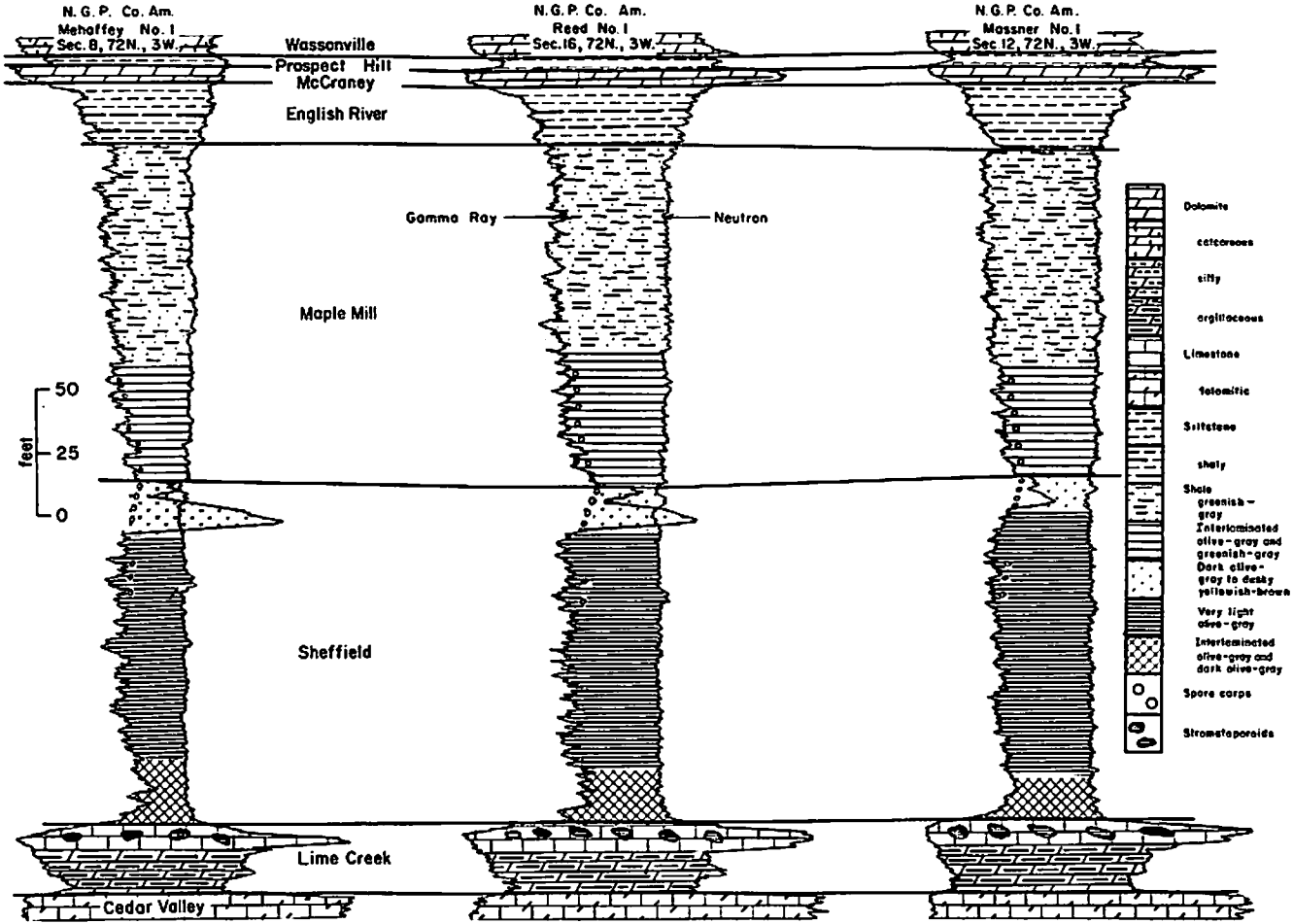


Figure 2. Gamma ray-neutron and lithologic logs of the Yellow Spring Group, Des Moines County.

	THICKNESS FEET
Lime Creek Formation	
Dolomite, greenish-gray, medium-textured, argillaceous; biostrome of stromatoporoids in matrix of very pale yellowish-brown fine-grained limestone near top; sharp upper and lower contact - - - - - - - - - -	30
Middle Devonian Series	
Cedar Valley Formation	
Limestone, very pale yellowish-brown, fine-textured, zones with embedded dolomite euhedra; very fossiliferous.	

The second well (fig. 3) used in establishing the type section for the Yellow Spring Group is the Northern Natural Gas Company Peterson No. 1 (W-11749) located in NE¼ NE¼ NE¼ NW¼ sec. 10, T. 90 N., R. 27 W., Webster County, Iowa. The well was completed in 1960 to a depth of 2187 feet. The land surface elevation is 1133 feet above sea level. The top of the Yellow Spring Group occurs at a depth of 277 feet, the base at 320.9 feet — a thickness of 43.9 feet. The group is overlain by the North Hill Group and underlain by the Lime Creek Formation.

	THICKNESS FEET
Mississippian System	
Kinderhook Series	
North Hill Group	
Starrs Cave Formation	
Dolomite, very pale yellowish-brown, fine sand-grade, euhedral, stylolitic, calcareous, with porous zones; recrystallized brachiopod and crinoid fragments in lower foot - - - -	5.6
Prospect Hill Formation	
Siltstone, light olive-gray, coarse to medium, dolomitic, argillaceous; with abundant medium to coarse, subrounded to subangular, slightly frosted, quartz sand grains (secondary overgrowths prominent, a few terminated quartz prisms in the top 0.05 feet); shaly partings -	1.4

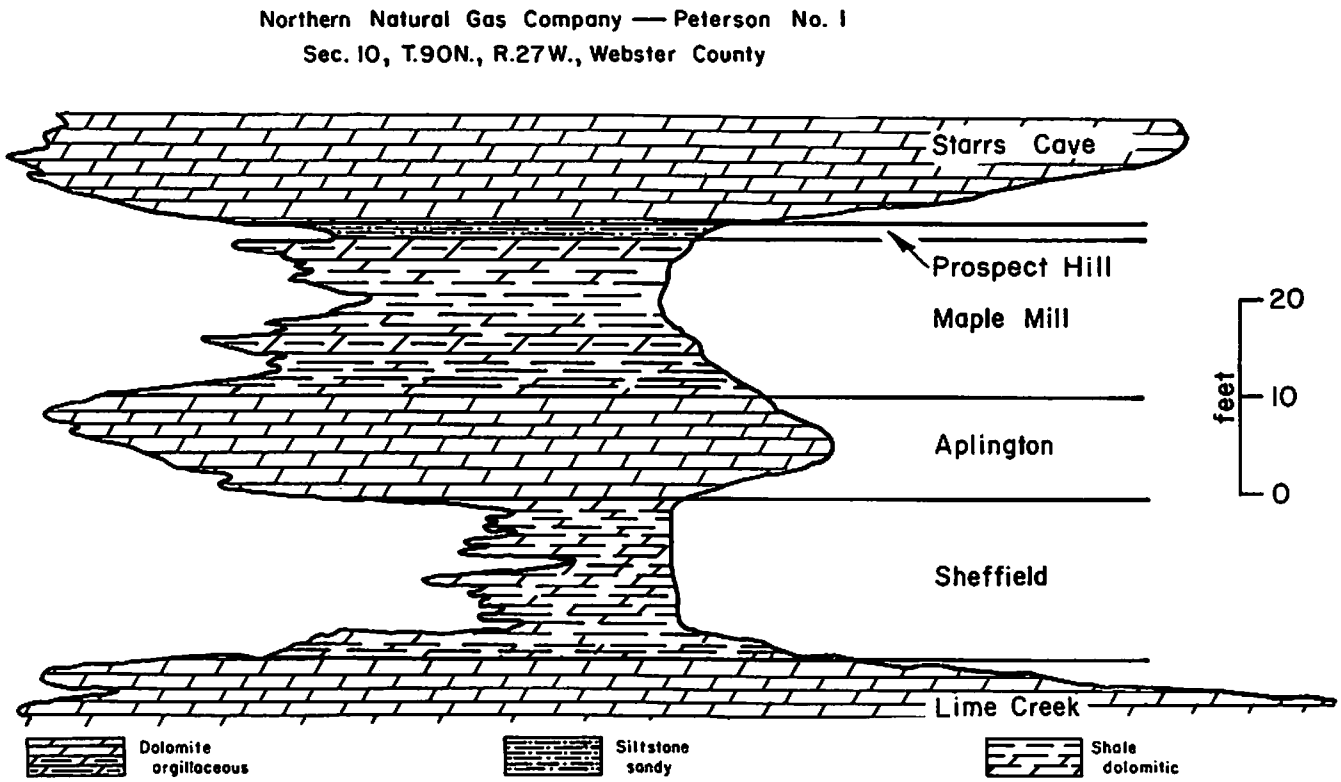


Figure 3. Gamma ray-resistivity and lithologic logs of the Yellow Spring Group, Webster County.

