

Conodont biostratigraphy of the upper member of the Henryhouse Formation (late Ludfordian—Pridoli, Silurian), southern Oklahoma, USA

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ABSTRACT: The upper member of the Henryhouse Formation constitutes a succession of moderately argillaceous carbonate mudstone and calcareous shale that crops out in the Arbuckle Mountain region in southern Oklahoma. In the central and southern Arbuckles, the thick upper member of less argillaceous carbonate strata (up to 100 m) rests disconformably on the thin lower member (Gorstian-early Ludfordian) and the unconformity coincides with the mid-Ludfordian Lau Event and carbon isotope excursion (CIE). On the Lawrence Uplift the upper member rests unconformably on the lower, Sheinwoodian part of the Clarita Formation. Five successive conodont faunas occur in the upper member: a thin basal interval characterized by *Jeppsonia* n. gen. (*J. snajdri*-*J. crispa* group); an interval lacking age-diagnostic conodonts; a thick interval characterized by *Oulodus elegans elegans*, *Belodella anfracta*, *Zieglerodina altidens* n. sp., *Panderodus cernus* n. sp., and *Dapsilodus terminus* n. sp., a fourth thin interval of *Ou. elegans detortus*, and a fifth thin interval with the acme of *B. coarctata* that extends up to the top of the Henryhouse. The *Jeppsonia* fauna is late Ludfordian in age, the undiagnostic interval may be late Ludfordian or early Pridoli in age, and the upper three faunas are Pridoli in age. The diverse shelly fauna of the Henryhouse Formation does not occur in the lower member and nearly all collections of shelly fossils were obtained from strata of the upper Henryhouse bearing the upper three Pridoli conodont faunas.

Keywords: conodont, Silurian, biostratigraphy, Oklahoma

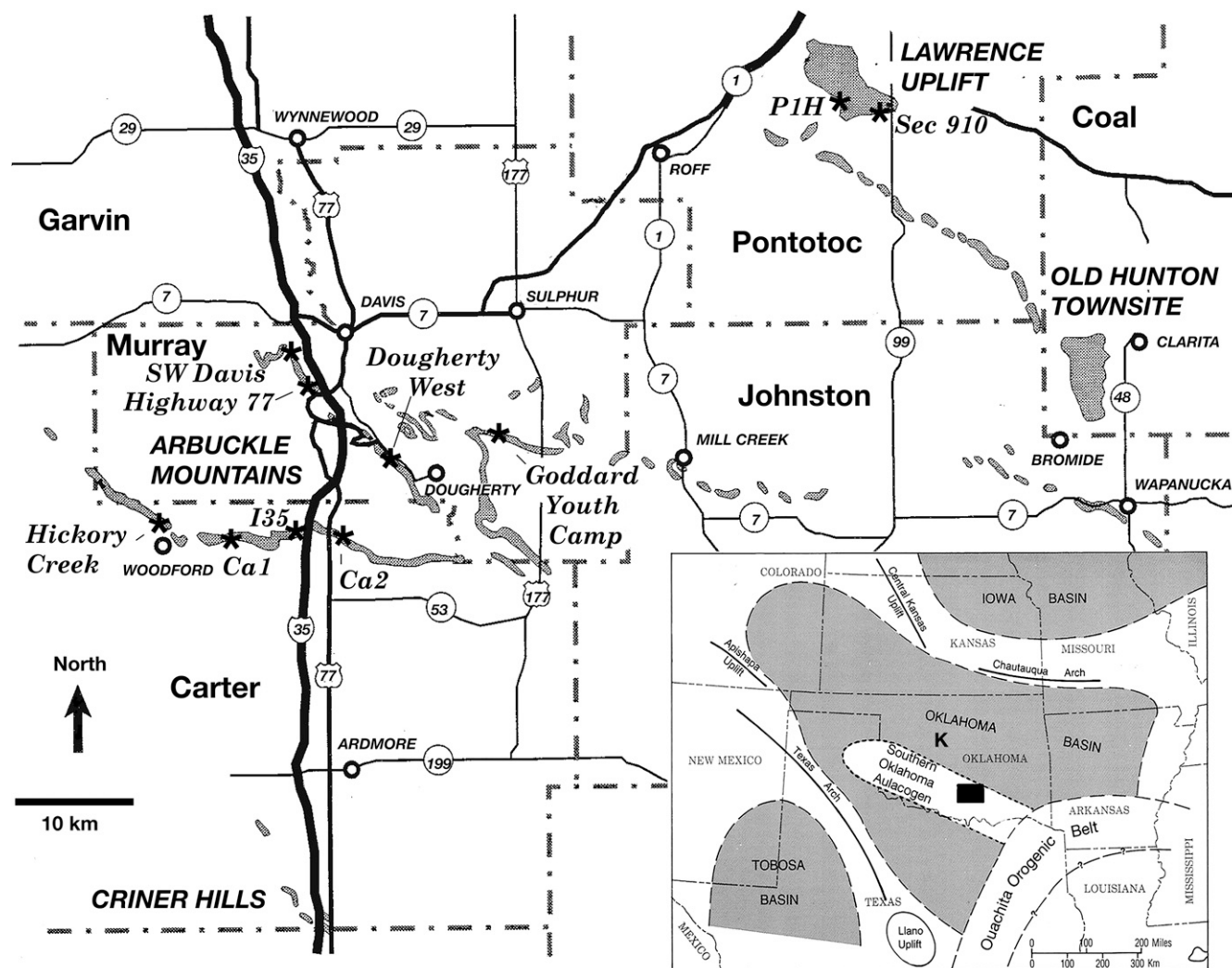
INTRODUCTION

The Ludlow-Pridoli Henryhouse Formation comprises the lower portion of the upper Silurian to Lower Devonian marlstone section of the Hunton Group that crops out in southern Oklahoma and extends into the subsurface of the adjacent Anadarko and Arkoma basins (text-figure 1). Amsden described the stratigraphy of the Hunton Group in Oklahoma and discussed the paleontology and age relations of the constituent formations in a series of publications spanning forty years (e.g., Amsden 1951, 1957, 1960, 1975, 1980, 1988). The upper Silurian to Lower Devonian marlstone interval, although lithologically uniform, had been divided into two formations in early studies (Maxwell 1936; Reeds 1911) because of the different brachiopod faunas in the late Silurian Henryhouse Formation and the Early Devonian Haragan Formation (text-figure 2). Amsden (1951, 1958) documented the distinct differences between the Henryhouse and Haragan brachiopod faunas, which he attributed to the presence of a major unconformity between the two marlstone units (Amsden 1960, 1988). Later research on trilobites (Campbell 1967, 1977), ostracodes (Lundin 1965, 1968), and corals (Sutherland 1965) supported the sharp faunal distinction between the two units. Subsequent workers have followed the subdivision of the Hunton marlstone into two formations, while acknowledging the difficulties of separating the units on lithological grounds (e.g., Stanley 2001). More recent work has questioned the magnitude, or even the existence of, an unconformity between the Henryhouse and Haragan formations at many sections (Barrick and

Klapper 1992; Jacobi et al. 2009). The differences in the fauna between the two units is likely a result of a regional biotic turnover related to the Klonk Oceanic Event (Barrick and Kleffner 2022; Barrick and Meyer 2019; Jacobi et al. 2009).

Barrick et al. (2010a) subdivided the Henryhouse Formation into two informal lithological units (text-figure 2). The basal unit of highly argillaceous and silty carbonates and shales was designated as the “lower member” of the Henryhouse Formation and the overlying, younger and less argillaceous carbonates as the “upper member.” Conodont faunas of the *Kockelella crassa*, *Ancoradella ploeckensis*, and *Polygnathoides siluricus* zones indicate that the lower member ranges in age from the early Gorstian into the middle Ludfordian (Ludlow). The mudstone lithofacies, *Dapsilodus* conodont biofacies, and presence of graptolites indicated relatively deep-water, offshore deposition for the lower member. The distinct lithological and conodont faunal break between the two members marks a disconformity corresponding to the Lau Oceanic Event and the mid-Ludfordian carbon isotope excursion (CIE) (Barrick et al. 2010a).

In this paper we document the conodont faunas of the upper member of the Henryhouse Formation, which ranges in age from late Ludfordian (post-Lau Event) to the end of the Pridoli (Klonk Event). Brief summaries of the faunas were published in Barrick (1988) and Barrick et al. (1990) and are updated here with illustrations of significant taxa. This paper fills the gap between the conodont faunas of the lower member of the Henryhouse Formation described by Barrick et al. (2010a) and



TEXT-FIGURE 1

Map of southern Oklahoma showing Hunton Group outcrop belt (shaded) and locations of sections discussed in this paper. Hunton outcrop map after Stanley (2001). Inset map of south-central North America shows locations of major tectonic features during early and middle Paleozoic time. Position of study area shown by black box; location of Kingfisher County is indicated by 'K'. Coordinates for localities are given in the Locality Appendix.

the papers of Barrick and Klapper (1992) and Jacobi et al. (2009), who documented the conodont succession across the Silurian-Devonian boundary in the uppermost beds of the Henryhouse and those of the lower Haragan.

MEMBERS OF THE HENRYHOUSE FORMATION

The lower member of the Henryhouse Formation is composed of up to 13.5 m of highly argillaceous, silty carbonate mudstones and calcareous shale that rest on the upper beds of the Wenlock to basal Ludlow Clarita Formation in the southern and central Arbuckle Mountains (Barrick et al., 2010a). It is largely restricted to the central and southern Arbuckle Mountains (text-figure 1). Because of the argillaceous nature of the lower member, well-exposed outcrops are rare and the basal part of the Henryhouse Formation is often a mostly covered interval lying between the exposed top of the Clarita Formation

and the lowest part of the upper member of the Henryhouse Formation.

Across most of the Hunton outcrop belt, the upper member of the Henryhouse Formation is thicker than the lower member, but the thickness varies with geography. In the southern Arbuckle sections (Hickory Creek, Ca1, I35, and Ca2, text-figure 1) the upper member is about 45-50 m thick. In the central Arbuckle sections (Highway 77, SW Davis, Dougherty West and Goddard Youth Camp; text-figure 1) the upper member is thinner, ranging from 10 to 20 m thick. On the Lawrence Uplift, where the lower member is very thin or absent (Sections 910, P1, and P1H; text-figure 1), the upper member attains its greatest thickness of 80 m.

The upper member of the Henryhouse Formation rests on the lower member in the central and southern Arbuckles. The

SILURIAN	DEVONIAN	SYSTEM	SERIES	STAGE	OCEANIC EPISODES & EVENTS	CORRADINI et. al. 2024 ZONATION		SOUTHERN OKLAHOMA		
	EARLY	PRIDOLI	LUDLOW	LUDFORDIAN	Klonk Event	<i>Caudicriodus woschmidtii</i>		<i>Caudicriodus anitae & C. murphyi</i>		
	LOCH. (base)									
					Pridoli episodes & events	<i>Oulodus elegans detortus</i>	U L	<i>Belodella coarctata</i>	<i>Oulodus e. detortus</i>	
					Klev Event	"Ozarkodina" <i>eosteinhornensis</i>		<i>Oulodus elegans</i> fauna		
					Hoburgen Secundo Episode	<i>Ozarkodina crispa</i>		Undiagnostic	<i>Jeppssonina</i> fauna	
					Lau Event	<i>Ozarkodina snajdr</i>		Missing?		
					Havdhem Primo Episode	<i>Polygnathoides siluricus</i>		<i>Polygnathoides siluricus</i>	UNIT 3	
					Etelham Sec. Episode	<i>Ancoradella ploeckensis</i>		<i>Ancoradella ploeckensis</i>		
					Linde Event				UNIT 2	
					Sproge Primo Episode	<i>Kockelella variabilis variabilis</i> Interval Zone		<i>Kockelella variabilis variabilis</i> Interval Zone		
						<i>Kockelella crassa</i>		<i>Kockelella crassa</i>	UNIT 1	

TEXT-FIGURE 2

Summary chart of the Ludlow-Pridoli conodont zonation of Corradini et al. (2014, 2024), oceanic episodes and events of Jeppsson and Aldridge (2000) and Jeppsson et al. (2006), and faunal intervals of the Henryhouse Formation. Lower Henryhouse zonal and age assignments are discussed in Barrick et al. (2010a).

lower few meters of the upper member are carbonate mudstone to packstone that contains relatively low amounts of fine terrigenous clastics. This basal unit is more prominent than the lower member in well-exposed sections, and in poorly exposed sections it forms a small ridge above the covered lower member. The greater part of the upper member in this area comprises a succession of argillaceous carbonate mudstone and wackestone in which the variable amounts of fine grained terrigenous clastics produce intervals of poorly exposed units separated by small, more resistant ridges. The skeletal content of the mudstone beds is usually less than 10%. HCl insoluble

residues, mostly clay-sized material, vary from 10 to 30% in an irregular manner through the measured sections. On the Lawrence Uplift, where the lower member is thin or absent, the lower several meters of slightly argillaceous carbonate mudstones are moderately well-exposed. The greater thickness of the upper member comprises carbonate mudstone and wackestone with greater amounts of fine-grained terrigenous clastics and calcareous shale and forms fewer, less prominent ridges. The upper member is mostly exposed as series of glades, from which most of the Henryhouse shelly fauna was collected (see discussion of the shelly fauna below).

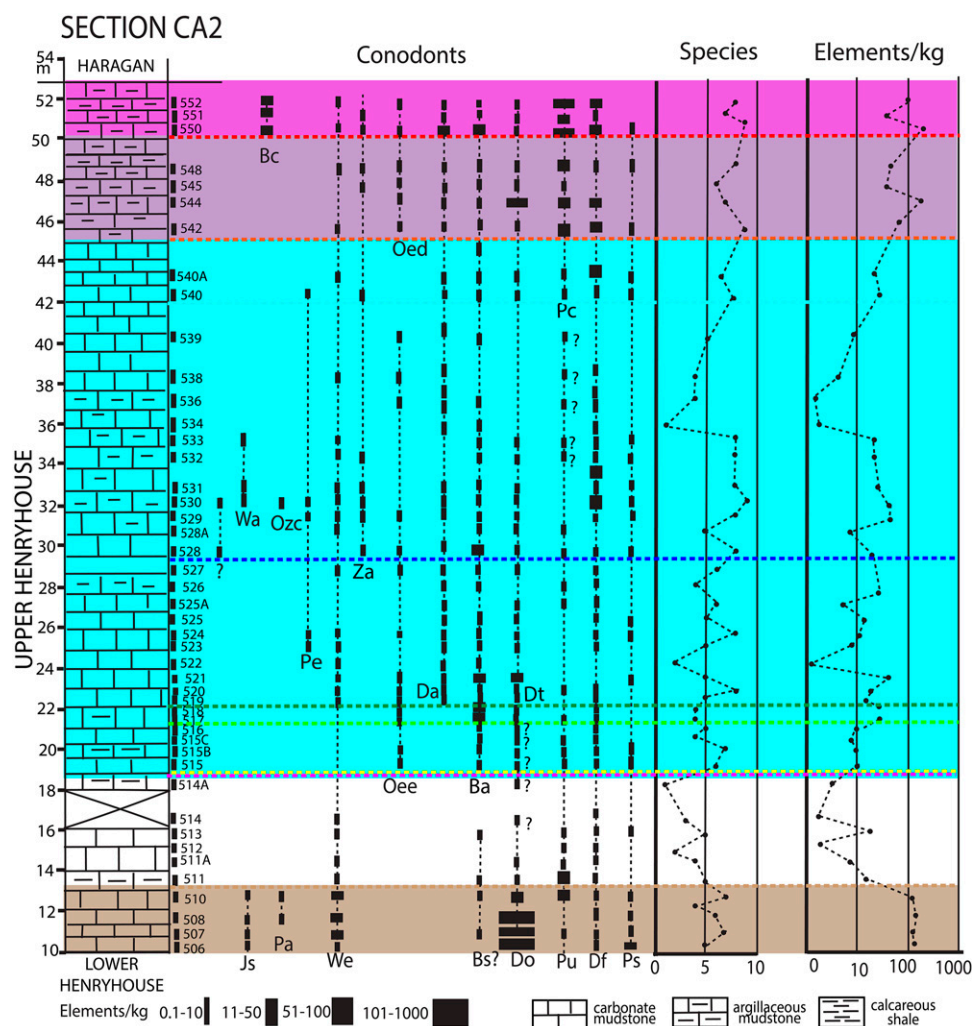
Southern Arbuckle sections: Ca2, I35, and Hickory Creek sections.