Devonian System
Upper Devonian Series
Yellow Spring Group
Maple Mill Shale

Dolomite, very light olive-gray, medium silt-grade, euhedral to subhedral, slightly silty, very argillaceous; porous and vuggy zones, disseminated pyrite; increasingly argillaceous toward base - - - - - - - - - - - - - - 2.1

Shale, very light olive-gray to greenish-gray, dolomitic, hard with some extremely dolomitic zones - - - - - - - - - - - - - 14.6

Aplington Formation

Dolomite, light olive-gray with weak medium-gray mottling, coarse to medium silt-grade, very porous, very vuggy; solution molds of crinoid fragments abundant, a few scattered brachiopod molds - - - - - - - - - 4.3

Dolomite, very light olive-gray with weak pale orange mottling, fine silt-grade, very tough, slightly calcareous, a few slightly porous zones; a few brachiopods; calcite-filled vugs at 300.6 feet; 0.05 foot brownish-gray shale parting at 301.5 feet; 0.5 foot zone of light olive-gray, argillaceous, medium silt-grade dolomite at 302.6 feet; gradational to bottom of bed - - 5.1

Sheffield Formation

Shale, light olive-gray with minor weak laminations of olive gray; hard, moderately dolomitic 17.8

Base of Yellow Spring Group

Lime Creek Formation

Dolomite, greenish-gray and medium-gray mottled, medium silt-grade, subhedral, slightly silty, slightly argillaceous; top 0.05 foot extremely pyritiferous; fractures in top 0.1 foot sealed with pyrite; scattered recrystallized crinoid stem segments - - - - - - - 1.2

Dolomite, pale yellowish-brown with weak medium light-gray mottling, fine sand- to coarse silt-grade, euhedral to subhedral, slightly calcareous, slightly to moderately porous.

Geophysical logs (fig.2) demonstrate the increasing clay content of the English River with depth. Drill cuttings of the Yellow Spring Group, beyond the type area in southeastern Iowa, show the same gradational contact with the Maple Mill. Consequently, for ease in mapping, the top of the English River, where present, has been selected for defining the top of the Yellow Spring Group.

Along a tributary to Yellow Spring Creek (NW¼ sec. 35, T. 71 N., R. 2 W.) Des Moines County, Iowa, the English River and less than five feet of the Maple Mill are exposed but the contact with the overlying North Hill Group may be observed (fig. 4).

Description of Formations

English River Formation

The term "English River grits" was first used by Bain (1895, p. 127) in reference to a siltstone occurring along the English River in northern Washington County, Iowa. He described the unit as underlying the Wassonville and overlying the Maple Mill and he placed it in the Kinderhook Series. Schoewe (1920, p. 76-77) referred to the English River gritstone member of the Kinderhook Series. It is obvious from their descriptions that not only the English River Formation, as it is recognized today, but also the Starrs Cave Limestone, the Prospect Hill Formation, and the McCraney Limestone were included in their English River gritstone. Moore (1928) described the English River Sandstone Member of the Hannibal Formation as unconformably underlying the Hampton and overlying the Maple Mill. Laudon (1929, p. 347) described the English River Formation as conformably overlying the Maple Mill and unconformably underlying the Hampton Formation. His basal unit of the Hampton, the North Hill member, included, in ascending order, what is now known as the McCraney Limestone, the Prospect Hill Formation and the Starrs Cave Limestone. His English River, therefore, is in agreement with the English River as it is defined today and he correlated it with the Hannibal of Missouri.

Although several authors have studied and described exposures of siltstone that occur along the English River in northern Washington County, a type section has never been clearly designated. In this report an exposure along the right bank of the English River, in SW¼ SE¼ NW¼ SE¼ sec. 8, T. 77 N., R. 8 W., Washington County, Iowa, is specifically designated as the type section for the English River Formation (fig. 5). This exposure is about 200 yards downstream from the bridge that crosses the English River 0.4 miles north of the center of the south line of section 8, T. 77 N., R. 8 W.

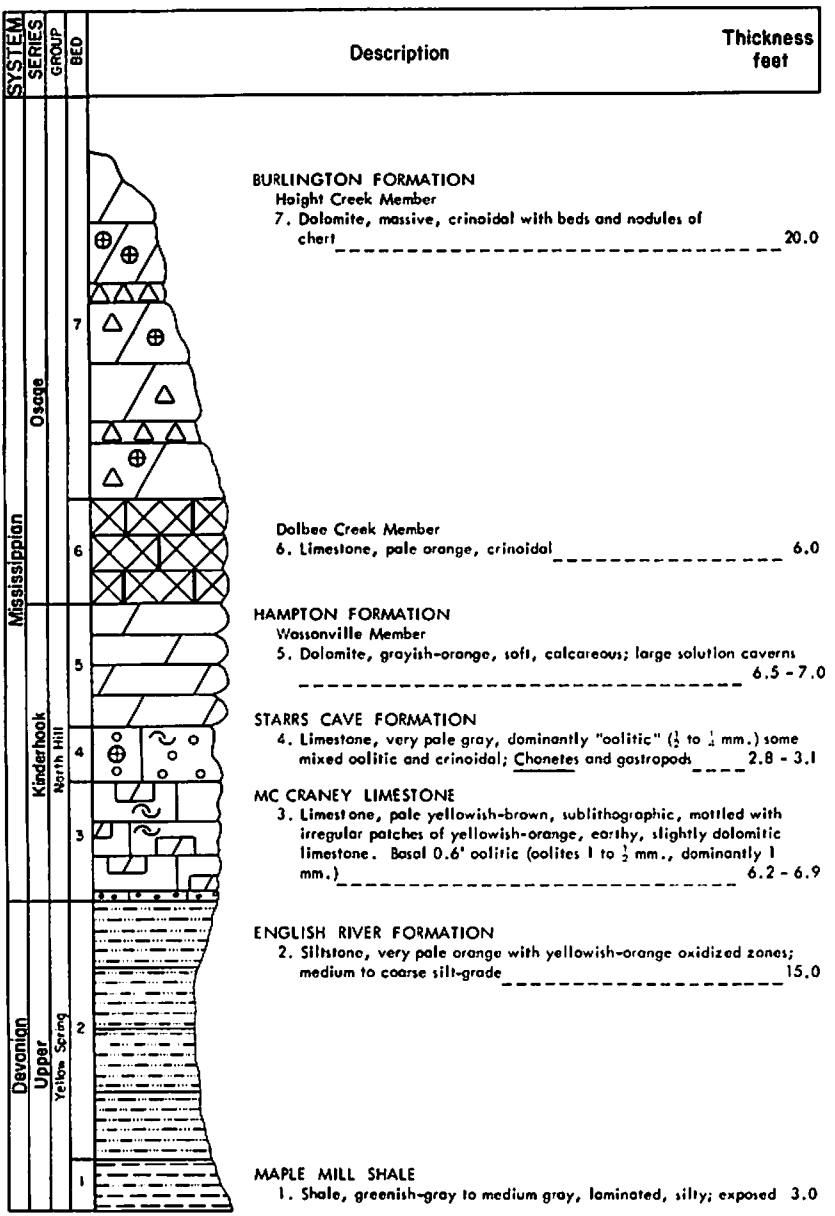


Figure 4. Yellow Spring tributary exposure NW¼ SW¼ sec. 35, T. 71 N., R. 2 W., Des Moines County, Iowa.