At section Ca2 of Amsden (1960), on the south flank of the Arbuckle Mountains just east of US Highway 77, the lower member is about 10 m thick, but only a few beds are exposed. Barrick et al. (2010a, p. 62) described the lower member at the Ca2 section. The base of the upper member is a distinct low ridge (3 m) of less argillaceous carbonate mudstones (text-figure 3). The remainder of the section is a series of depressions of poorly exposed carbonate mudstone and wackestone alternating with small ridges of better exposed less argillaceous carbonate mudstone. Some of the more argillaceous units of the upper member are reddish brown in color, unlike the typical

brown color of the Henryhouse. The upper member is about 43 m thick.

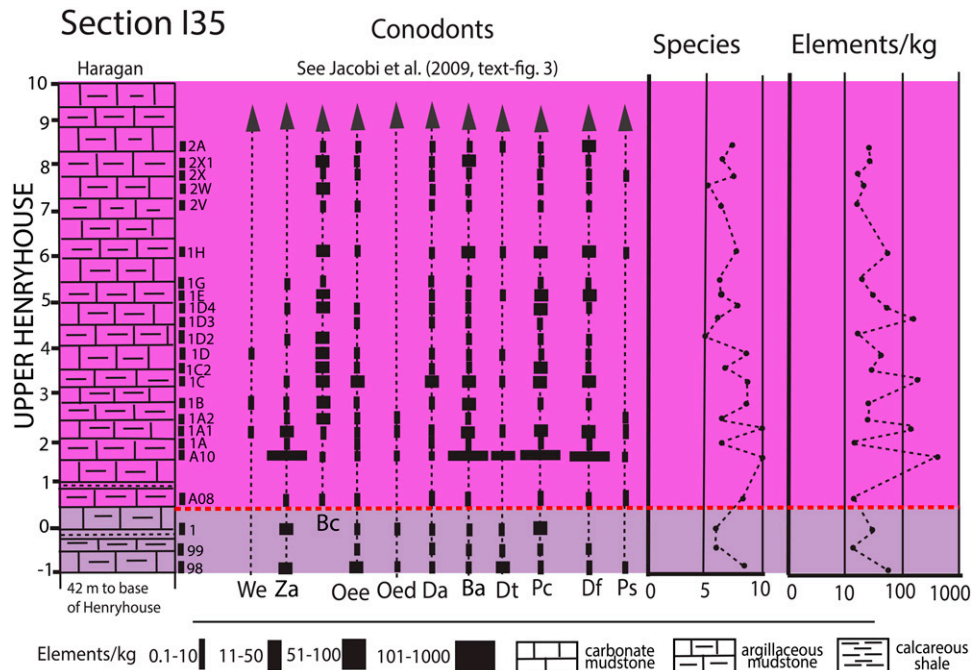
The I35 section is about 1 km west of the Ca2 section, along the southbound lane of Interstate 35. This is Stop 2 of Barrick et al. (1990) and Stop 3 of Al-Shaieb et al. (1993). Jacobi et al. (2009) described the conodont faunas and carbon isotope stratigraphy across the Henryhouse-Haragan interval, spanning the Silurian-Devonian boundary. Here we include an additional 7 m of upper Henryhouse strata (text-figure 4) below the section shown in Jacobi et al. (2009, text-fig. 3).

The Hickory Creek section, about 13 km west of the Ca2 section, is poorly exposed (text-figure 5) The basal limestone of the upper



TEXT-FIGURE 3

Stratigraphic column of the upper Henryhouse member at the Ca2 section showing distribution and abundance of conodont taxa. The *Jeppssonia* fauna is indicated by the brown shading, the undiagnostic fauna by no color, the *Oulodus elegans* fauna by the blue shading, the *Ou. elegans detortus* interval by the purple shading, and the *Belodella coarctata* interval by the reddish-purple shading. Colored horizontal dashed lines indicate significant first and last occurrences: brown – highest *Jeppssonia* species; pink – lowest *Belodella anfracta* (Ba); yellow – lowest *Oulodus elegans elegans* (Oee); green – *Dvorakia amsdeni* (Da); bright green – *Dapsilodus terminus* (Dt); dark blue – lowest *Zieglerodina altidens* (Za); bright blue – *Panderodus cernus* (Pc); orange – *Oulodus elegans detortus* (Oed); red – *Belodella coarctata* (Bc). Bs – *Belodella silurica*; Jc – *Jeppssonia crassa*; Jp – *J. parasnjdri*; Js – *J. snjdri*; Df – *Decoriconus fragilis*; Do – *Dapsilodus obliquicostatus*; Dvs – *Dvorakia?* sp.; Ozc – *Ozarkodina typica* group; Pa – *Parazieglerodina auriformis*; Pe – *Praecriodius* sp.; Ps – *Pseudooneotodus* spp.; Pu – *Panderodus unicosatus*; We – *Wurmiella excavata*; Wa – *Wurmiella* sp. A, Ze – *Zieglerodina eosteinhornensis*.

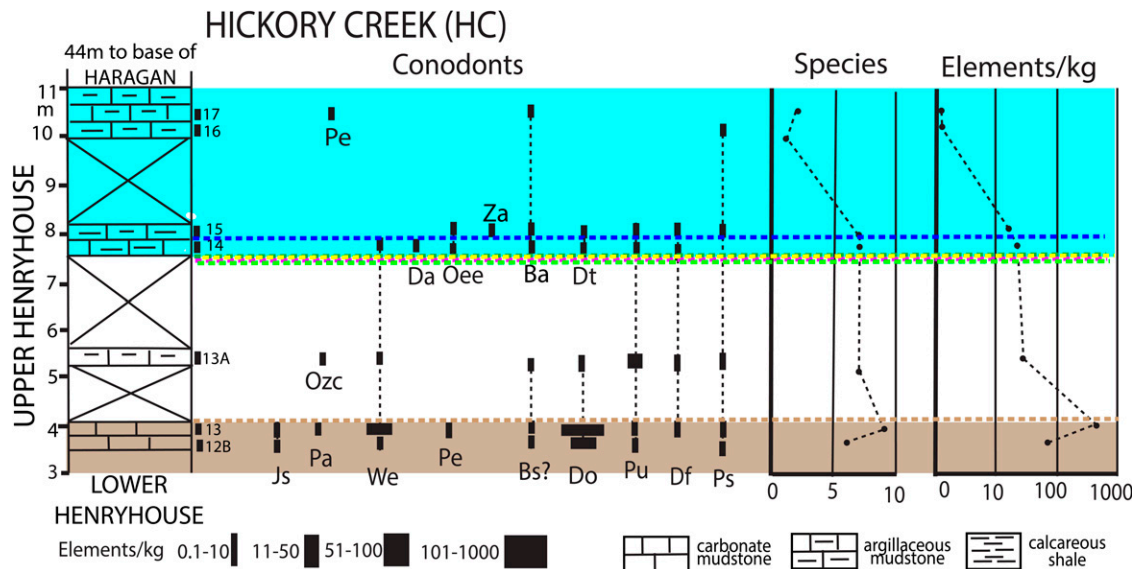


TEXT-FIGURE 4
Stratigraphic column of the uppermost part of the upper Henryhouse member at the I 35 section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.

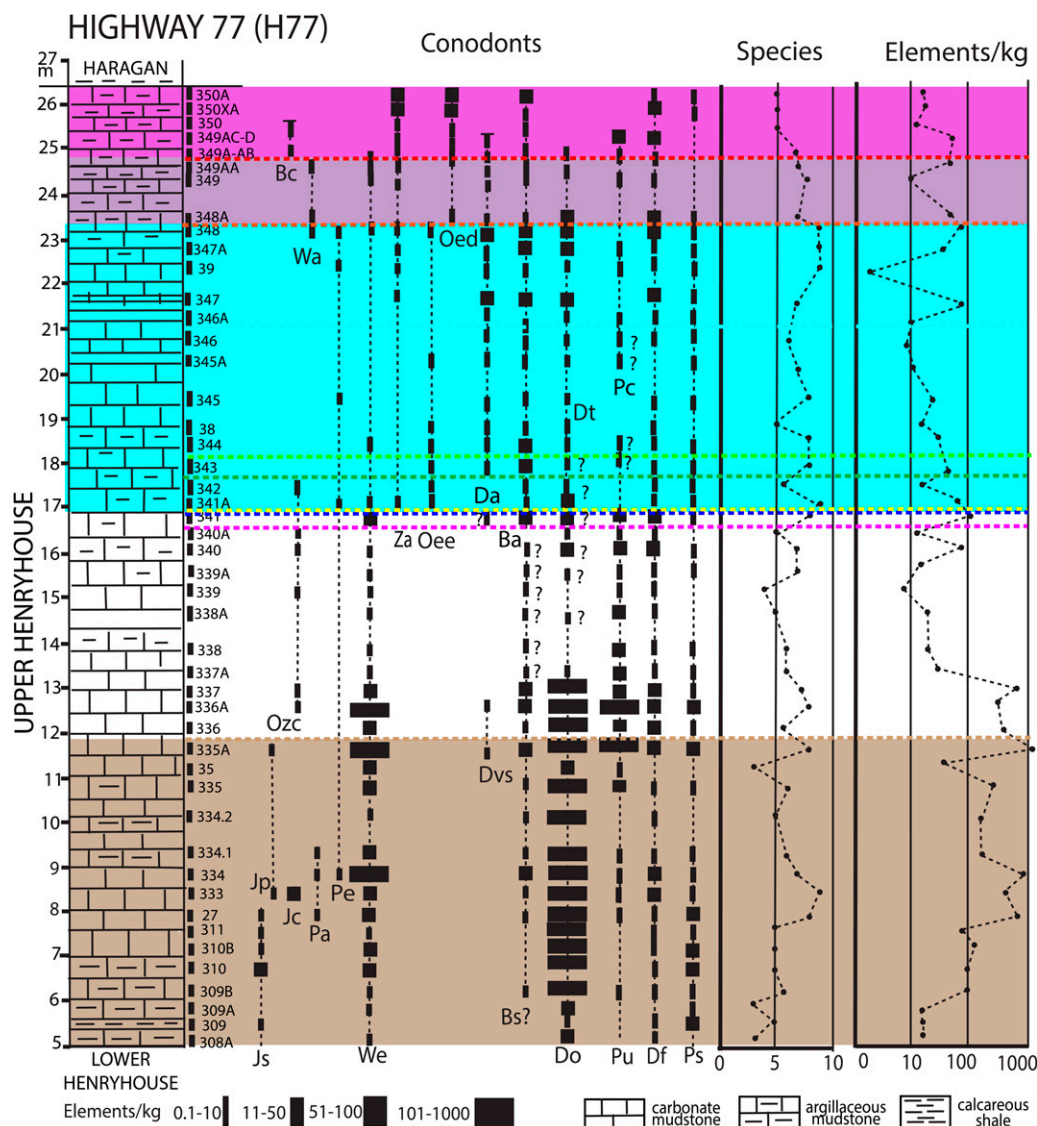
Henryhouse forms a small ridge above the covered lower member. A couple of small mudstone ridges higher in the section were also sampled. The thickness of the upper member at Hickory Creek is estimated from Amsden (1960) to be about 50 m. We could not gain access to the type section of the Henryhouse Formation at section Ca1 of Amsden (1960), which lies on strike between the Ca2 and Hickory Creek sections.

Central Arbuckle Mountains: Highway 77, Dougherty West, Goddard Youth Camp, and Southwest Davis Oilfield sections

The Highway 77 section is the well-known and well-exposed Hunton Group section at the Highway 77 roadcut in the central Arbuckle Mountains (text-figure 6). This outcrop has been a stop on numerous fieldtrips and serves as a reference section for study



TEXT-FIGURE 5
Stratigraphic column of the upper Henryhouse member at the Hickory Creek section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.