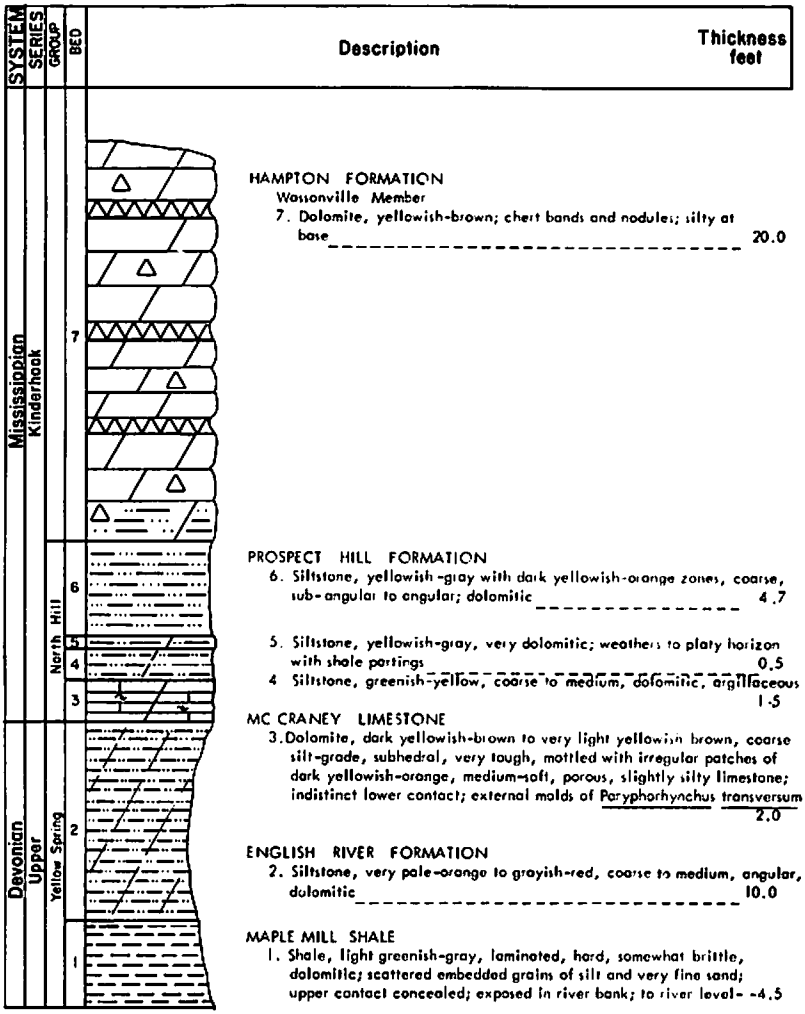


Figure 5. Type section English River Formation SW¼ SE¼ NW¼ SE¼ sec. 8, T. 77 N., R. 8 W., Washington County, Iowa.

The English River Formation is fairly uniform in thickness, averaging approximately 20 feet. Except for a few very local occurrences in north-central Iowa the English River is confined to southeastern Iowa. Because the English River is relatively thin and because the English River - Maple Mill contact is gradational, and therefore difficult to recognize in subsurface studies, the English River has been included with the Maple Mill for mapping purposes (fig. 6).

The panel diagram (fig. 7) was constructed to aid in visualizing the relationships of the Prospect Hill, McCraney and the English

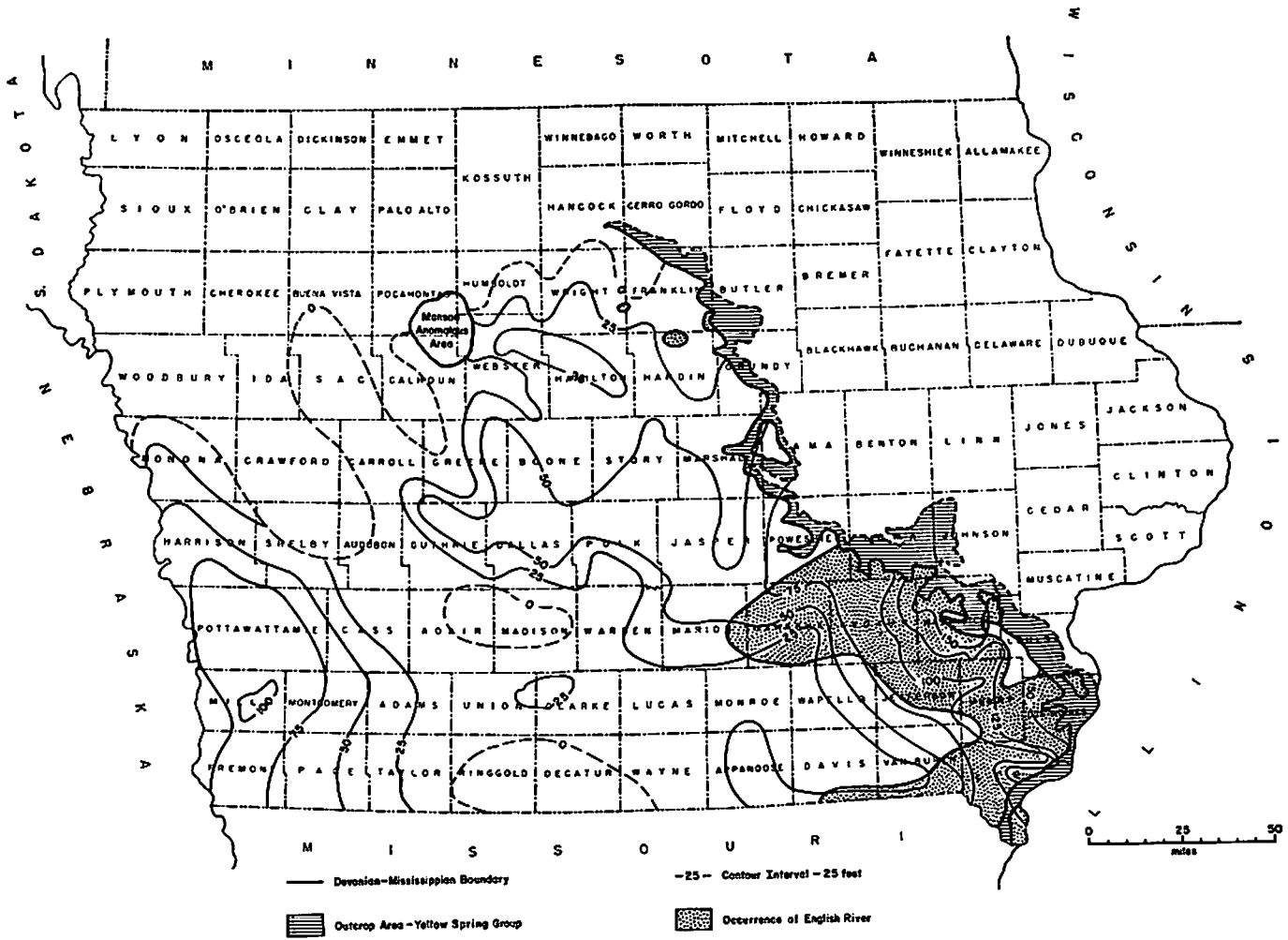


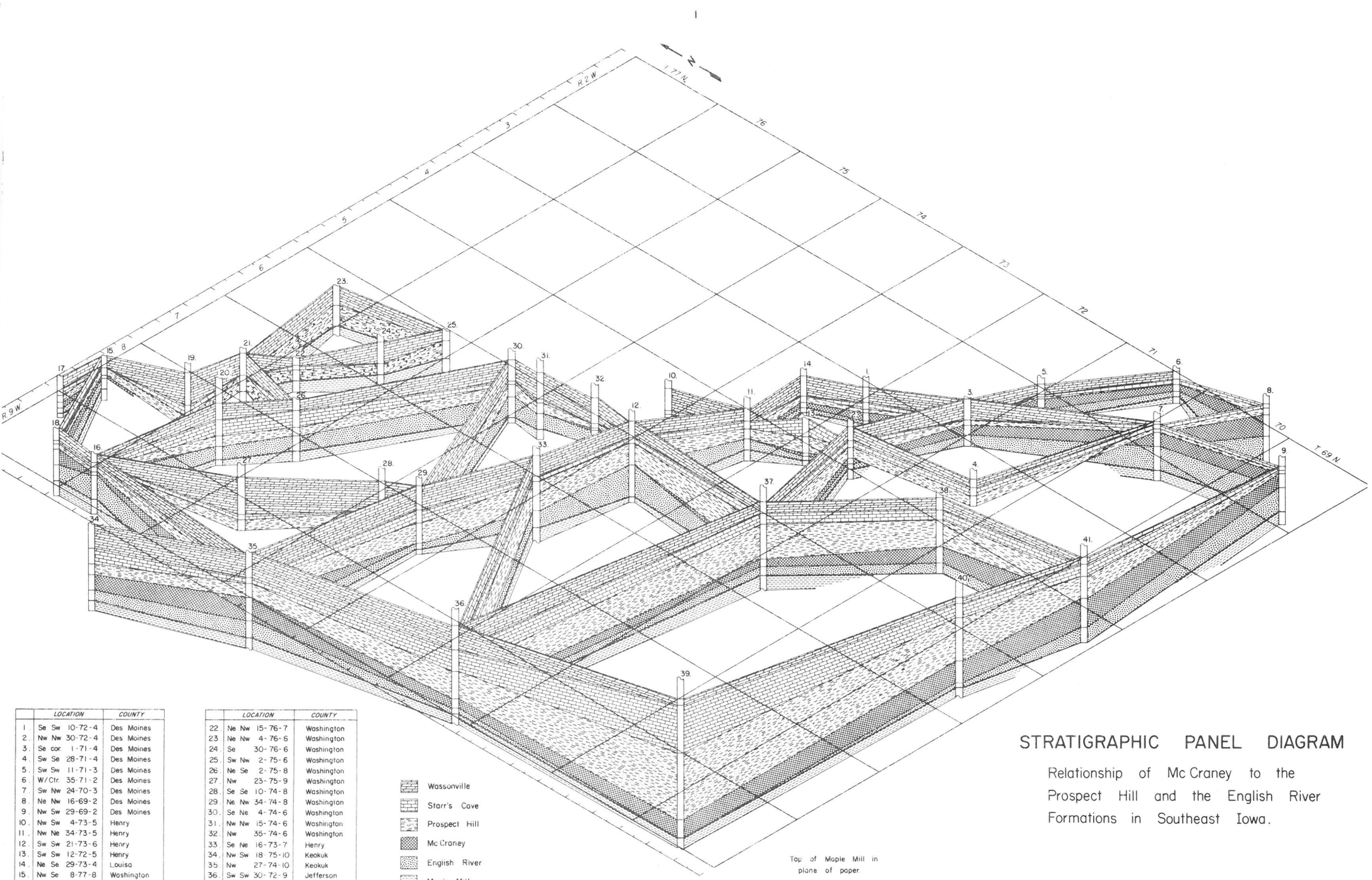
Figure 6. Distribution and thickness map of the Maple Mill Shale and the English River Formation in Iowa.