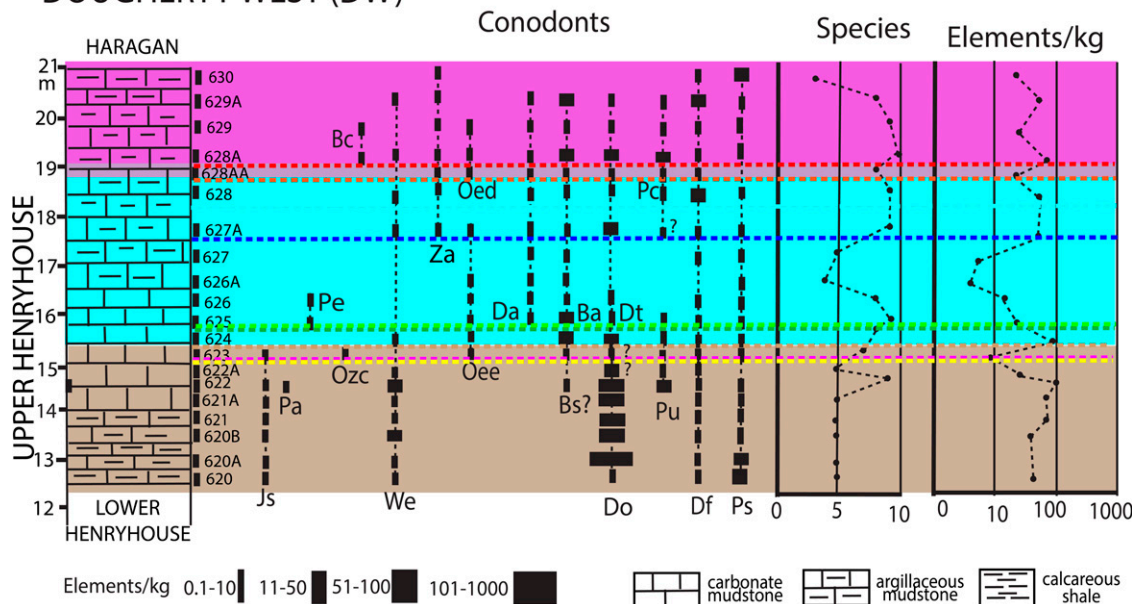
TEXT-FIGURE 6

Stratigraphic column of the upper Henryhouse member at the Highway 77 section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.

of Hunton Group stratigraphy. This is section M17 of Amsden (1960), the Highway 77 section of Barrick and Klapper (1976, 1992) and Jacobi et al. (2009), field trip Stop 1 of Barrick et al. (1990), and field trip Stop 6 of Al-Shaieb et al. (1993). Stanley (2001, Stop 9, fig. 49) gives a generalized measured section of the Henryhouse at Highway 77. Barrick et al. (2010a, text-fig. 5) described in detail the lithofacies, conodont faunas, and the carbon and oxygen isotope stratigraphy of the lower member of the Henryhouse Formation at the Highway 77 section. The contact of the base of the upper member with the lower member of the Henryhouse Formation lies at the base of a prominent 20-cm thick light brown carbonate mudstone bed (sample 308A, Barrick et al. 2010a). The lower 2 m are moderately argillaceous mudstone and wackestone that are overlain by 3 m of less argillaceous mudstone and wackestone that form a resistant ridge. The rest of the upper member (15 m) is composed of carbonate mudstone to wackestone with varying contents of fine-grained terrigenous clastics. Saltzman

(2001, text-fig. 2; Saltzman 2002, text-fig. 6) published a stable isotope curve for the Hunton Group based on this section. Values of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ show surprisingly little variation through the upper member of the Henryhouse between the Lau CIE and Klonk CIE. Jacobi et al. (2009, text-fig. 4) provided a more detailed conodont biostratigraphy than Barrick and Klapper (1992) across the Silurian-Devonian boundary at the Highway 77 section and illustrated the stable isotope stratigraphy through the Klonk CIE. Theiling (2013, text-fig. 8) and Theiling et al. (2017, text-fig. 3) resolved subtidal cycles in the uppermost part of the Henryhouse Formation (*Oulodus elegans detortus* Zone) that are composed of lower thinly bedded shale and carbonate mudstone and wackestone (substorm wave base) overlain by medium-bedded wackestone and packstone (near fairweather wave base). Analyses of Nd and Sm isotopes indicated major contributions of an average Acadian source and an older Canadian Shield and/or Transcontinental Arch source for the fine-grained terrigenous clastics (Theiling et al. 2017).

DOUGHERTY WEST (DW)

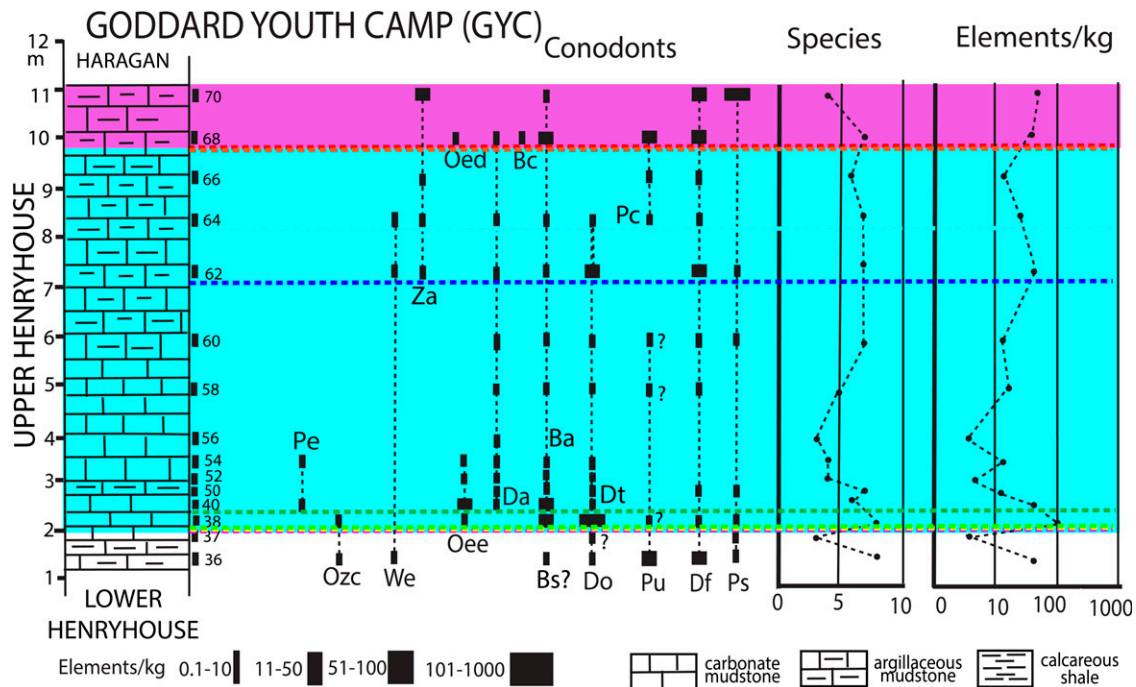


TEXT-FIGURE 7

Stratigraphic column of the upper Henryhouse member at the Dougherty West section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.

The thickest and most completely exposed section of the lower member occurs in the base and bank of a small natural stream that cuts through the steeply dipping beds of the Hunton Group southwest of Price's Falls, the Dougherty West section of Barrick et al.

(2010a) (text-fig. 7). This section exposes 12.5 m of the lower member of the Henryhouse Formation and both the lower contact of the member with the underlying Clarita Formation and its upper contact with the upper member of the Henryhouse Formation. The



TEXT-FIGURE 8

Stratigraphic column of the upper Henryhouse member at the Goddard Youth Camp Section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.

upper Henryhouse is just 8 m thick. The basal 1.2 m of the upper Henryhouse is soft-weathering argillaceous carbonate mudstone. It is overlain by a well-exposed 2.2 m ridge of less argillaceous carbonate mudstone and wackestone, followed by a lower ridge of 4.6 m of more argillaceous carbonate mudstone. The overlying section of argillaceous carbonate mudstone is assigned to the Haragan Formation based on the recovery of *Caudicriodus* elements.

The section at the Goddard Youth Camp (text-figure 8) appears to be the same as section M10 of Amsden (1960). Stanley (2001) described a similar section as his Stop 4 (Goddard Youth Camp section). Recognition of the Henryhouse Formation in this area is problematic based on lithology alone. The basal 6 ft (1.83 m) of yellowish gray carbonate mudstone that Amsden (1960) assigned to the Henryhouse Formation lacked fossils, whereas he reported a large shelly fauna from the mottled yellow and red carbonate mudstones of the overlying beds. Stanley (2001) reported that the thickness of the Henryhouse Formation is at least 7.0 ft (2.13 m) thick. Beds assigned to the lower member of the Henryhouse Formation are soft-weathering, argillaceous carbonate mudstones (Barrick et al. 2010a). The basal 1 m of the upper Henryhouse is a unit of less argillaceous, more resistant weathering carbonate mudstone and wackestone. This unit is overlain by 7 to 8 m of softly weathering argillaceous carbonate mudstone, some beds of which are red-brown in color, in contrast to the usual brown coloring. The Henryhouse/Haragan contact was determined by the presence of *Caudicriodus* elements.

The Southwest Davis Oilfield section (text-figure 9) lies about 2 km northwest of the Highway 77 section. The short stratigraphic section forms part of a small, overturned fault block. The upper member of the Henryhouse rests directly on the Llandovery Cochrane Formation and the basal 0.5 m of the Henryhouse produced reworked Cochrane conodonts. The entire section of 4.5 m is the typical argillaceous mudstone and wackestone of the Henryhouse. The base of the Woodford Shale lies above a covered interval of 1.5 m.

Lawrence Uplift: P1, P1H, and 910 sections

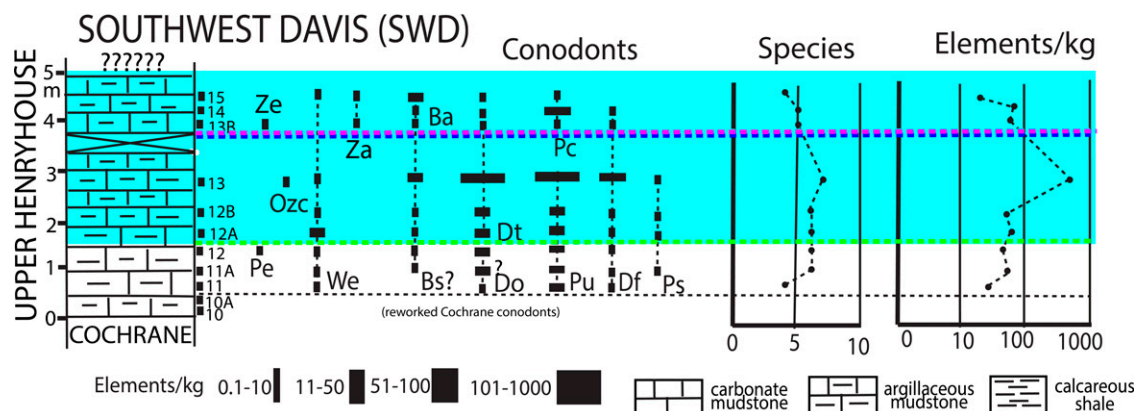
The Henryhouse Formation at section P1 of Amsden (1960) is about 75 m thick, all of which is the upper member of the

Henryhouse. The base of the upper member rests directly on the lower part (Sheinwoodian) of the Clarita Formation and the lower member of the Henryhouse is absent. The lower 11 m of the upper member forms a small, well exposed outcrop along Chimneyhill Creek, section P1H (text-figure 10). Argillaceous carbonate mudstone and wackestone dominate the section and few beds of packstone and thin shales are present. The overlying 54 m of the upper Henryhouse occurs as a series of glades of poorly exposed, fossiliferous argillaceous carbonate wackestone that extend from the top of section P1H to near the top of the member. Many of the shelly fossils from the upper Henryhouse were obtained from the glades in section P1 and nearby sections on the Lawrence Uplift (Amsden 1960; see discussion of Henryhouse shelly faunas below). The uppermost 10 m of the upper member is better exposed and conodont faunas from the upper member and lower beds of the overlying Haragan Formation were described by Barrick and Klapper (1992).

Section 910 (text-figure 11) lies in the road and road ditch of a dirt road that runs along the boundary of sections 9 and 10 about 5 km southeast of section P1H. Grading of the road permitted exposure of more resistant carbonate units. About 20 m of the Henryhouse Formation could be measured. The lowest 2.5 m is poorly exposed extremely argillaceous carbonate mudstone that is the lower member. The occurrence of *Polygnathoides siluricus* confirms this assignment. Above the lower member is a small resistant 5-m ridge of less argillaceous carbonate mudstone and wackestone. The remainder of the upper member is less well exposed argillaceous carbonate mudstone like that seen at section P1.

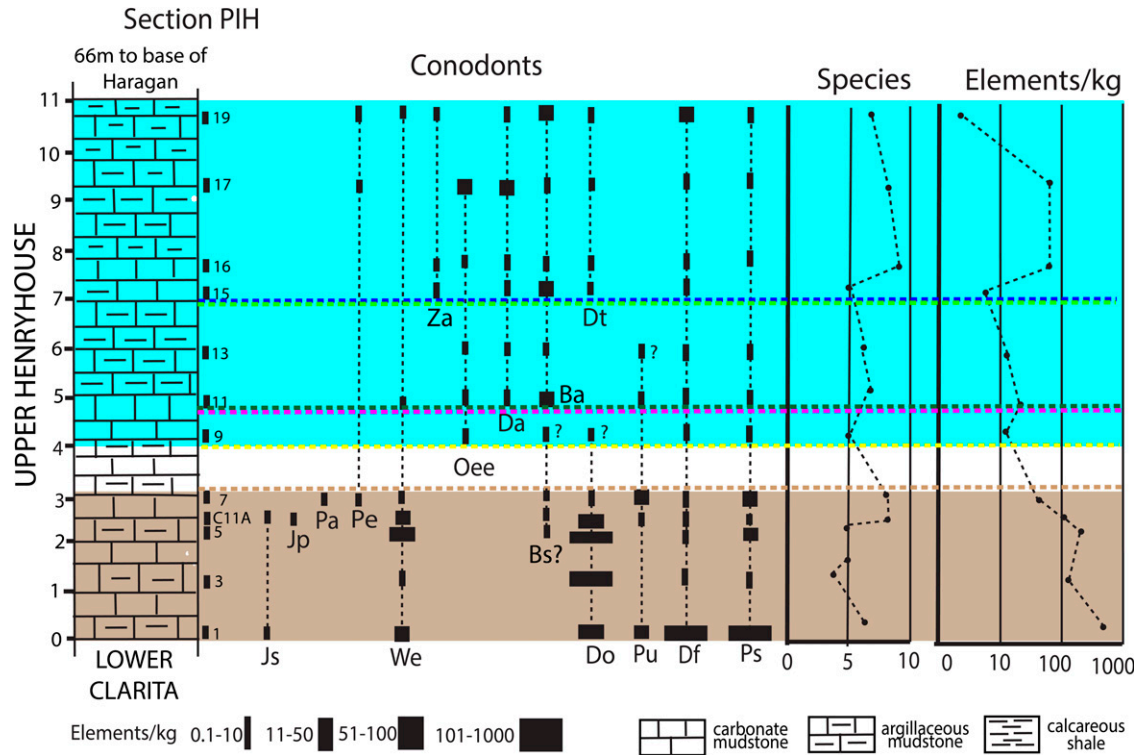
UPPER HENRYHOUSE CONODONT FAUNAS

The samples used in this study were collected over a period of about 60 years, starting with a small number of Amoco samples collected by Klapper during the 1960's. In 1972-1973, Klapper and Barrick took a new set of Henryhouse samples, which were intended to form the basis for the latter's MS thesis. The poor recovery of conodonts from many samples was not sufficient for this project. Later, in 1978-1979, Barrick collected some additional samples with the assistance of T. W. Amsden. Finally, from 1993 to 1996, Barrick collected numerous, sometimes large (5-10 kg)



TEXT-FIGURE 9

Stratigraphic column of the upper Henryhouse member at the Southwest Davis Oilfield section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.



TEXT-FIGURE 10

Stratigraphic column of the upper Henryhouse member at the P1H section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.

samples that form the greater part of the results presented here. The earlier samples were processed with unbuffered 10% formic acid and the argillaceous residues were forcefully washed through the sieves. Later samples were also processed with unbuffered formic acid, but the argillaceous residues were gently rinsed to remove the acid and dried. The residues were processed like clay shale, being soaked in kerosene which was decanted and replaced by hot water. The disaggregated clay could then be gently washed through sieves (usually 125 μ m). Regardless of the procedure used, many conodont elements are broken. Conodont elements from the Henryhouse show variable degrees of fine etching of the surfaces that can be seen in SEM images. Some of the etching is possibly owing to the use of unbuffered formic acid, but elements from some later samples processed using buffered formic acid are also etched in a similar manner.