River in southeast Iowa. The area illustrated extends from northwest Washington County southeasterly to Lee County, Iowa. A lithologic continuity exits between the English River of northern Washington County and the English River of the Burlington area. At both locations it is overlain by the McCraney. Straka (1968, personal communication) agrees that, lithologically, a siltstone found below the McCraney can be traced from Wellman (Washington County) to Burlington (Des Moines County). However, he finds a faunal unconformity within this siltstone and therefore considers this interval at the two locations as separate units. He, like Collinson, places the English River of the Burlington area in the Maple Mill (Devonian) and the English River of the Wellman area as a separate unit (possibly Mississippian). We concede the possibility of a faunal hiatus between the English River of the Burlington area and the English River of the type area in Washington County, as described by Straka. However, according to the code of stratigraphic nomenclature (American Commission on Stratigraphic Nomenclature, 1961): formations are the basic rock-stratigraphic units and may include breaks in the time-stratigraphic sequence. As shown on the panel diagram (fig. 7) the English River is lithologically continuous and mappable between Wellman and Burlington. The Iowa Geological Survey places it in the Upper Devonian, the uppermost formation of the Yellow Spring Group.

Maple Mill Shale

The term Maple Mill Shale was proposed by Bain (1895, p. 127) for the shales that underlie the English River Formation and that are younger than the Louisiana (the latter is not recognized in Iowa). Although less than 30 feet of Maple Mill is exposed along the English River in northern Washington County, Bain noted that well records in southeastern Iowa indicate a total thickness of about 200 feet. He designated the type section for the Maple Mill in SE¼ NW¼ sec. 4, T. 77 N., R. 8 W., Washington County, Iowa. The authors of this report, after a careful search of the location designated by Bain, found only loess and Kansan till. Their conclusion is that the location is in error (probably typographical). The nearest Maple Mill exposure is that described as bed 1, figure 5 of this report. A good reference section is the High Bridge section (Straka, 1968, p. 6) located in SE¼ SE¼ SW¼ sec. 17, T. 77 N., R. 7 W.,Washington County, Iowa (not NE¼ NW¼ sec. 20, as reported by Straka).

Moore (1928, p. 21-22) described the Maple Mill as the basal member of the Hannibal, grading into the overlying English River



	LOCATION	COUNTY
1.	Se Sw 10-72-4	Des Moines
2.	Nw Nw 30-72-4	Des Moines
3.	Se cor 1-71-4	Des Moines
4.	Sw Se 28-71-4	Des Moines
5.	Sw Sw 11-71-3	Des Moines
6.	W/Ctr. 35-71-2	Des Moines
7.	Sw Nw 24-70-3	Des Moines
8.	Ne Nw 16-69-2	Des Moines
9.	Nw Sw 29-69-2	Des Moines
10.	Nw Sw 4-73-5	Henry
11.	Nw Ne 34-73-5	Henry
12.	Sw Sw 21-73-6	Henry
13.	Sw Sw 12-72-5	Henry
14.	Ne Se 29-73-4	Louisa
15.	Nw Se 8-77-8	Washington
16.	Nw Ne 18-76-9	Washington
17.	Ne Se 11-77-9	Washington
18.	Ne Sw 31-77-9	Washington
19.	Cen. NL 9-76-8	Washington
20.	Sw Ne 29-76-8	Washington
21.	Ne Se 6-76-7	Washington

	LOCATION	COUNTY
22.	Ne Nw 15-76-7	Washington
23.	Ne Nw 4-76-6	Washington
24.	Se 30-76-6	Washington
25.	Sw Nw 2-75-6	Washington
26.	Ne Se 2-75-8	Washington
27.	Nw 23-75-9	Washington
28.	Se Se 10-74-8	Washington
29.	Ne Nw 34-74-8	Washington
30.	Se Ne 4-74-6	Washington
31.	Nw Nw 15-74-6	Washington
32.	Nw 35-74-6	Washington
33.	Se Ne 16-73-7	Henry
34.	Nw Sw 18-75-10	Keokuk
35.	Nw 27-74-10	Keokuk
36.	Sw Sw 30-72-9	Jefferson
37.	Nw Sw 9-71-6	Henry
38.	Se Ne 9-70-5	Henry
39.	Nw Ne 19-69-9	Van Buren
40	Sw Sw 21-69-6	Lee
41.	Nw Se 34-69-5	Lee

STRATIGRAPHIC PANEL DIAGRAM

Relationship of Mc Craney to the Prospect Hill and the English River Formations in Southeast Iowa.

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Figure 7. Stratigraphic panel diagram showing the relationships of the Prospect Hill, McCraney, and the English River in southeast Iowa.

and unconformably overlying the Sweetland Creek. Later, Moore (1935, p. 240) equated the English River and part of the Maple Mill with the Hannibal. Laudon (1929, p. 346-347) defined the Maple Mill as basal Kinderhook overlain by the English River and lying unconformably on the Sheffield (north-central Iowa) or on the Cedar Valley (southeast Iowa). At that time the Aplington was an unnamed unit of shaly dolomite included in the upper part of the Sheffield. Although Laudon considered part of the shale interval of southeast Iowa as correlative of the Sheffield, he made no attempt to differentiate the Sheffield in southeast Iowa. L. A. Thomas (1949) correlated the Maple Mill as Upper Devonian and the English River as Mississipian. Stainbrook (1950a, p. 209-212) considered the Maple Mill to be basal Kinderhook and designated the units of the Kinderhook, in ascending order, as Maple Mill, English River, Louisiana, Hannibal, and Chouteau. He correlated the Louisiana with the McCraney. Collinson and others (1967, p. 968) placed the Mississippian-Devonian boundary at the top of the Maple Mill but discarded the term English River and included it (the English River) as a siltstone facies of the Maple Mill. Straka (1968, p. 17-19) also placed the Mississippian-Devonian boundary near the top of the Maple Mill but he considered the English River as a siltstone facies of the McCraney and assigned the English River and the McCraney to the Kinderhook.

The Maple Mill ranges in thickness from 0 to over 150 feet (fig. 6), the thicker sections occurring in southeastern and southwestern Iowa with thinner intervals in the central portion of Iowa from Missouri to the northern limits of the formation. The area of thinner Maple Mill generally is characterized by the occurrence of discoidal, concentrically laminated, limonite pellets (oolites) at the top of the shale. Where this zone is more prominently developed, the shale is colored dusky-red to moderate brown. In Taylor County the oolites are composed of hematite, the shale is hematitic, and some massive hematite is indicated in the cuttings. At some places, where the Maple Mill is thicker, small black residues of clay are observed in the upper part of the formation. Presumably these were oolites that have been leached of iron oxide. As noted by Carlson (1963, p. 12), a red shale "oolitic" hematite zone that suggests a regional unconformity is present in central Iowa, northeastern Kansas, northwestern Missouri and in the Boice Shale of southeastern Nebraska. Spore carps are common in the lower one-half of the Maple Mill in southeastern Iowa.