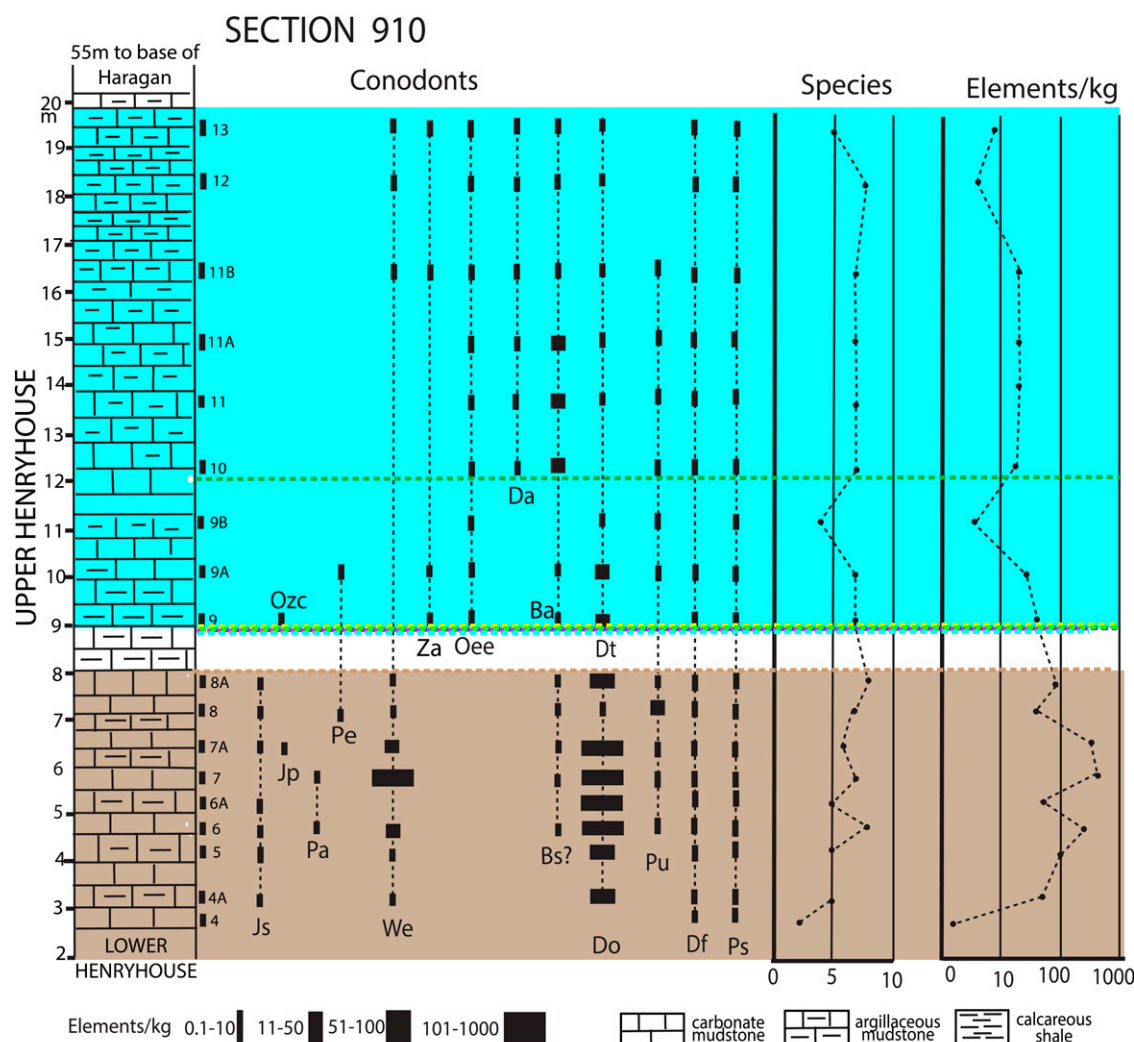
Five successive conodont faunas occur in the upper member of the Henryhouse, with indistinct boundaries between adjacent faunas. These faunas are best documented at the Highway 77 section (text-figure 6), where the upper Henryhouse is better exposed and could be more heavily sampled. The rarity of index conodont species that are used in existing zonations makes it difficult to precisely correlate the faunas outside of the study area.

The oldest fauna, the *Jeppsonia* n. gen. fauna, occurs at the base of the upper member of the Henryhouse, just above the position of the Lau CIE. This fauna is largely restricted to the less argillaceous, more resistant carbonate strata that occur in the lower part of the upper member and extends only a short interval into the more argillaceous overlying carbonate strata.

The *Jeppsonia* fauna is characterized by the uncommon occurrences of *J. snajdri*, *J. parasnajdri*, *J. crispa*, and *Parazieglerodina auriformis*, which are restricted to this faunal level. This fauna is strongly dominated by elements of *Dapsilodus obliquicostatus*, which constitute 40% to 80% of the elements. Elements of *Wurmiella excavata* are the second most abundant group, 10 to 25% of the elements. Other coniform species are uncommon. *Panderodus unicostatus* is rare in the lower part of the fauna, but becomes more common, up to 10% in the upper part. The total abundance of elements is high, up to just over 1000 elements per kg. The *Jeppsonia* n. gen. fauna can be recognized at the Highway 77, Ca2, Hickory Creek, Dougherty West, P1H, and 910 sections.

The base of the second conodont fauna, the undiagnostic fauna, is marked by the rarity of *Dapsilodus obliquicostatus* and *Wurmiella excavata*, and low abundance, usually less than 50 elements per kg. All species, except for all species of *Jeppsonia* n. gen. and *Parazieglerodina*, range up from the older fauna. No new species appear. The more common elements in samples of the undiagnostic fauna are those of *Panderodus unicostatus*. The undiagnostic interval is relatively thin. It is about 5 m thick at Ca2, 3 m thick at Highway 77, and less than 1 m thick at Hickory Creek, P1H, section 910, and at Goddard Youth Camp it forms the basal 1 m of the upper member of the Henryhouse. It is absent at the Dougherty West Section.

The base of the third fauna, the *Oulodus elegans* fauna, is identified by the appearance of any of several species that range through the *Oulodus elegans* fauna to the top of the upper



TEXT-FIGURE 11

Stratigraphic column of the upper Henryhouse member at the 910 section showing distribution and abundance of conodont taxa. See caption to text-figure 3 for explanation.

member of the Henryhouse. The first occurrence of either *Oulodus elegans*, *Zieglerodina altidens* n. sp., *Dvorakia amsdeni*, or *Belodella anfracta* indicate the base of the fauna. The order of appearance of these species differs slightly from section to section. *Dapsilodus terminus* n. sp. and *Panderodus cernuus* n. sp. appear within the *Oulodus elegans* fauna. Abundance of elements is low, between 10 and 100 elements per kilogram, and diversity (number of species) is only slightly higher (6-8) than in the faunas lower in the upper member (5-7). The elements of no one species dominate the fauna, but elements of *Belodella* tend to be slightly more abundant and occur in more samples of the fauna than species of other genera.

The base of the fourth faunal interval is defined by the first appearance of *Oulodus elegans detortus*. It forms just a thin stratigraphic interval near the top of the upper Henryhouse. All species of the *Oulodus elegans* fauna may be present.

The fifth fauna is the *Belodella coarctata* fauna, which was described by Barrick and Klapper (1992) and has been discussed

further by Jacobi et al. (2009) and Barrick and Kleffner (2022). The *B. coarctata* fauna is an excellent indicator of highest Silurian strata because this short-ranging species forms a conspicuous acme before its disappearance just below the base of the Devonian. It is best seen at the I35 section (Barrick and Klapper, 1992; Jacobi et al. 2009), and occurs at Highway 77, Ca2, Dougherty West, Goddard Youth Camp, and section P1 (Barrick and Klapper, 1992).

The stratigraphic distribution of the five conodont faunas shows that deposition of the Henryhouse carbonate mudstones was not necessarily uniform nor continuous through time at all sections, especially in the lower part of the upper member. In most sections, the *Jeppsonia* faunal interval is relatively thin, 3 m or less (Ca2, Hickory Creek, Dougherty West, P1H). It is thickest at the Highway 77 section (12 m) and Section 910 (8 m). But at some sections the fauna is missing (Southwest Davis, Goddard Youth Camp). In a similar manner, the undiagnostic fauna varies greatly in thickness. It is thickest at the Ca2 (6 m), Highway 77 (5 m), and Hickory Creek (3.5 m) sections.

At most other sections the undiagnostic interval is only a meter thick, but at the thin Dougherty West section the *Oulodus elegans* fauna rests directly on the *Jeppsonia* fauna. In the Arbuckle Mountain sections, the *Oulodus elegans* fauna uniformly occupies the upper third to half of the upper Henryhouse section. In the sections on the Lawrence Uplift (P1, Section 910), the *Oulodus elegans* faunal interval occupies most of the thickness of the upper Henryhouse. In both regions the thin intervals of the *Oulodus elegans detortus* and *Belodella coarctata* faunas lie just below the overlying Haragan Formation.

SILURIAN CONODONT BIOSTRATIGRAPHY

Current zonations

The standard Silurian conodont zonation for the upper part of the Ludlow through the Přidolí is based on older publications, starting with the Cellon section (Walliser 1964), and updated by Corradini et al. (2014, 2024). Melchin et al. (2020) reproduced the version of the zonation published by Cramer et al. (2011) without change.

The post-Lau Ludfordian conodont zones are the *Ozarkodina snajdri* Interval Zone and the *O. crisper* Zone. A *Pedavis latialata* Zone was first used by Walliser (1964) to follow the pre-Lau *Polygnathoides siluricus* Zone. Some workers have retained this zone, whereas others have omitted it (see Corradini et al. 2014, text-fig. 3). The sporadic occurrences of “*Pedavis*” elements (or *Praeicriodus* – see below) has hindered the use of this zone. Corradini et al. (2014, p. 68) used the *Pe. latialata/O. snajdri* Interval Zone to encompass the stratigraphic interval at Cellon between the last occurrence of *Po. siluricus* through the higher first occurrence of *O. snajdri*, and the superjacent first occurrence of *O. crisper*. The *O. crisper* Zone corresponds to the range of *O. crisper*, which extends into the lowermost part of the Přidolí, at least at Cellon (Corradini et al. 2014).

The lower part of the Přidolí was poorly subdivided and was assigned to the “*Ozarkodina*” *eosteinhornensis* Interval Zone by Cramer et al. (2011) and Corradini et al. (2014, 2024). The base of the zone was defined by the highest *Ozarkodina crisper* and the top of the zone by the superjacent lowest *Oulodus elegans detortus*. *Zieglerodina* species (“*Ozarkodina eosteinhornensis* group”) occur through and above the zone. The base of *Oulodus elegans detortus* Zone is defined by the first occurrence of the subspecies. Corradini et al. (2014) subdivided the *Ou. e. detortus* Zone into two zones. The last occurrence of *Dapsilodus obliquicostatus* defined the boundary between the lower and upper zones. The range of “*Oz.*” *eosteinhornensis* s. l. lies within the Lower *Ou. e. detortus* Zone. The top of the Upper *Ou. e. detortus* Zone is defined by the superjacent first appearance of *Caudicriodus* species.

Slavík and Carls (2012) subdivided the upper Ludfordian of Bohemia into five zones above the level of the Lau Event (post *Polygnathoides siluricus*). Their *Delotaxis* fauna (*Oulodus* sp.) is a low diversity and low abundance fauna that is interpreted as the interval of a post-Lau recovery. The second zone is the *Parazieglerodina plodowskii* Zone, which corresponds to the short total range of the species. The third zone is the *Pedavis latialata* Zone, the base of which is the first occurrence of this species. The lowest “*Ozarkodina*” *snajdri* occurs less than a meter higher in the Požáry Quarry. Diversity and abundance

are greater in this zone than below. The fourth zone is the “*O.*” *parasnajdri* Zone, based on the first occurrence of this species. The fifth zone is the “*O.*” *crisper* Zone, based on the first occurrence of the nominal species. Peaks of abundance occur in the “*O.*” *crisper* Zone, where *Wurmiella excavata*, *Panderodus unicostatus*, *Pseudooneotodus* species and other coniform species become more common.

A recent proposal subdivides the Přidolí Series into two stages in Bohemia. This uses a series of five local conodont zones based on first occurrences, three of which are species of *Zieglerodina* (Manda et al. 2023, p. 103, 105; Vacek et al. 2018). The *Z. zellmeri* Zone lies at the base of the Přidolí in the Požáry Quarry (*Sk. parultimus* graptolite Zone). The next zone, the *Z. ? ivochlupaci* Zone lies near the top of the lower part of the Přidolí (Jarovian Stage of Manda et al. 2023). The base of the *Oulodus detortus* Zone lies just below the top of the Jarovian and ranges into the upper Přidolí (Radotinian Stage of Manda et al. 2023). The “*Ozarkodina*” *eosteinhornensis* s. s. Zone occupies a thin interval above the *O. detortus* Zone at some sections and the species largely overlaps with *Z. klonkensis* in the Požáry Quarry. The *Z. klonkensis* Zone spans the greater part of the Radotinian Stage and the top of the zone is just below the lowest appearance of *Caudicriodus* species.

A slightly different set of conodont zones has been applied in the Baltic region, based largely on cores in Lithuania (Spiridonov et al., 2017, 2020a,b). The post-Lau Ludfordian was subdivided into a lower *Ozarkodina snajdri* Interval Zone and an upper *Zieglerodina ? baccata-O. crisper* Zone (Spiridonov et al. 2017, 2020a). The base of the *O. snajdri* Interzone is just above the last occurrence of *Polygnathoides siluricus*. These authors noted that an acme of *Panderodus equicostatus* characterizes strata through the Lau Event and just above it. In the Vidukle-61 core (Spiridonov et al. 2020a), *O. snajdri* first occurs near the maximum values of $\delta^{13}\text{C}$ of the Lau Event not far above the last *Po. siluricus*, but in the Milaicial-103 core (Spiridonov et al. 2017), *O. snajdri* does not appear until the topmost sample of the the *O. snajdri* Interval Zone. The first *Z. ? baccata* defines the lower boundary of the *Zieglerodina ? baccata-O. crisper* Zone. The species *Z. ? scanica* is restricted to a short interval near the top of the *O. snajdri* Interval Zone in both cores. *Oulodus elegans elegans* appears approximately at the base of the *Z. ? baccata-O. crisper* Zone in both cores. *Ozarkodina crisper* occurs in a short interval in the upper part of the *Z. ? baccata-O. crisper* Zone in the Vidukle-61 core.

Conodont faunas from the Přidolí Series were analyzed from the Milaicial-103 core (Spiridonov et al. 2020b, text-fig. 3). The lower part of the Přidolí conodont succession was assigned to the “*Ozarkodina*” *eosteinhornensis* Interval Zone, the base of which is just above the last occurrence of *Zieglerodina ? baccata* and *Ozarkodina crisper* and their zone. In the lower part of the “*Oz. eosteinhornensis* Interzone, *Z. ? scanica* reappears with *Panderodus unicostatus* and these two species dominate the fauna (>70%). *Oulodus elegans elegans* is less common. The greater part of the *Oz. eosteinhornensis* Interval Zone is an interval of low abundance and diversity, the Silate Event of Spiridonov et al. (2020b). The base of the upper Přidolí *Delotaxis* (*Oulodus*) *detortus* Zone is defined by the first appearance of the nominal subspecies. “*Oz.*” *eosteinhornensis* s. l. appears near base of the Interval Zone and is common into the middle of the *D. detortus* Zone. Starting in the uppermost

part of the “Oz.” *eosteinhornensis* Interzone, *O. elegans* becomes abundant and remains abundant into the Klonk CIE. The lower part of the *D. detortus* Zone is the *Lanea canadensis* Subzone. The upper subzone, the *Z. remscheidensis* s. l. Subzone, is based on the first occurrence of *Z. remscheidensis* s. l., which is common into the interval of the Klonk CIE at the top of the *D. detortus* Zone. The shallow water species, *Ozarkodina ambigua* is also abundant in the *Z. remscheidensis* Subzone.

Correlation of conodont faunas of the upper member of the Henryhouse Formation

A similar pattern of succession of conodont species occurs in each of the areas discussed above, but the ranges of several significant species are reported to be different in each area. Some of the inconsistencies in ranges may be due to species being recognized using different criteria, such as *Oulodus elegans detortus* and species of *Zieglerodina* (see discussion in Carls et al. 2007). These problems make precise correlation of the faunal intervals of the upper member of the Henryhouse with other areas difficult. Text-figure 12 summarizes the tentative correlation of the faunas of the upper Henryhouse Formation with the more recent Silurian conodont zonal schemes.

The *Jeppssonina* fauna of the lower part of the upper member of the Henryhouse Formation corresponds in general to the *Pedavis latialata*-*Ozarkodina snajdri*-*O. crispa* zonal intervals discussed above. The species *J. snajdri*, *J. parasnajdri* and *J. crispa* occur, but the occurrences are too sparse to permit reliable zonal assignments in the upper Henryhouse sections. *Jeppssonina snajdri* appears at the base of the upper member with abundant *Wurmiella* and *Dapsilodus* immediately above

the highest *Polygnathoides siluricus*. The only confirmed specimen of *Pe. latialata* occurs with *J. snajdri* (HC13). *Jeppssonina parasnajdri* first appears higher in the sections where it occurs with *J. snajdri*. The only occurrences of *J. crispa* are at Highway 77, where it occurs with *J. parasnajdri*. *Parazieglerodina auriformis* is similar to *Pa. plodowskii*, which has a limited range in Bohemia (Slavík and Carls 2012). In contrast, *Pa. auriformis* most commonly occurs within the range of *J. snajdri* and ranges up to overlap with *J. crispa*.

The upper member of the Henryhouse rests on the lower member and older strata unconformably. Where the upper member rests on the lower member, only traces of the Lau CIE is preserved (Barrick et al. 2010a,b). A basal interval of *Pedavis latialata* (Cellon) or *Oulodus* species (Bohemia) is absent. It is possible that the oldest part of the post-Lau interval is missing in Henryhouse sections. The dominance of *Dapsilodus obliquicostatus* and *Wurmiella excavata* through the *Jeppssonina* interval is unlike faunas described from the other regions. In Bohemia few coniforms were recovered and *Panderodus uncostatus* dominates (Slavík et al. 2010). In Lithuania, *Panderodus* species are the most common forms, and other coniforms are poorly represented (Spiridonov et al. 2017). Relative abundances are not given for the Cellon section, but several coniform genera are shown as occurring in most of the samples (Corradini et al. 2014).

The exact age of the undiagnostic fauna of the upper member of the Henryhouse cannot be determined because index taxa are absent. The base of the faunal interval is no older than the *Jeppssonina crispa* Zone and the age of the top of the interval depends on how one interprets the age of the base of the overlying *Oulodus elegans* fauna. If one considers the highest occurrence of *Jeppssonina* species, in particular *J. crispa*, to reliably indicate the top of the Ludfordian, then the undiagnostic fauna should be early Pridoli in age as shown in text-figure 12. The sparse occurrences of *Jeppssonina* species in the upper member makes this a questionable determination. The interval of high abundance of *Dapsilodus* does extend a couple meters higher than the last occurrence of *Jeppssonina* species at Highway 77 but does not extend up to the base of the *Oulodus elegans* fauna.

The base of the *Oulodus elegans* fauna is not well defined and can be recognized by the presence of any of several species. *Oulodus elegans elegans* is characteristic of Pridoli strata, but the species appears in uppermost Ludfordian strata at Cellon (Corradini et al. 2014), Bohemia (Slavík and Carls 2012), and Lithuania (Spiridonov et al. 2017). The species occurs well above the highest *Jeppssonina crispa* at the Highway 77 section, so a Pridoli age for its lowest occurrence in the upper Henryhouse is likely. The levels of the first occurrences of the other taxa characteristic of the *Ou. elegans* fauna, *Zieglerodina altidens* n. sp., *Dvorakia amsdeni*, or *Belodella anfracta*, are not known relative to the series boundary. *Panderodus cernus* n. sp. and *Dapsilodus terminus* n. sp. occur with the *Ou. elegans* fauna, but usually appear somewhat above the base of the interval. Because none of the *Zieglerodina* species used to zone the Pridoli in Bohemia have been identified, these zones cannot be used for correlation of the upper Henryhouse.

Oulodus elegans detortus appears in the upper part of the *Ou. elegans* faunal interval and the *Ou. elegans detortus* Zone can

SYSTEM	SERIES	STAGE	CORRADINI et. al. 2024		BOHEMIA	LITHUANIA	SOUTHERN OKLAHOMA
					KLONK	EVENT	
SILURIAN	PRIDOLI	RAD.	<i>Oulodus elegans detortus</i>	U	<i>Zieglerodina klonkensis</i>	<i>Oulodus detortus</i>	<i>Z. r.</i> <i>Belodella coarctata</i>
				L	<i>Oulodus detortus</i>	L. c.	<i>Oulodus elegans detortus</i>
			“Ozarkodina” <i>eosteinhornensis</i> Interval Zone		<i>Zieglerodina ivochlupaci</i>	<i>Ozarkodina eosteinhornensis</i> Interval Zone	<i>Oulodus elegans</i> fauna
					<i>Zieglerodina zellmeri</i>		Undiagnostic fauna
	LUDFORDIAN	LUDFORDIAN	<i>Ozarkodina crispa</i>		<i>Ozarkodina crispa</i>	<i>Zieglerodina? baccata</i> - <i>Ozarkodina crispa</i>	<i>Jeppssonina</i> fauna
			<i>Ozarkodina parasnajdri</i>				
			<i>Pedavis latialatus</i>				
			<i>Parazieglerodina plodowskii</i>				
			<i>Delotaxis</i> fauna			<i>Ozarkodina snajdri</i> Interval Zone	Missing?
					LAU	EVENT	

TEXT-FIGURE 12

Comparison of conodont zonations between the Lau and Klonk Events. The zonation of Corradini et al. (2024) is based on Corradini et al. (2014) and reflects the Cellon succession. The Bohemia zones are described in Slavík and Carls (2012), Vacek et al. (2018) and Manda et al. (2023). Proposed upper stage of the Pridoli: Rad. = Radotinian. The Lithuania zones are described in Spiridonov et al. (2017, 2020a,b). Subzones of the Lithuania *Oulodus detortus* Zone: L. c. = *Lanea canadensis* Subzone; Z. r. = *Zieglerodina remscheidensis* Subzone. Correlations of zones shown are only approximations. See discussion in text for comparisons with the upper Henryhouse faunal intervals.

be identified. The level at which *Ou. elegans detortus* appears within the Pridoli varies by area. In Bohemia it appears just above the base of the *Zieglerodina ivochupaci* Zone and within the range of *Z. eosteinhornensis* s. s. (Carls et al. 2007). Manda et al. (2023) show *Ou. elegans detortus* as occurring in the upper part of the lower stage of the Pridoli, the Jarovian Stage. At Cellon, *Ou. elegans detortus* appears below the lowest *Z. eosteinhornensis* s. s. (Corradini et al. 2014, text-fig. 6). In Lithuania, the *Ou. elegans detortus* Zone occupies the upper half of the Pridoli section in the Milaicia103 core (Spiridonov et al. 2020b). In contrast to these sections, the *Ou. elegans detortus* Zone in the Henryhouse spans a relatively thin interval of strata just below the *Belodella coarctata* fauna. The latest Silurian age of the *Belodella coarctata* fauna is shown by its position in a thin interval below the start of the Klonk CIE. The base of the Upper *Ou. elegans detortus* Zone of Corradini et al. (2014), which is defined by the subjacent last occurrence of *Dapsilodus*, occupies an insignificantly small interval within the *B. coarctata* fauna, just below the Klonk Event (Jacobi et al. 2009, text-fig. 4; text-figure 12 herein).

Age of the Henryhouse shelly fauna

The shelly faunas of the Henryhouse Formations were described in a series of publications (brachiopods - Amsden 1951 1958; ostracodes - Lundin 1965; echinoderms - Strimple 1963; corals - Sutherland 1965; trilobites - Campbell 1967). In each of these papers the Henryhouse Formation was originally assigned a Ludlow age, for at that time the Pridoli Stage had not been established. These authors also indicated that most species ranged through the entire thickness of the Henryhouse, in part to distinguish the Henryhouse faunas from those of the underlying Wenlock Clarita Formation and the overlying Devonian Haragan Formation. This interpretation is like that shown in Amsden (1988, text-fig. 6), where just a few Henryhouse brachiopod species are restricted to either the lower or upper parts of the formation.

Later studies on conodont faunas demonstrated that the uppermost strata of the Henryhouse Formation are Pridoli in age, but the precise location of the Ludlow-Pridoli boundary could not be recognized (Barrick 1988; Barrick and Klapper 1992; Barrick et al. 1990). Barrick et al. (2010a) were able to show that the Henryhouse Formation comprises two lithostratigraphic units, the lower unit of which is primarily restricted to the southern and central Arbuckle Mountain sections (e.g., the Ca2, Highway 77, Dougherty West sections). In these Arbuckle Mountain sections a disconformity corresponding to the mid-Ludfordian Lau Event separates the lower part of the Henryhouse from the upper part. In sections to the north and east, especially on the Lawrence Uplift, the lower member of the Henryhouse is absent, except for a thin interval in section 910, and the upper part of the Henryhouse rests unconformably on the lower part of the Clarita Formation. Barrick et al. (2010a) proposed that Henryhouse shelly faunas were mostly likely post-Lau Event in age, late Ludfordian-Pridoli.

Only a few brachiopods were reported by Amsden (1951, 1958, 1960) from the lower member of the Henryhouse at one section (Amsden 1960, section Ca1, units F-J). A section-by-section review of all other shelly fossil occurrences (using the sample levels in Amsden 1960, which were used by the other authors) reveals that few macrofossils were obtained from the lower part of the upper Henryhouse. We suspect that the

Henryhouse shelly fauna is essentially Pridoli in age because nearly all collections occur well above the range of the *Jeppsonia* species. In the sections in the southern and central Arbuckles, the *Oulodus elegans* fauna, which, occurs well above the highest *Jeppsonia* species, appears below the levels of the shelly fossil collections in Amsden (1960).

	Highest <i>Jeppsonia</i>	lowest <i>O.</i> <i>elegans</i>	lowest shelly fossil collection
Hickory Creek	4m	7.5m	13m (Ca1, see above)
Ca2	13m	19m	26.5m
Highway 77	12m	17m	21.3m

On the Lawrence Uplift, the *Jeppsonia* interval occupies the lowermost part of the thick upper Henryhouse sections. At section P1, from which significant shelly fossil collections were obtained, the top of the *Jeppsonia* interval lies at 3 m and the lowest *Oulodus elegans* occurs at 4 m. Amsden (1960) listed nine brachiopod species from section P1, Unit G (0-3 m), which includes the *Jeppsonia* interval. Only these nine species are as old as late Ludfordian in age. All higher collections are interpreted to be Pridoli in age. All collections of other shelly fossils on the Lawrence Uplift occur well above the base of the Henryhouse, and most lie from the middle to the top of the Henryhouse, indicating they are Pridoli in age. The ostracode fauna of Lundin (1965) was described from upper part of the Henryhouse on the Lawrence Uplift, except for one species. Most of the coral collections of Sutherland (1965) and trilobites of Campbell (1967; revised by DeKoster 2021) came from the Lawrence Uplift, except for small collections from well above the occurrence of *O. elegans* at section Ca1. Nearly all the echinoderms described by Strimple (1963) were collected from the middle to upper part of the Henryhouse on the Lawrence Uplift.

The Henryhouse shelly fauna had been correlated with the Ludlow Brownsport Formation in western Tennessee by most authors. A possible reason for this is that the glades of the Brownsport Formation produced large and diverse shelly fossil collections, unlike the overlying Pridoli Decatur Formation. Only Strimple (1963) suggested based on echinoderms that a better correlation of the Henryhouse would be with the Pridoli Decatur Formation. Barrick et al. (2010b) using conodonts and carbon isotopes showed that the Lau Event occurred in some sections of the Brownsport above the Beech River Member, in strata commonly assigned to the “Bob” Member, and below the Lobelville Member. We note that Amsden (1949) was critical of this three-member subdivision of the Brownsport, calling them poorly defined faunal intervals. He did not reference his fossil collections to individual members, making it difficult to determine which occurrences were pre- or post-Lau Event. Subsequent considerations of the Henryhouse shelly faunas have assigned them a Ludlow or Ludlow-Pridoli age. For example, Adrain (1996) described a new Ludlow species of trilobite from the Henryhouse on the Lawrence Uplift that is more likely Pridoli in age. Boucot (1999) reported that the brachiopod *Dicoelosia-Skenidoides* Community, which is based on the brachiopod fauna of the upper Henryhouse at section P1 on the Lawrence Uplift, as Ludlow in age, but we interpret it to

be Pridoli in age. Frest et al. (1999) assigned a Ludlow age to the echinoderm *Elpidocrinus-Parapisocrinus* Association, which is based on collections from the Pridoli upper Henryhouse on the Lawrence Uplift. Oliver (1999) considered the Henryhouse coral assemblage to be Ludlow in age, as opposed to our interpreted Pridoli age.