In this investigation the Maple Mill is placed in the Upper Devonian and is defined as a shale conformably underlying the English River,

where present, and overlying the Aplington or the Sheffield where the former is absent or not differentiated.

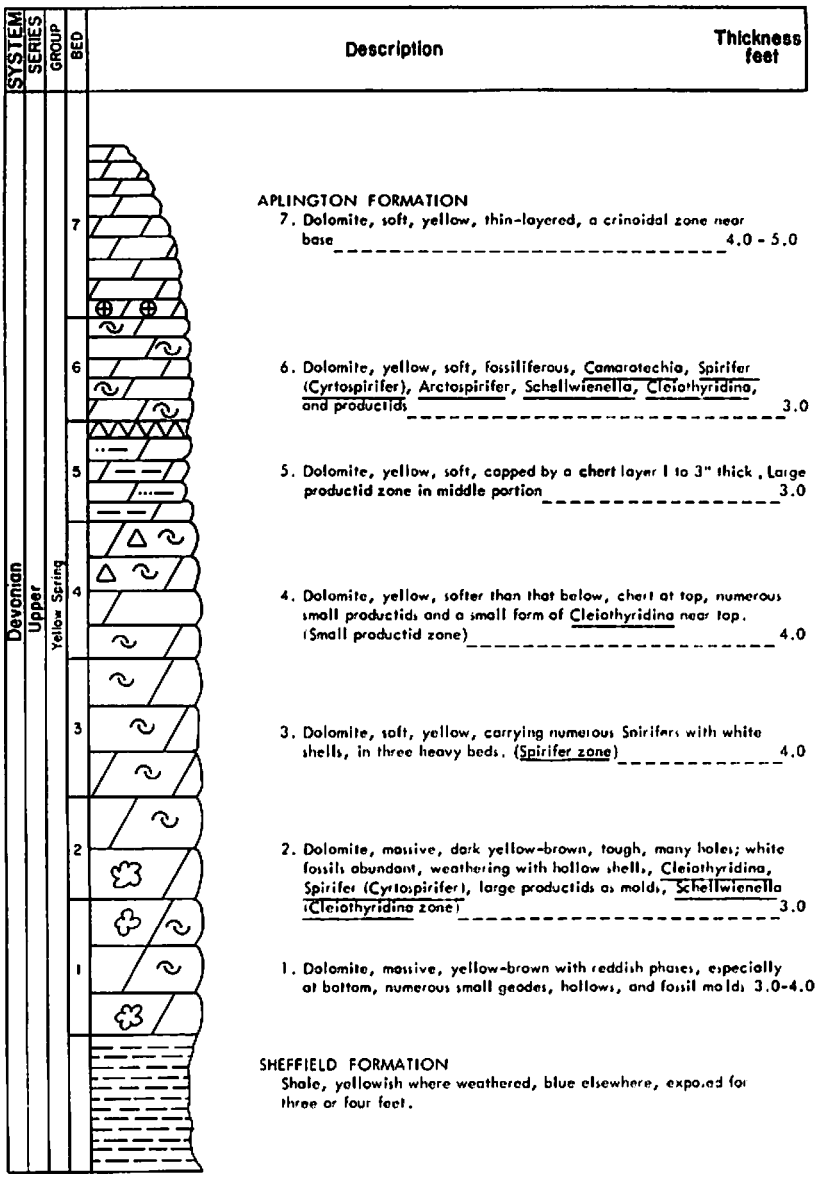

Figure 8. Type section Aplington Formation W½ NW¼ sec. 20, T. 90 N., R. 17 W., Butler County, Iowa.

Aplington Formation

The Aplington Formation was named by M. A. Stainbrook (1950b) for exposures in a quarry half a mile north of the town of Aplington (W½ NW¼ sec. 20, T. 90 N., R. 17 W., Butler County). He regarded the Aplington as the lower member of the Kinderhook Series and described it as a brown dolomite with subordinate shale and limestone near the base and with white to light-gray chert in the upper part. The type section depicted in figure 8 is modified from Stainbrook (1950b, p. 367).

Since the Aplington type section was described by Stainbrook, working of the quarry and accumulation of debris has obliterated part of the section. It appears that all of Stainbrook's bed 7 and part of bed 6 have been removed by stripping. Also, the lower part of bed 1 and the contact with the underlying Sheffield is no longer exposed.

Although Stainbrook correlated the Aplington as lower Kinderhook, his correlation was based on similarity of the Aplington fauna with the fauna of the Percha Shale of New Mexico. Miller and Collinson (1951), on the basis of the goniatite *Falciclymenia bowsheri*, found in the Percha, correlated the Percha with the Upper Devonian *toIII* to *toIV*. Anderson (1966, p. 401) stated:

> "Although the Aplington conodont fauna is meager, it supports the assignment of the Aplington to the Upper Devonian Series. A correlation with zone *toIV* to *toV* cannot definitely be made, although it is probable."

The Aplington Formation ranges in thickness from 0 to over 40 feet (fig. 9). The thicker sections occur in and near the outcrop area of Butler, Cerro Gordo, Franklin, Grundy and Hardin Counties and in southeastern Webster County. The Aplington is less than 10 feet thick in an area which closely follows the Thurman-Redfield structural zone (Hershey and others, 1960, p. 35) and is absent along a possible extension of this zone in part of Boone County. The typical Aplington dolomite is not present in extreme southeastern Iowa nor in an area of south-central Iowa from parts of Decatur and Ringgold Counties northward to central Adair, Madison, Warren, and Marion Counties. The absence of the typical Aplington dolomite in this area does not preclude the possibility that it is present in these areas as a shaly facies.

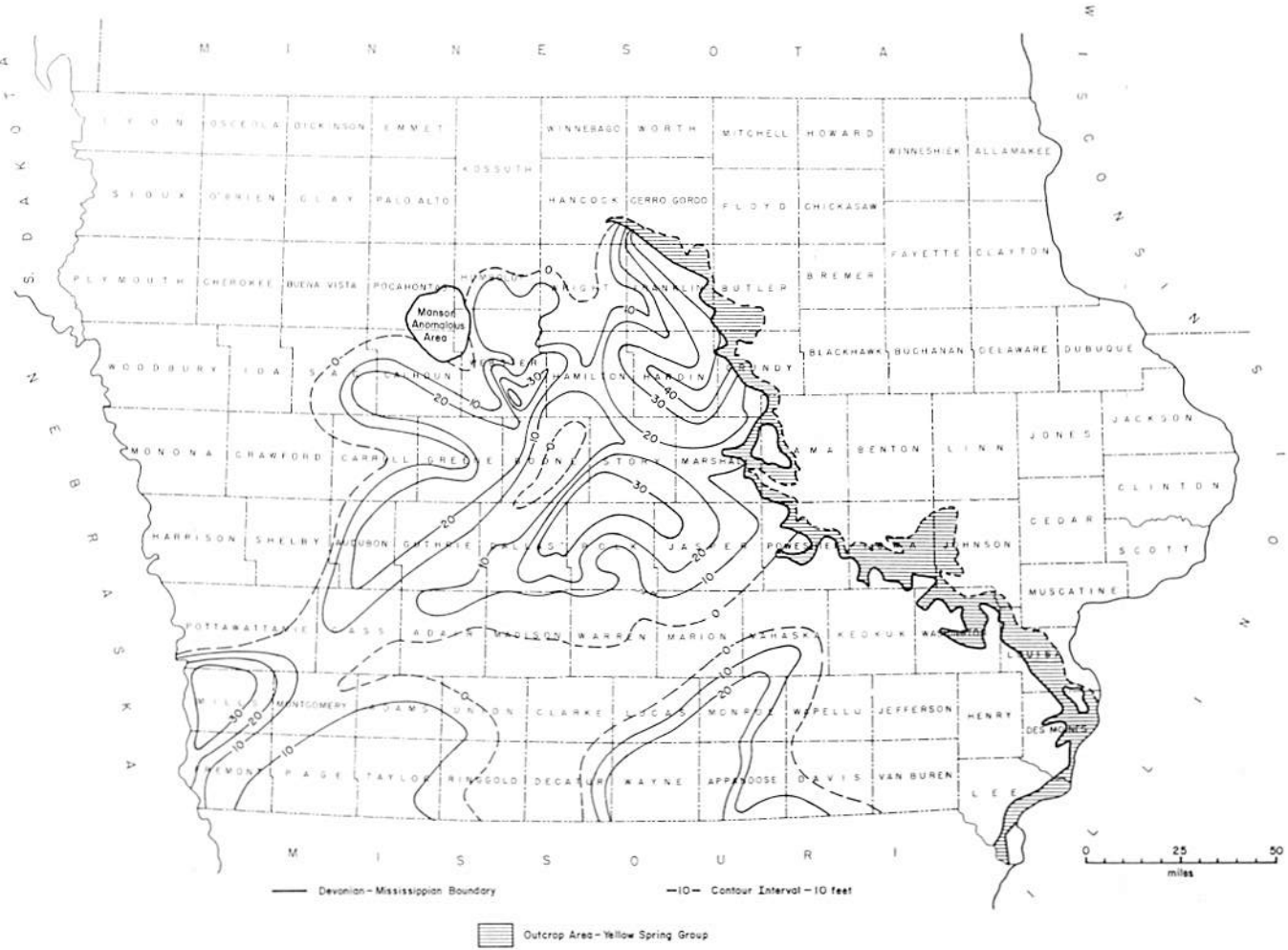

Figure 9. Distribution and thickness map of the Aplington Formation in Iowa.