In the subsurface of the Anadarko Basin, Amsden (1969, 1975, 1980, 1988) recognized the *Kirkidium* facies as a shallow water equivalent of the outcrop Henryhouse. *Polygnathoides siluricus*, a pre-Lau Event conodont species, occurs in beds with an uncertain relationship to the *Kirkidium* facies in Kingfisher

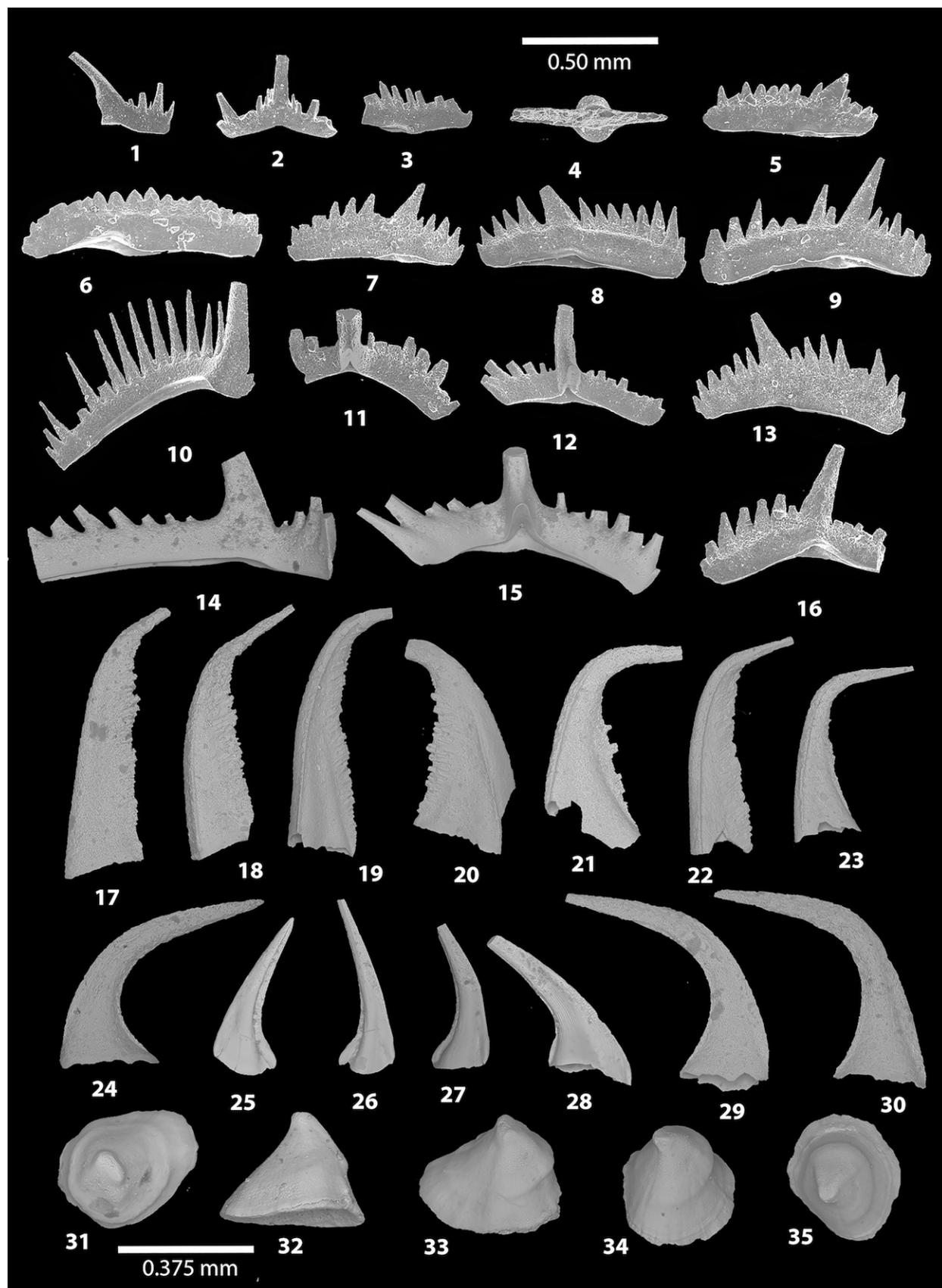
County (text-figure 1; Pan American 1 Post Unit, 8,325 ft., Amsden 1975, p. 38), showing that strata equivalent in age to the lower Henryhouse occur in the subsurface. Samples of the *Kirkidium* facies that have been processed for conodonts produced small faunas characterized by undiagnostic *Panderodus* species. Amsden (1949) described *Kirkidium pingue* (as *Rhipidium pingue*) from strata in the upper 30 ft (10m) of the Brownsport Formation. At Sewell's Spring, the *Kirkidium* faunas occur above a "well-developed 'Lobelville' coral fauna" (Amsden 1949, p. 31), which has been considered to lie at the top of the Brownsport above the "Bob" Member. Barrick et al. (2010b) demonstrated that the Lau Event occurred in the

PLATE 1

Conodont elements from the upper member of the Henryhouse Formation.

Figures 1-16, scale bar = 0.50mm; 50X. Figures 17-35, scale bar = 0.375mm; 75X. SUI = University of Iowa.

- 1 *Wurmiella* sp. A, S₂ element, SUI149806, Highway 77-348.
- 2 *Wurmiella* sp. A, S₀ element, SUI149807, Highway 77-348.
- 3 *Wurmiella* sp. A, P₁ element, SUI149808, Highway 77-348.
- 4 *Wurmiella excavata* (Branson and Mehl 1933), P₁ element, SUI149809, Highway 77-336A.
- 5 *Wurmiella excavata* (Branson and Mehl 1933), P₁ element, SUI149810, Highway 77-336A.
- 6 *Wurmiella excavata* (Branson and Mehl 1933), P₁ element, SUI149811, Highway 77-335.
- 7 *Wurmiella excavata* (Branson and Mehl 1933), P₁ element, SUI149812, 910-7A.
- 8 *Wurmiella excavata* (Branson and Mehl 1933), P₁ element, SUI149813, 910-7A.
- 9 *Wurmiella excavata* (Branson and Mehl 1933), P₁ element, SUI149814, 910-7A.
- 10 *Wurmiella excavata* (Branson and Mehl 1933), M element, SUI149815, 910-7A.
- 11 *Wurmiella excavata* (Branson and Mehl 1933), S₁ element, SUI149816, 910-7A.
- 12 *Wurmiella excavata* (Branson and Mehl 1933), S₂ element, SUI149817, 910-7A.
- 13 *Wurmiella excavata* (Branson and Mehl 1933), P₁ element, SUI149818, 910-7A.
- 14 *Wurmiella excavata* (Branson and Mehl 1933), S₃ element, SUI149819, P1H-1.
- 15 *Wurmiella excavata* (Branson and Mehl 1933), S₂ element, SUI149820, P1H-2.
- 16 *Wurmiella excavata* (Branson and Mehl 1933), P₂ element, SUI149821, 910-7A.
- 17 *Belodella anfracta* Barrick and Klapper 1992, S element, SUI149822, 910-11A.
- 18 *Belodella anfracta* Barrick and Klapper 1992, S element, SUI149823, 910-11.
- 19 *Belodella anfracta* Barrick and Klapper 1992, S element, SUI149824, 910-11.
- 20 *Belodella anfracta* Barrick and Klapper 1992, tortiform element, SUI149825, 910-11.
- 21 *Belodella anfracta* Barrick and Klapper 1992, tortiform element, SUI149826, 910-11.
- 22 *Belodella anfracta* Barrick and Klapper 1992, S element, SUI149827, 910-11.
- 23 *Belodella anfracta* Barrick and Klapper 1992, S element, SUI149828, 910-11A.
- 24 *Dvorakia amsdeni* Barrick and Klapper 1992, S element, SUI149829, 910-11B.
- 25 *Decoriconus fragilis* (Branson and Mehl 1933), S element, SUI149830, PH1-1.
- 26 *Decoriconus fragilis* (Branson and Mehl 1933), S element, SUI149831, PH1-1.
- 27 *Decoriconus fragilis* (Branson and Mehl 1933), S element, SUI149832, PH1-1.
- 28 *Decoriconus fragilis* (Branson and Mehl 1933), S element, SUI149833, PH1-1.
- 29 *Dvorakia amsdeni* Barrick and Klapper 1992, S element, SUI149834, 910-11B.
- 30 *Dvorakia amsdeni* Barrick and Klapper 1992, S element, SUI149835, 910-11B.
- 31 *Pseudooneotodus* sp., upper view, SUI149836, PH1-1.
- 32 *Pseudooneotodus* sp., side view, SUI149837, PH1-1.
- 33 *Pseudooneotodus* sp., oblique view, SUI149838, PH1-1.
- 34 *Pseudooneotodus* sp., oblique view, SUI149839, PH1-1.
- 35 *Pseudooneotodus* sp., upper view, SUI149840, PH1-9.



middle of the Brownsport Formation in the typical grainstones of the “Bob” Member, below the Lobelville Member. We suggest that the subsurface *Kirkidium* facies is mostly equivalent in age to the late Ludfordian-Pridoli upper Henryhouse.

SUMMARY

Five successive conodont faunas occur in the upper member of the Henryhouse Formation in southern Oklahoma: a thin basal interval characterized by species of *Jeppsonia* n. gen.; an interval lacking

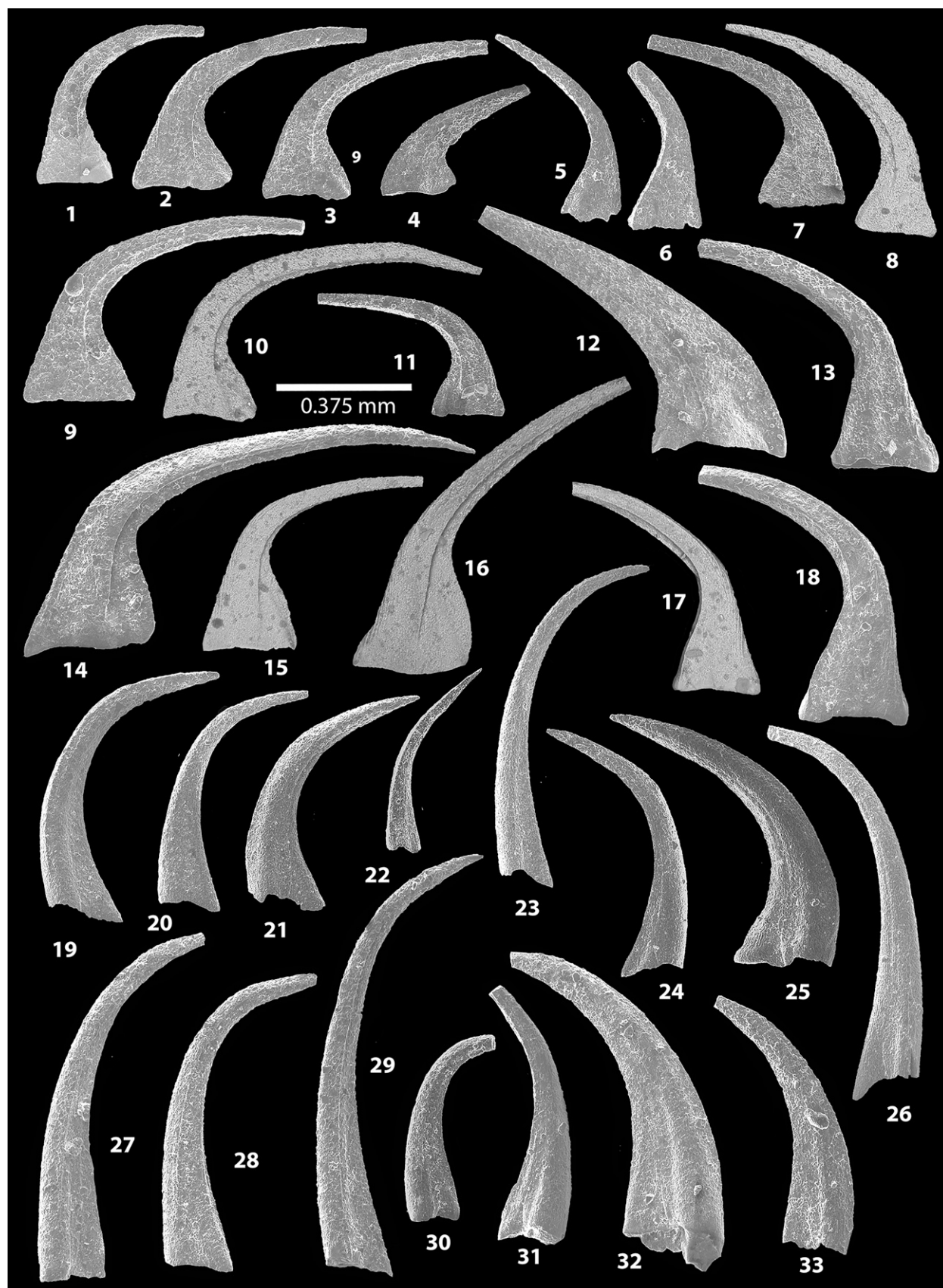
age-diagnostic conodonts; a thick interval characterized by *Oulodus elegans elegans*, *Belodella anfracta*, *Zieglerodina altidens* n. sp., *Panderodus cernuus* n. sp., and *Dapsilodus terminus* n. sp.; a fourth thin interval of *Ou. elegans detortus*; and a fifth thin interval with the acme of *B. coarctata* that extends up to the top of the Henryhouse. The *Jeppsonia* fauna is interpreted to be late Ludfordian in age, the undiagnostic interval may be late Ludfordian or early Pridoli in age, and the upper three faunas are Pridoli in age. Nearly all collections of the diverse shelly fauna of the Henryhouse Formation were obtained from strata of the upper Henryhouse that bear

PLATE 2

Conodont elements from the upper member of the Henryhouse Formation.

Scale bar = 0.375mm; 75X. SUI = University of Iowa.