An approximate correlative of the Aplington, the Louisiana, appears to be present in the subsurface of parts of southeast Iowa. In the Davis County No. 1 Aeschilman (W-18123) the following sequence is interpreted:

FORMATION	DEPTH IN FEET
Prospect Hill	785-814
McCraney	814-822
English River	822-828
Maple Mill	828-850
Aplington-Louisiana (?)	850-866
Sheffield	866-893
Lime Creek	893-

Additional subsurface studies are needed to confirm the presence of a shaly Aplington facies in southeastern Iowa and to clarify the Aplington-Louisiana relationships.

In this report the Aplington is defined as the dolomite beneath the Maple Mill (or younger beds) and underlain by the Sheffield.

Sheffield Formation

The term Sheffield was first proposed by C. L. Fenton (1919) and was defined as 90 feet of clay-shale lying unconformably below the Hackberry (Lime Creek) and unconformably overlying the Shell Rock. A. O. Thomas (1922, p. 116) noted that the shale at Rockford and at Mason City is stratigraphically lower than the shale at the town of Sheffield and concluded that the term Sheffield, as used by Fenton was unavailable. Thomas then offered the term Juniper Hill for the Upper Devonian shale at Rockford and Mason City. At the same time, Van Tuyl (1922, p. 91) described the Sheffield and designated the exposures around the town of Sheffield as typical.

In this report a type section for the Sheffield is proposed for exposures at the pit of the Sheffield Brick and Tile Company. This pit is located in NW¼ SE¼ SW¼ sec. 9, T. 93 N., R. 20 W., Franklin County, Iowa (fig.10).

Anderson (1966, p. 400) placed the Sheffield in the Upper Devonian zones *to*I through *to*II. This correlation was made on the basis of the conodonts *Palmatolepis triangularis* and *Pa. quadrantinodosalobata.*

The Sheffield is exposed in Butler, Cerro Gordo and Franklin Counties and is found in the subsurface in both southwest and southeast Iowa and ranges in thickness from 0-200 feet (fig. 11). Like the Maple Mill, the areas of thicker occurrences of the Sheffield are in southwestern and southeastern Iowa. In southwestern Iowa 173 and 178 feet of Sheffield have been recorded from wells in Fremont County (W-17957, W- 1958). In southeastern Iowa thicknesses ranging from 175 to 195 feet are known. In north-central Iowa,

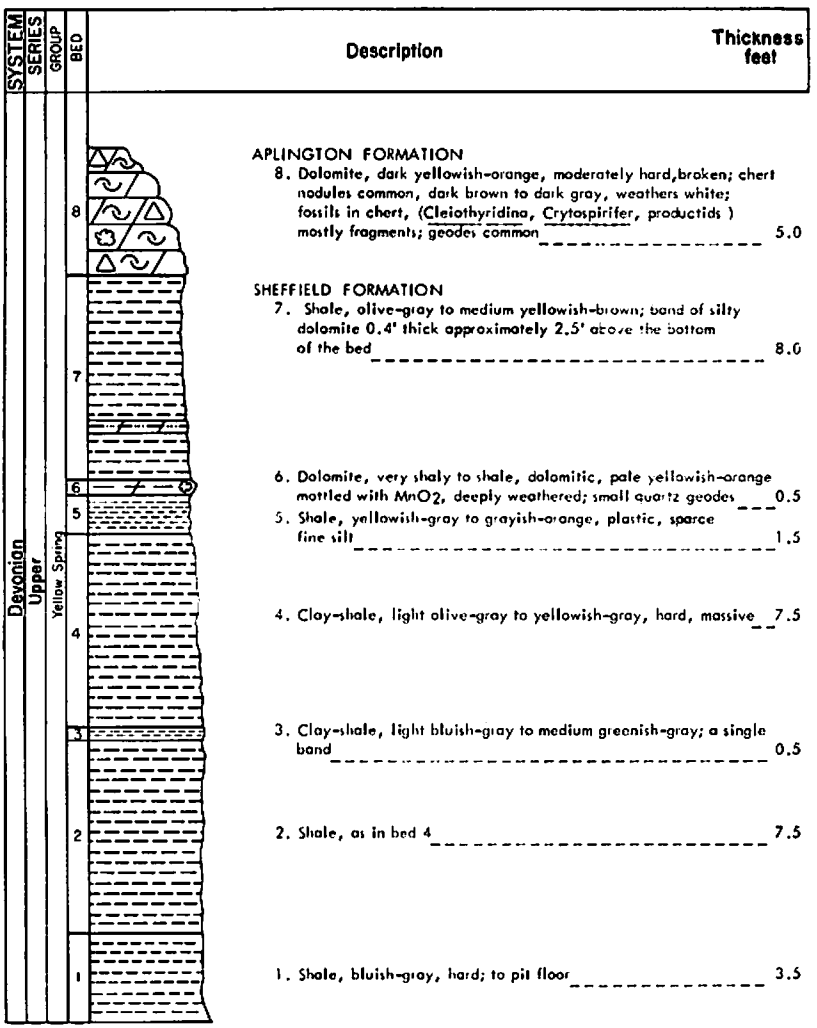

Figure 10. Type section Sheffield Formation NW¼ SE¼ SW¼ sec. 9, T. 93 N., R. 20 W., Franklin County, Iowa.

where the Sheffield is exposed, the thickness does not exceed 75 feet. Two areas in central Iowa where the Sheffield is not present probably represent areas of non-deposition rather than erosion.

As used in this report, the Sheffield is defined as the shale underlying the Aplington (where present) or the Maple Mill, and overlying the Lime Creek. Where the Aplington is missing, or not differentiated, the contact between the Maple Mill and the Sheffield is recognized at a pronounced color change from grayish-green or olive-gray shale (Maple Mill) to very dark olive-gray or dusky yellowish-brown (Sheffield). This contact frequently is characterized by an abundance of crushed spore carps. A zone of slightly smaller, partially crushed spore carps commonly occurs about 25 feet below this contact in southeastern Iowa.

Section at Sperry Mine

When the United States Gypsum Company drove the shaft for their Sperry mine (near center NW¼ sec. 3, T. 71 N., R. 3 W., Des Moines County, Iowa) samples were taken at two-foot intervals from the lower part of the English River down through the Wapsipinicon. These samples were logged by Campbell and Dorheim (1959). Kulik separated and identified the conodonts from the lithologic samples taken from the base of the English River into the Wapsipinicon and his findings were reviewed by Klapper and Ziegler. A summary of their notes (Kulik, Klapper and Ziegler, 1968) and Klapper and others (in press) is presented in figure 12.

Comparison of the conodont zoning of the Sperry samples with Anderson's zoning of the Sheffield (Anderson, 1966, p. 400) suggests that the upper part of the Sheffield may be missing in north-central Iowa.

Area of Occurrence and Thickness

The area of occurrence of the Yellow Spring Group in Iowa is bounded on the north by a line extending from Des Moines County northwesterly to the Cerro Gordo - Hancock County border and thence southwesterly to Monona County (fig. 13). This probably was a positive area which received sediments intermittently during the deposition of the Group. A comparison of the formation thickness maps (figs. 6, 9, 11) indicates that there were isolated areas of nondeposition for each of the formations, but at each of these locations at least one of the formations within the Group occurs.