- 1 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149841, PR-2.
- 2 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149842, PR-2.
- 3 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149843, PR-2.
- 4 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., M element, SUI149844, H77-348.
- 5 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., holotype, S₀ element, SUI149845, PR-2.
- 6 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S₀ element, SUI149846, PR-2.
- 7 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149847, PR-2.
- 8 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149848, I35-A10.
- 9 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149849, PR-2.
- 10 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149850, I32-A10.
- 11 *Dapsilodus terminus* Barrick, Klapper and Peavey, n. sp., S element, SUI149851, H77-348.
- 12 *Dapsilodus obliquicostatus* (Branson and Mehl 1933), M element, SUI149852, H77-333.
- 13 *Dapsilodus obliquicostatus* (Branson and Mehl 1933), S₀ element, SUI149853, H77-333.
- 14 *Dapsilodus obliquicostatus* (Branson and Mehl 1933), S element, SUI149854, H77-333.
- 15 *Dapsilodus obliquicostatus* (Branson and Mehl 1933), S element, SUI149855, H77-33.
- 16 *Dapsilodus obliquicostatus* (Branson and Mehl 1933), S element, SUI149856, H77-33.
- 17 *Dapsilodus obliquicostatus* (Branson and Mehl 1933), S₀ element, SUI149857, H77-33.
- 18 *Dapsilodus obliquicostatus* (Branson and Mehl 1933), S₀ element, SUI149858, H77-333.
- 19 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., arcuatiform element, inner view, SUI149859, H77-349B.
- 20 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., arcuatiform element, inner view, SUI149860, H77-349AC.
- 21 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., falciform element, inner view, SUI149861, H77-349AC.
- 22 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., tortiform element, inner view, SUI149862, H77-349B.
- 23 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., graciliform element, inner view, SUI149863, H77-349AC.
- 24 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., arcuatiform element, outer view, SUI149864, H77-349B.
- 25 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., holotype, falciform element, outer view, SUI149865, H77-349AC.
- 26 *Panderodus cernuus* Barrick, Klapper and Peavey, n. sp., graciliform element, outer view, SUI149866, H77-349B.
- 27 *Panderodus unicostatus* (Branson and Mehl 1933), arcuatiform element, inner view, SUI149867, H77-336A.
- 28 *Panderodus unicostatus* (Branson and Mehl 1933), arcuatiform element, outer view, SUI149868, H77-338A.
- 29 *Panderodus unicostatus* (Branson and Mehl 1933), graciliform element, outer view, SUI149869, H77-336A.
- 30 *Panderodus unicostatus* (Branson and Mehl 1933), truncatiform element, outer view, SUI149870, H77-336A.
- 31 *Panderodus unicostatus* (Branson and Mehl 1933), tortiform element, outer view, SUI149871, H77-336A.
- 32 *Panderodus unicostatus* (Branson and Mehl 1933), falciform element, inner view, SUI149872, H77-336A.
- 33 *Panderodus unicostatus* (Branson and Mehl 1933), falciform element, inner view, SUI149873, H77-336A.



the upper three Pridoli conodont faunas. The *Kirkidium* facies of the subsurface Henryhouse is correlated with the upper member of the Henryhouse Formation. Correlation of the upper Henryhouse conodont faunal intervals with other areas is difficult.

SYSTEMATIC PALEONTOLOGY

Phylum CONODONTA Pander 1856

Class CAVIDONTI Sweet 1988

Order BELODELLIDA Sweet 1988

Family BELODELLIDAE Khodalevich and Tschernich 1973

Genus *Belodella* Ethington 1959

Remarks: *Belodella coarctata* and *B. anfracta* were described by Barrick and Klapper (1992), based on material from the uppermost part of the Henryhouse Formation. *Belodella coarctata* has a very short range confined to the upper part of the *Oulodus elegans detortus* Zone in southern Oklahoma,

West Texas (Barrick et al. 2010a) and Western Tennessee (Barrick and Kleffner 2022).

Belodella anfracta Barrick and Klapper 1992

Plate 1, figs. 17–23.

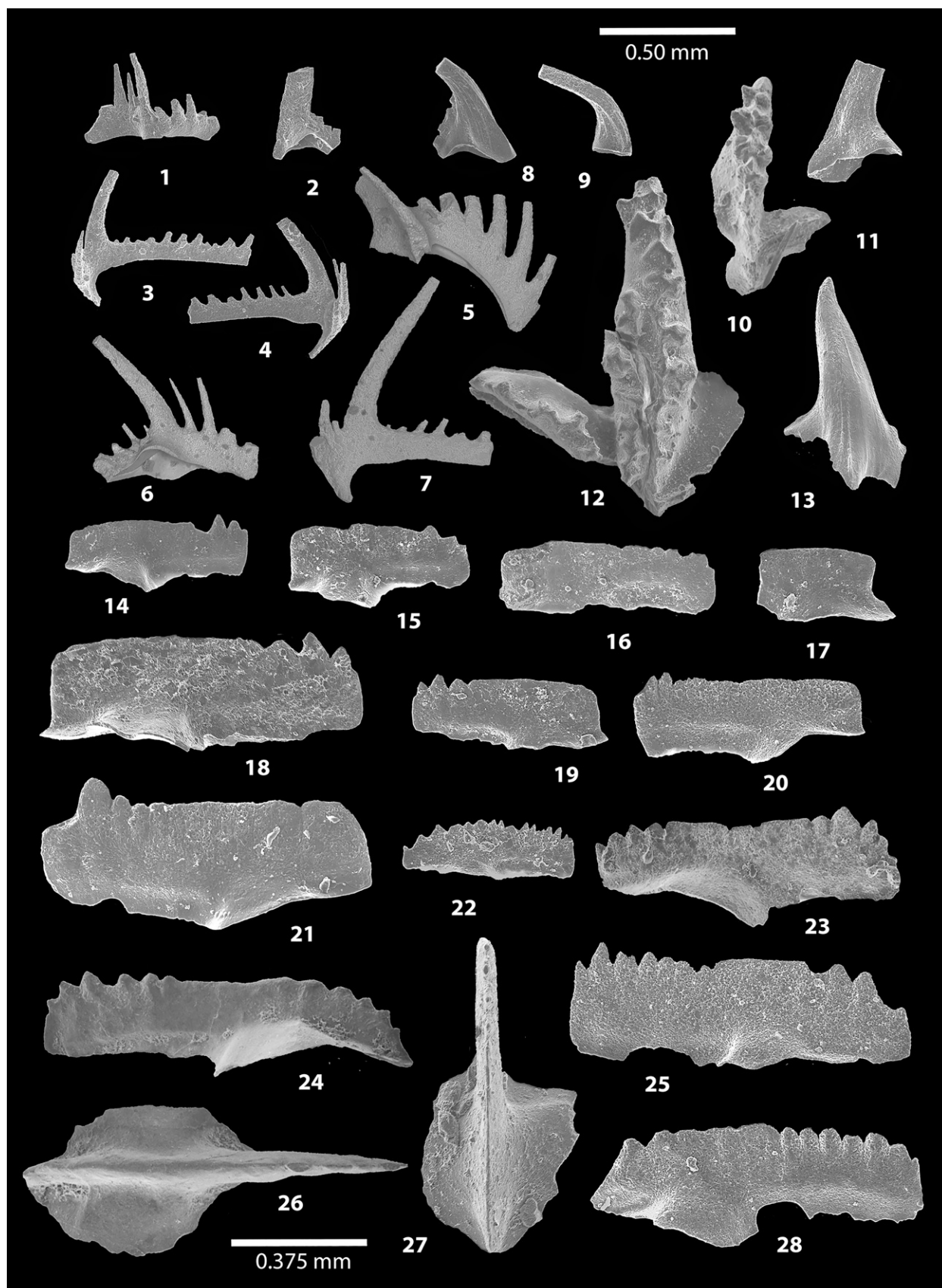
Remarks: The exact level of the lowest occurrence of *B. anfracta* was not determined at the time the species was named, but the species was thought to be limited to Pridoli strata. Elements of *Belodella* are uncommon in the *Jeppssonina* faunal interval and often poorly preserved. Absent from these collections are the diagnostic Sc (S₃?) element that has the sigmoidal deflection of the posterior margin. Also absent are shorter elements with a broad base (tortiform element of Barrick and Klapper 1992) that occur with *B. anfracta* in younger strata. Neither type of element has been reported from the Homerian-Ludlow? species *B. silurica* Barrick 1977, in which only long slender elements were described. Based on the lowest occurrence of Sc and “tortiform” elements, *B. anfracta* appears above the

PLATE 3

Conodont elements from the upper member of the Henryhouse Formation.

Figures 1–13, scale bar = 0.50mm; 50X. Figures 14–28, scale bar = 0.375mm, 75X. SUI = University of Iowa.

- 1 *Oulodus elegans elegans* (Walliser 1964), P₂ element, SUI149874, PH1-17.
- 2 *Oulodus elegans elegans* (Walliser 1964), M element, SUI149875, PH1-17.
- 3 *Oulodus elegans elegans* (Walliser 1964), S₂ element, SUI149876, PH1-17.
- 4 *Oulodus elegans elegans* (Walliser 1964), S₂ element, SUI149877, PH1-17.
- 5 *Oulodus elegans elegans* (Walliser 1964), P₂ element, SUI149878, 910-11B.
- 6 *Oulodus elegans elegans* (Walliser 1964), P₁ element, SUI149879, PH1-17.
- 7 *Oulodus elegans elegans* (Walliser 1964), S₂ element, SUI149880, 910-11B.
- 8 *Praeicriodus* sp., coniform element, SUI149881, PH1-16.
- 9 *Praeicriodus* sp., coniform element, SUI149882, PH1-16.
- 10 *Pedavis? latialata* (Walliser 1964), P₁ element, SUI149883, HC-13.
- 11 *Praeicriodus* sp., coniform element, SUI149884, H77-345.
- 12 *Praeicriodus* sp., P₁ element, SUI149885, H77-345.
- 13 *Praeicriodus* sp., coniform element, SUI149886, PH1-16.
- 14 *Jeppssonina crispera* (Walliser 1964), P₁ element, SUI149887, H77-333.
- 15 *Jeppssonina crispera* (Walliser 1964), P₁ element, SUI149888, H77-333.
- 16 *Jeppssonina crispera* (Walliser 1964), P₁ element, SUI149889, H77-333.
- 17 *Jeppssonina crispera* (Walliser 1964), P₁ element, SUI149890, H77-333.
- 18 *Jeppssonina crispera* (Walliser 1964), P₁ element, SUI149891, H77-333.
- 19 *Jeppssonina crispera* (Walliser 1964), P₁ element, SUI149892, H77-333.
- 20 *Jeppssonina parasnadjri* (Viira and Aldridge 1998), P₁ element, SUI149893, PH1-11A.
- 21 *Jeppssonina parasnadjri* (Viira and Aldridge 1998), P₁ element, SUI149894, 910-4A.
- 22 *Jeppssonina snadjri* (Walliser 1964), P₁ element, SUI149895, 910-7.
- 23 *Jeppssonina snadjri* (Walliser 1964), P₁ element, SUI149896, H77-27.
- 24 *Jeppssonina snadjri* (Walliser 1964), P₁ element, SUI149897, H77-27.
- 25 *Jeppssonina snadjri* (Walliser 1964), P₁ element, SUI149898, 910-7A.
- 26 *Jeppssonina parasnadjri* (Viira and Aldridge 1998), P₁ element, SUI149899, H77-27.
- 27 *Jeppssonina crispera* (Walliser 1964), P₁ element, SUI149900, H77-333.
- 28 *Jeppssonina snadjri* (Walliser 1964), P₁ element, SUI149901, 910-8A.



Jeppssonina faunal interval and near the beginning of the *Oulodus elegans* faunal interval, or the beginning of the Pridoli.

Genus *Dvorakia* Klapper and Barrick 1983

Dvorakia amsdeni Barrick and Klapper 1992

Plate 1, figs. 24, 29, 30

Remarks: *Dvorakia amsdeni* is a common and characteristic species of Pridoli strata in southern North America (Barrick and Klapper 1992; Barrick and Kleffner 2022). Based on the upper Henryhouse collections, it first appears at about the same level as *Oulodus elegans elegans*. The first occurrence of the species is not better defined because the ancestor is not known. *Walliserodus*, which is similar to *Dvorakia*, apparently went extinct at the mid-Ludlow Lau event. Some *Dvorakia*-like coniforms occur in the upper part of the low diversity interval above the end of the *Jeppssonina* interval that lack the flange-like margins of *D. amsdeni* but are too few to characterize.

Family DAPSILODONTIDAE Sweet 1988

Genus *Dapsilodus* Cooper 1976

Dapsilodus obliquicostatus (Branson and Mehl 1933)

Plate 2, figs. 12–18.

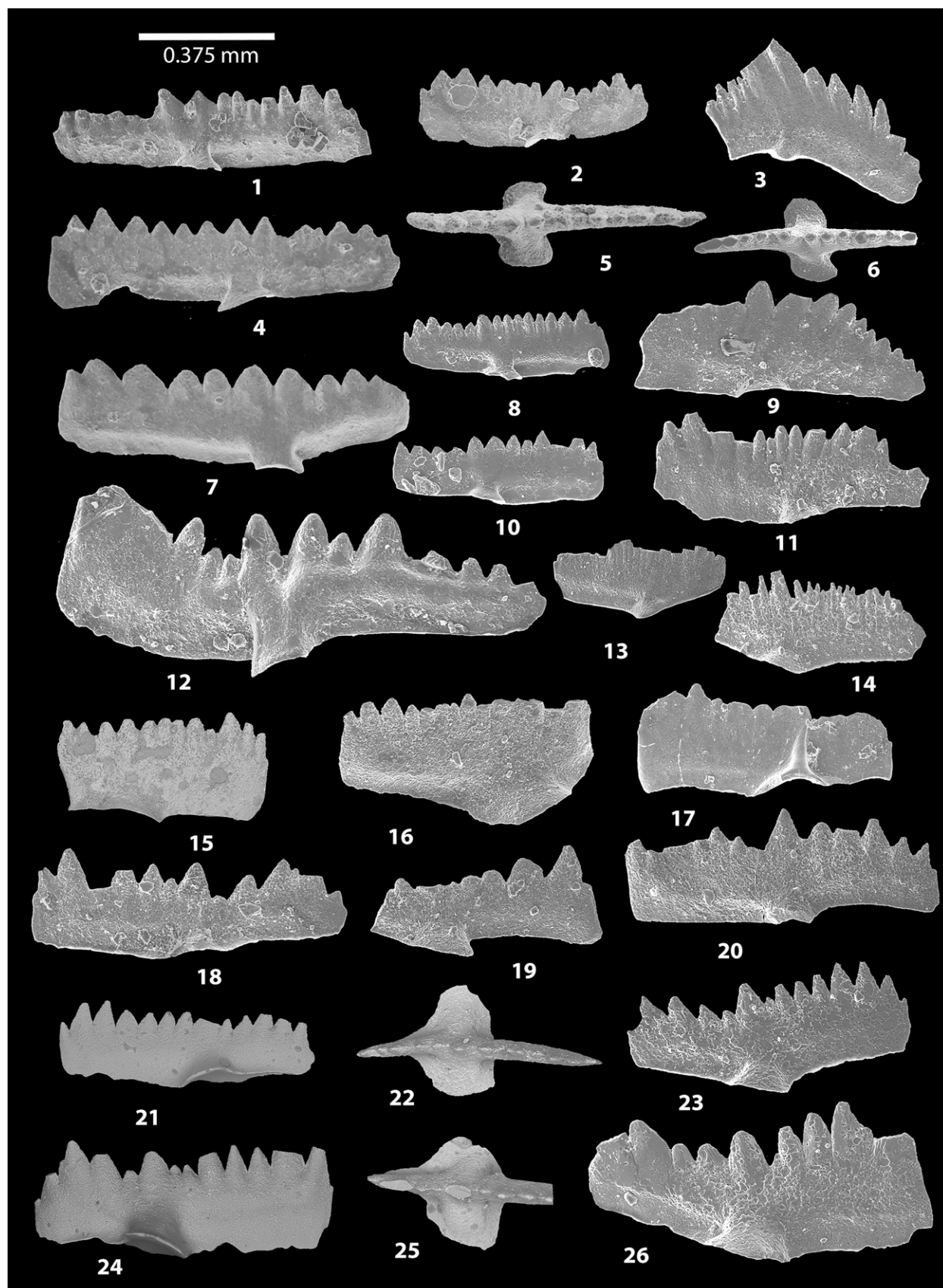
Remarks: In the lower portion of the upper Henryhouse, through the *Jeppssonina* faunal interval, *Dapsilodus obliquicostatus* is extremely abundant, comprising over one-half of all conodont elements in many samples. The S₁ to S₄ elements (SbSc of Barrick 1977) possess a moderately high, triangular base with thin solid margins flanking the basal cavity. The lower edge of the base may be flat or the “anterior” tip curves downward. The “anterior” margin of the base is often twisted or slightly curved to one side. The curvature of the cusp varies greatly, ranging from 90 degrees relative to the base up to 150 degrees. These variations are likely related to the position of the S elements in the apparatus. The curvature of the cusp of the S₀ (Sa) element is more consistent, about 120 degrees relative to the base. The anterior margin of the S₀ element is a thin flange in small specimens that thickens and flattens to a wide edge in medium specimens. In larger specimens this margin splits into two flanges at the base that merge upward to a single wide flange and then to a simple thin flange near the top of the base. The P element (M of Barrick 1977) has a small base with thin flanges flanking the basal cavity. The wide cusp narrows uniformly to the tip and is oriented at an angle of about 120 degrees relative to the base.