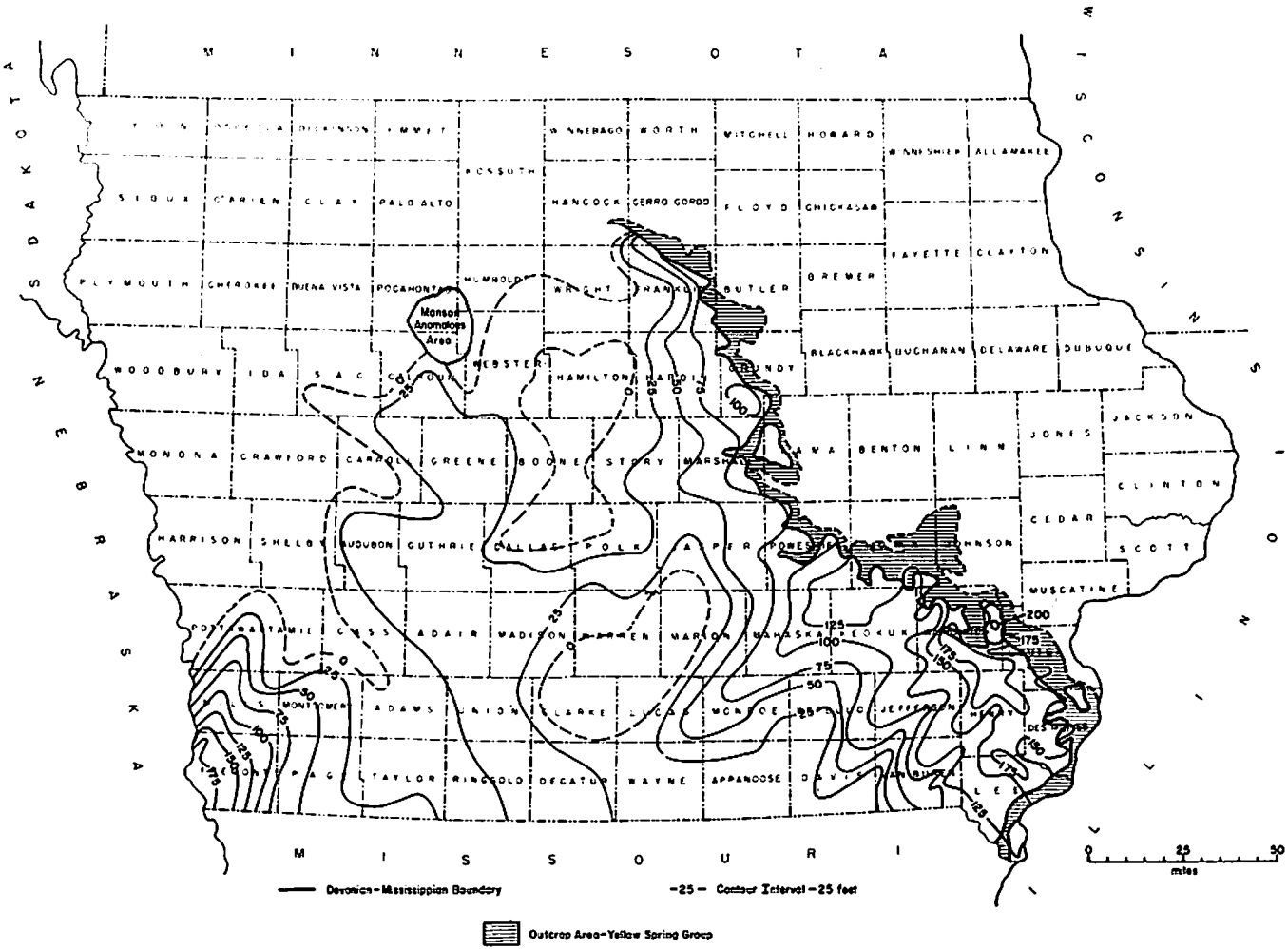

Figure 11. Distribution and thickness map of the Sheffield Formation in Iowa.

Thicknesses of 275 to 315 feet are common for the Group in extreme southeastern Iowa and thicknesses of 150 to 250 feet occur in extreme southwestern Iowa. Thicknesses of 50 feet or less occur in an area from south-central Iowa northwesterly through Cass, Audubon and Crawford Counties.

Upper and Lower Boundaries

The top of the Yellow Spring Group is placed at the top of the English River Formation or, where the English River is absent, at the top of the Maple Mill Shale. Everywhere in Iowa sediments of the Yellow Spring Group are overlain by rocks of the North Hill Group (Workman and Gillette, 1956). Whereas the Yellow Spring Group is dominantly clastic, the North Hill Group is dominantly carbonate.

In a normal section the Prospect Hill (siltstone) is separated from the English River (siltstone) by the McCraney Limestone (fig. 7). Where the McCraney is absent or where only one siltstone is present it can be identified using lithologic criteria. The English River dominantly is a medium-to fine-grained siltstone that is usually dolomitic and grades downward into the Maple Mill Shale by an increase in argillaceous content. By comparison, the Prospect Hill is a medium-to coarse-grained siltstone that is usually dolomitic and usually contains embedded quartz sand grains. Locally, in north-central Iowa the Prospect Hill may vary lithologically from a very silty dolomite to a dolomitic sand within one drill hole.

The Maple Mill is present over most of the area of occurrence of the Yellow Spring Group (fig. 6). It represents a period of relatively stable deposional conditions until near the close of the period when coarser material was introduced into the environment causing a gradual change from shale to siltstone (English River). This sequence appears to represent a period of continuous deposition.

On the other hand, after deposition of the English River silt, the depositional pattern changed. The English River, or the Maple Mill where the English River is absent, is overlain in southeastern Iowa chiefly by the McCraney, in north-central Iowa by the Prospect Hill or the McCraney, and in south-central Iowa (in subsurface) by the Starrs Cave. Each of the formations comprising the North Hill Group directly overlie the continuously deposited Maple Mill - English River sequence, except for a very limited area in Franklin County where the McCraney directly overlies the Aplington.

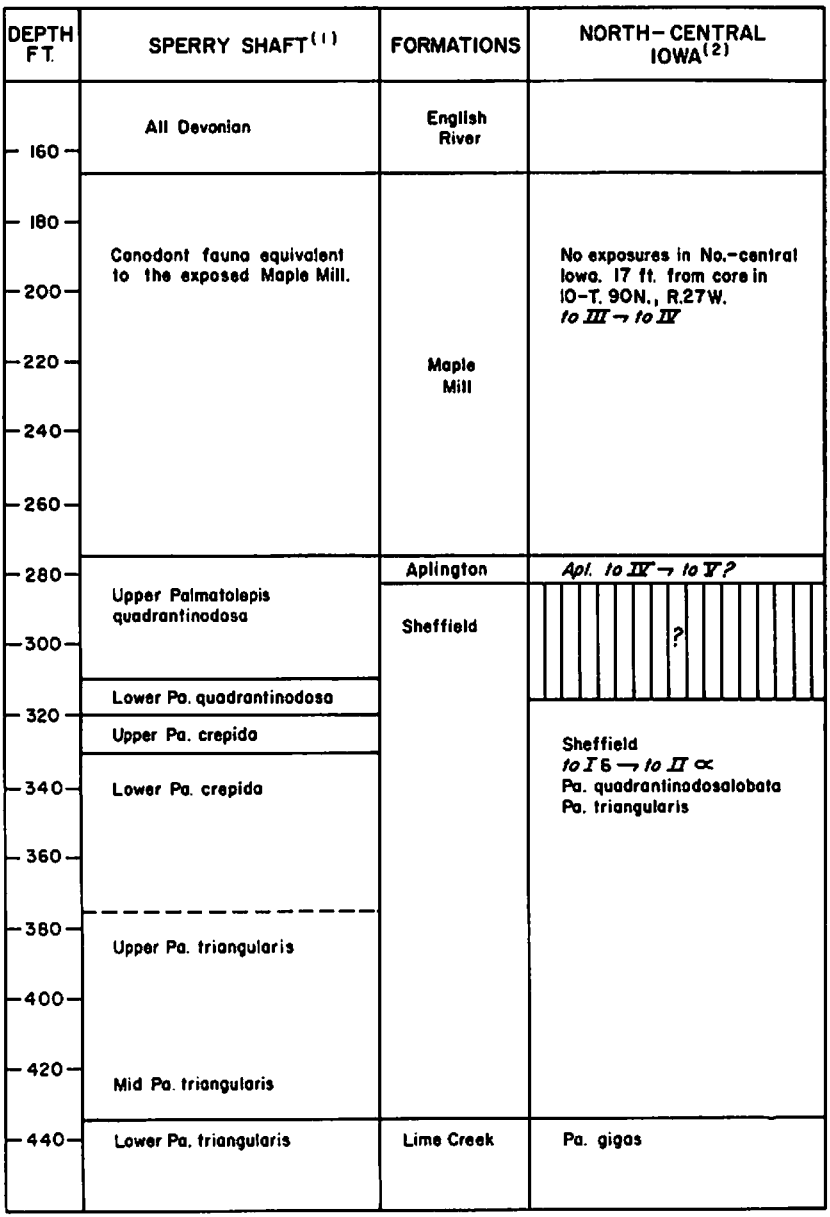

Figure 12. Conodont zonation at Sperry mine shaft and in north-central Iowa. Modified from (1) Klapper, Gilbert and others (in press), pl. 4; (2) Anderson, W. I. (1966), fig. 3, p. 402.

Based upon the foregoing, upon the sharpness of the Yellow Spring-McCraney contacts and upon the presence of the laminated discoidal limonite-hematite pellets (see discussion of Maple Mill, p. 15) that suggest a widespread weathering environment at the top of the Maple Mill, the Yellow Spring-North Hill contact is considered to be unconformable.

The lower contact (Sheffield-Lime Creek) poses no difficulty. In north-central Iowa the Sheffield (clearly a shale) overlies the well developed carbonate members (Owen and Cerro Gordo) of the Lime Creek. Even in southeastern Iowa, where the Lime Creek is a shale, the marked increase in carbonate content is readily noted. In southwest and south-central Iowa the Lime Creek is a limestone. Seldom, if ever, is this boundary a problem.

Age of the Group

Paleontologists long have debated the placement of the Devonian-Mississippian boundary. For many years the North Hill Group and the sequence of rocks now proposed for the Yellow Spring Group were placed in the Kinderhook Series of the Mississippian System. However, it was recognized that the lower formations might transgress the Devonian-Mississippian boundary or that they possibly could be Devonian in age. Recent work in correlating the conodont zones of the Upper Mississippi Valley with the type European section (Renich-Schiefergebirge) has helped to resolve the problem and has demonstrated the need to reposition the Mississippian-Devonian boundary. A brief review of recent work follows.

Collinson (1961, fig. 1, p. 100) considered the English River as Devonian-Mississippian but he placed the unit at the type locality (along the English River in Washington County, Iowa) in the Mississippian. Scott and Collinson (1961) described a Devonian conodont fauna from the English River at Cascade Station, in Burlington, but found undoubted Mississippian forms in what they called English River at other southeastern Iowa localities. Collinson and others (1967, p. 968) suggest placing the Devonian siltstone at Cascade in the Maple Mill or, as an alternative, proposing a new name for this Devonian siltstone. Straka (1968) recovered both Mississippian (*culI*) and Devonian-Mississipian (*tolV-culI*) conodonts from the English River at the type locality and assigned the unit to the *culI* zone, tentatively placing the Mississippian-Devonian boundary at the base. Klapper (personal communication, 1968) has stated that the English River at the type locality contains no conodonts diagnostic for

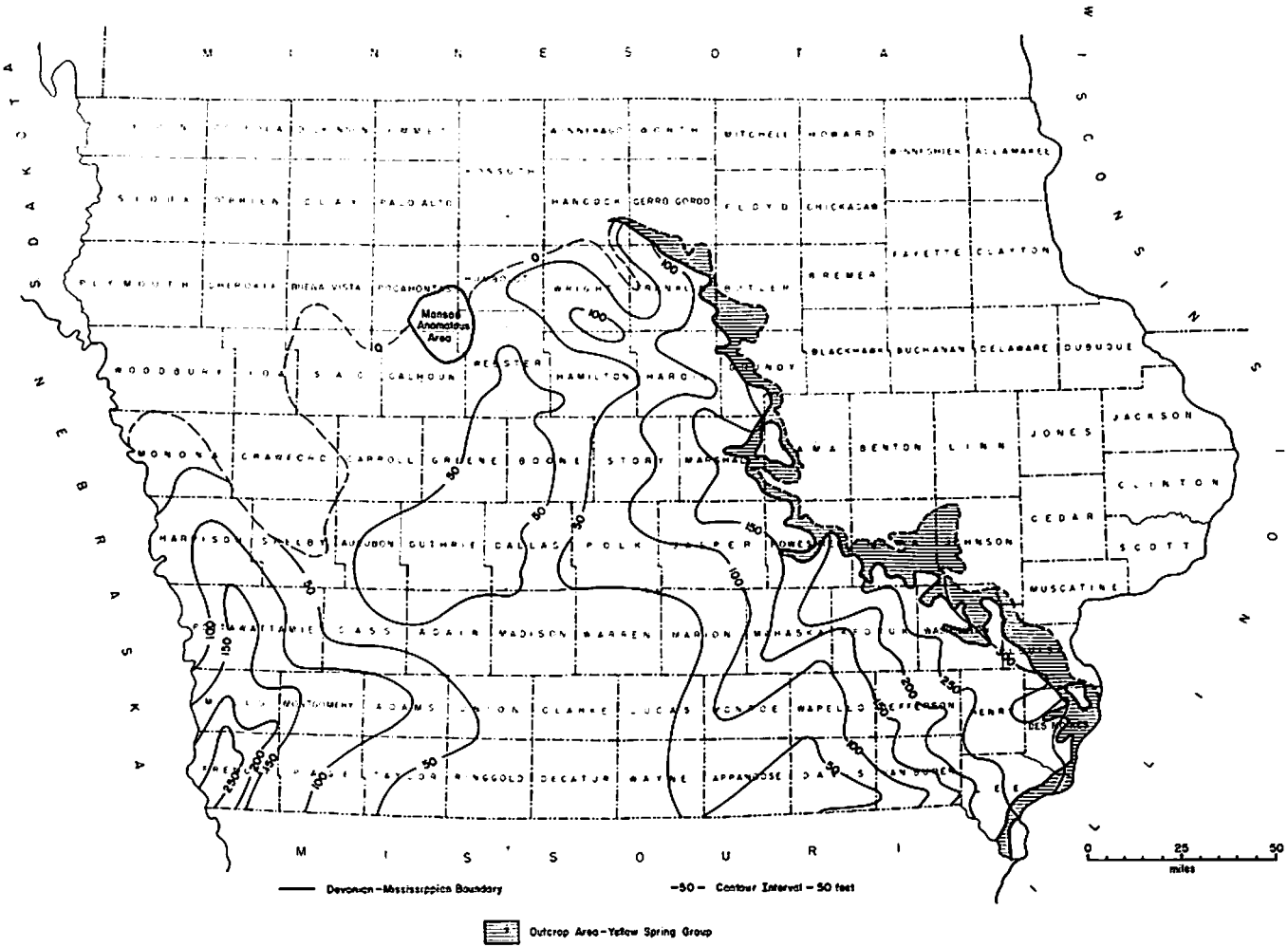

Figure 13. Distribution and thickness map of the Yellow Spring Group in Iowa.

a Mississipian determination. He considers the placement of the Mississippian-Devonian boundary, in terms of the English River, an open question.

Anderson (1964, p. 329) placed the "English River" (his quotes) of north-central Iowa in the Mississippian *cul* zone. The quotation marks indicated doubt relative to the use of the term English River of southeastern Iowa usage, for a somewhat similar siltstone in north-central Iowa. Recent field work, restudy of numerous well samples and the construction of cross sections suggest that, where a single siltstone is encountered in north-central Iowa, it is Prospect Hill rather than English River. Anderson (personal communication, 1968) is in agreement with this interpretation. Locally in north-central Iowa, however, two siltstones do occur separated by the McCraney Limestone. W-10767 and W-11167 are examples.

It appears that conodont workers consider the formations of the North Hill Group to be clearly Mississippian and the Maple Mill shale to be clearly Devonian. Thus the English River is the key to the paleontological boundary problem. Precision in placing this boundary, of course, is scientifically important. For mapping, subsurface logging and other utilitarian purposes, however, the Iowa Geological Survey places the top of the Yellow Spring Group at the contact of the English River (or the Maple Mill where the former is not present) with the base of the North Hill Group.

CONCLUSIONS

The Yellow Spring Group, a new group name, is designated for the four formations that were removed from the Kinderhook and placed in the Upper Devonian, because the strata are distinctive as a mappable unit.

The Yellow Spring Group, as proposed in this report, overlies the Lime Creek Formation and is overlain by the North Hill Group.

In the Upper Mississippi Valley the transition from Devonian to Mississippian was one of more or less continuous deposition. For this reason the Devonian-Mississippian boundary has been, and may still be, a subject of controversy. Following the definition of this boundary in Germany much work has been completed in Iowa on conodont

zonations. As a result of this work it became apparent that the boundary as proposed in the early literature was too low in the section.

The Iowa Geological Survey places the Mississippian-Devonian boundary at the top of the English River and below the North Hill Group because the McCraney-English River contact is more easily recognized over greater areas than the gradational English River-Maple Mill contact (in subsurface).

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