PLATE 4

Conodont elements from the upper member of the Henryhouse Formation.

Scale bar = 0.375, 75X. SUI = University of Iowa.

- 1 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI149902, H77-27.
- 2 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI149903, H77-27.
- 3 *Parazieglerodina auriformis* (Simpson 2003), P₂ element, SUI149904, HC-13.
- 4 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI 149905, H77-27.
- 5 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI149906, H77-27.
- 6 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI149907, HC-13.
- 7 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI149908, H77-27.
- 8 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI149909, HC-13.
- 9 *Ozarkodina typica* Branson and Mehl 1933, P₁ element, SUI149910, H77-341.
- 10 *Parazieglerodina auriformis* (Simpson 2003), P₁ element, SUI149911, HC-13
- 11 *Ozarkodina?* sp., P₁ element, SUI149912, H77-339A.
- 12 *Ozarkodina* sp., P₁ element, SUI149913, H77-336A.
- 13 *Zieglerodina denticulata* (Viira 2000)?, P₁ element, SUI149914, DW-628.
- 14 *Zieglerodina denticulata* (Viira 2000)?, P₁ element, SUI149915, H77-344.
- 15 *Zieglerodina?* morphotype C, P₁ element, SUI149916, I35-1A1.
- 16 *Zieglerodina?* morphotype C, P₁ element, SUI149917, Ca2-23.
- 17 *Zieglerodina eosteinhornensis* (Walliser 1964), P₁ element, SUI149918, SWD-13B.
- 18 *Zieglerodina* morphotype A, P₁ element, SUI149919, Ca2-516.
- 19 *Zieglerodina* morphotype A, P₁ element, SUI149920, Ca2-516.
- 20 *Zieglerodina* morphotype A, P₁ element, SUI149921, Ca2-23.
- 21 *Zieglerodina* morphotype D, P₁ element, SUI149922, I35-2E.
- 22 *Zieglerodina* morphotype D, P₁ element, SUI149923, I35-2E.
- 23 *Zieglerodina* morphotype B, P₁ element, SUI149924, 910-9A.
- 24 *Zieglerodina* morphotype D, P₁ element, SUI149925, I35-2E.
- 25 *Zieglerodina* morphotype D, P₁ element, SUI149926, I35-2E.
- 26 *Zieglerodina* morphotype B, P₁ element, SUI149927, 910-9.



Dapsilodus obliquicostatus was based on elements from the *Pol-ygnathoides siluricus* Zone at the Lithium, Missouri section (Branson and Mehl 1933; Rexroad and Craig 1971). The post-Lau Event upper Henryhouse *Dapsilodus* elements are identical with those from our pre-Lau *siluricus* Zone collections from Lithium.

***Dapsilodus terminus* Barrick, Klapper and Peavey n. sp.**

Plate 2, figs. 1–11.

Dapsilodus sp. BARRICK and KLAPPER 1992, p. 44, pl. 2, fig. 2.

Dapsilodus obliquicostatus (Branson and Mehl 1933). –CORRADINI and CORRIGA 2010, pl. 1, fig. 7.

Dapsilodus obliquicostatus (Branson and Mehl 1933). –CORRADINI and CORRIGA 2012, fig. 6B.

Dapsilodus sp. BARRICK and KLEFFNER 2022, pl. 3, fig. 19.

Diagnosis: Small coniform P and S₁–S₄ elements have strongly compressed short bases with a small basal cavity. Anterior margin

is broad, posterior margin is narrow, almost abutting edge of basal cavity. Weak lateral costae lie near posterior margin. Cusps of S₁–S₄ elements are strongly curved at nearly a right angle. Cusp of S₀ element is only slightly reclined.

Holotype: S₀ element, SUI149845, Pl 2, fig. 5, PR-2.

Etymology: terminus – Latin, the last

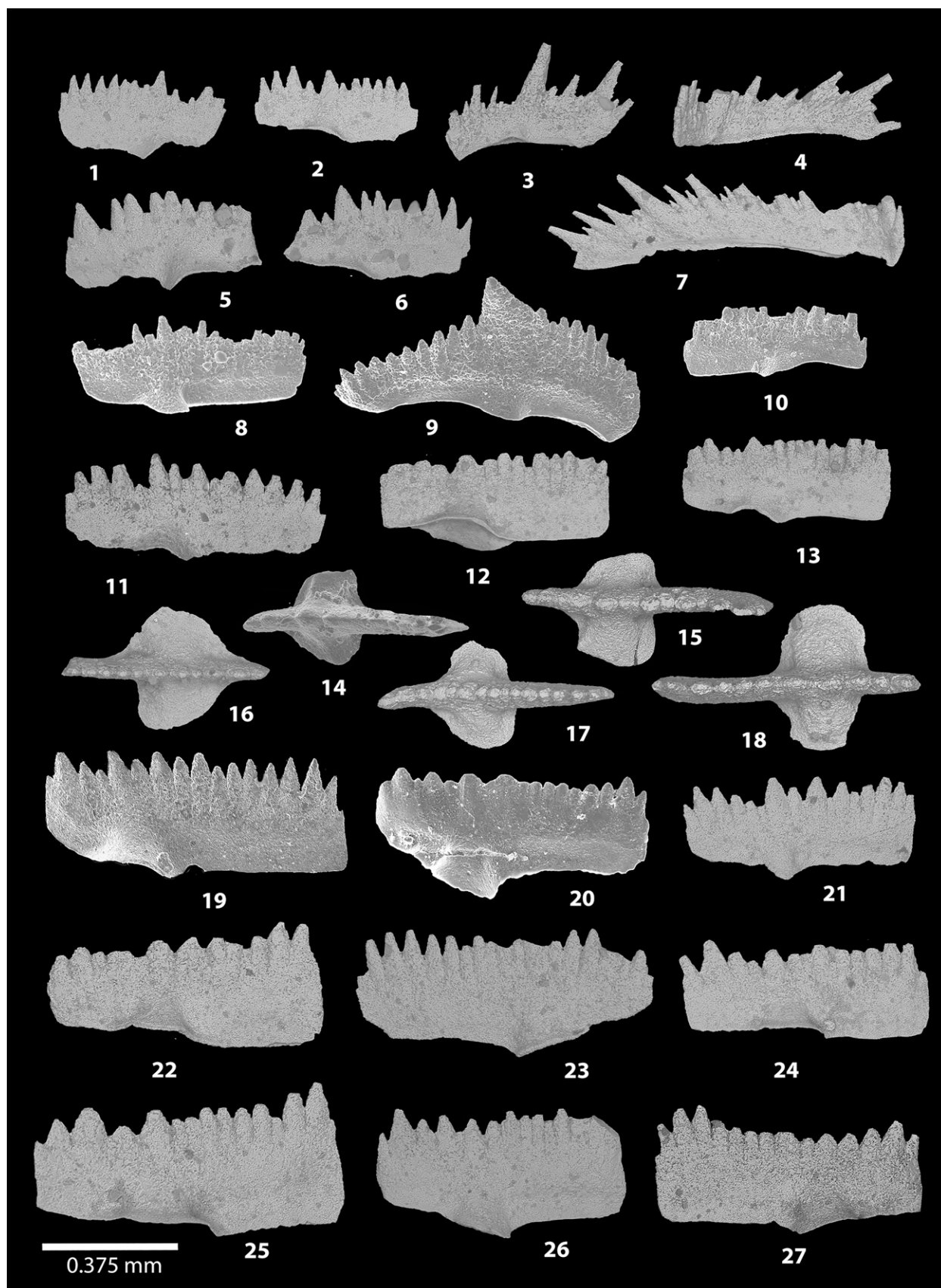
Description: P element has a short base and small basal cavity. Broad cusp is inclined at about 120 degrees and has a distinct notch where it meets the base. S₁–S₄ elements have small bases with equally small basal cavities. The elements are strongly compressed, and the base is concave where the cusp is twisted out of the “anterior-posterior” plane of the base. The “anterior” margin of the basal cavity is wide and the “posterior” margin is much narrower, such that the edge of the basal cavity lies almost adjacent to the “posterior” margin. Weakly developed lateral costae also lie near the “posterior” margin. Cusps vary

PLATE 5

Conodont elements from the upper member of the Henryhouse Formation.

Scale bar=0.375 mm, 75X. SUI=University of Iowa.

- 1 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149928, I35-A10.
- 2 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149929, I35-A10.
- 3 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., S₁ element, SUI149930, I35-A10.
- 4 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., S₂ element, SUI149931, I35-A10.
- 5 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149932, I35-A10.
- 6 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149933, I35-A10.
- 7 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., S₂ element, SUI149934, I35-A10.
- 8 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149935, DW-628.
- 9 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₂ element, SUI149936, 910-9.
- 10 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149937, DW-628.
- 11 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149938, H77-331A.
- 12 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149839, I35-1A1.
- 13 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149840, I35-A10.
- 14 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149841 H77-341A.
- 15 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149842, I35-A10.
- 16 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149843, I35-1A1.
- 17 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149844, I35-A10.
- 18 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149845, I35-A10.
- 19 *Zieglerodina* morphotype B?, P₁ element, SUI149846, 910-9.
- 20 *Zieglerodina* morphotype B?, P₁ element, SUI149847, SWD-13B.
- 21 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149848, I35-A10.
- 22 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149849, I35-A10.
- 23 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149850, I35-A10.
- 24 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149851, I35-A10.
- 25 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149852, I35-A10.
- 26 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149853, I35-A10.
- 27 *Zieglerodina altidens* Barrick, Klapper and Peavey, n. sp., P₁ element, SUI149854, I35-A10.



in orientation and may lie near the “anterior-posterior” plane or be strongly curved to one side. All elements, though, are strongly recurved so the cusps lie about 90 degrees relative to the base. The base-cusp junction is clearly defined by the constriction of element width. In the S_0 element, “anterior” margin is very broad, and the basal cavity lies adjacent to the “posterior” margin. Unlike the strongly recurved S_1 - S_4 elements, the cusp of the S_0 element extends upward at an angle of 120 degrees relative to the base.

Remarks: A combination of characters distinguish *Dapsilodus terminus* n. sp. from the older species *D. obliquicostatus*. The upward-extending cusp of the S_0 element of *D. terminus* n. sp. is the most obvious feature. The small strongly compressed bases of the S_1 - S_4 elements, the difference in the width of the “anterior” margin relative to the width of the “posterior” margin, and the distinct juncture between the base and the strongly recurved cusp together characterize the new species. The P element is less distinct, but in *D. terminus* n. sp. it has just a more pronounced angle between the base and the cusp.

The two species are easy to distinguish when abundant faunas from Ludfordian and older strata are compared with abundant faunas from late Pridoli strata (*O. elegans detortus* Zone). The morphological transition from *D. obliquicostatus* to *D. terminus* n. sp. appears to be gradual, although the small faunas we obtained through the intervening strata make it difficult to evaluate this properly. The identification of the level of the first occurrence of *D. terminus* is, thus, hard to determine exactly. Generally, elements of *D. terminus* n. sp. can be confidently recognized above the level at which *Oulodus elegans elegans* occurs in the upper Henryhouse sections.

Dapsilodus terminus n. sp. occurs in southern North America wherever latest Pridoli conodonts have been recovered: West Texas (*Dapsilodus* sp. in Barrick et al. 2005); Western Tennessee (*Dapsilodus* sp. in Barrick and Kleffner 2022); Missouri in the Bainbridge Formation (collections from the I-55 roadcut locality of McAdams et al. 2018, text-fig. 6), as well as the upper Henryhouse Formation in southern Oklahoma. The species also occurs in the Carnic Alps and Sardinia (Corradini and Corriga 2010, 2012; Corradini et al. 2019).

Class CONODONTI Branson 1938

Order PANDERODONTIDA Sweet 1988

Family PANDERODONTIDEA Lindström 1970

Genus *Panderodus* Ethington 1959

Remarks: The apparatus of *Panderodus* has been reconstructed by Sansom et al. (1994) and Murdock and Smith (2021). Functional analysis of individual elements and the apparatus indicate a combination of grasping and cutting functions for the different elements for this microphagous predator (Murdock and Smith 2021; Murdock et al. 2013). The assignment of Silurian *Panderodus* elements to species, though, has not been consistent, nor are most species assignments well justified. Jeppsson (1983b) stated the problems clearly and little has changed since then. Most illustrated specimens cannot be assigned confidently to a species because too few images are published and because the elements of most collections have not been described in sufficient detail. As Jeppsson noted, large collections of well-preserved specimens

are needed. Also, correctly applying the old single-element species names to the reconstructed apparatuses depends not just on studies of the type material, but also on new collections from strata from which the types were obtained. The nomenclatural model of Jeppsson (1983a,b) has affected how names have been applied. He preferred to treat a lineage with a single species name which could be subdivided into chronological subspecies. For this reason, several names based on Ordovician species have been applied to Silurian apparatuses (e.g., *P. equicostatus* and *P. panderi*). Jeppsson (1983b) reported that seven or eight species, subdivisible into about ten subspecies occur on Gotland, but he did not complete his planned monograph on *Panderodus*.

Panderodus unicostatus (Branson and Mehl 1933)

Plate 2, figs. 27–33.

Remarks: At least two major groups of *Panderodus* species occur in the Silurian. The more common group is the *P. unicostatus*-*P. equicostatus* group, the costate (S_1 - S_4) elements of which have relatively short, gently recurved rounded cusps. For many years, the name *Panderodus unicostatus* (Branson and Mehl 1933), based on Ludlow material from Bainbridge Formation at the Lithium, Missouri section, was applied to nearly all the forms of the *P. unicostatus* group. Later, Jeppsson (1983a) began using the name *P. equicostatus* (Rhodes 1953), based on material from Upper Ordovician strata in Wales, a name that has come into more common use recently. Sansom and Smith (2004) selected a neotype for this species because the holotype has been lost. The name *P. acostatus* (Branson and Branson 1947) from the Llandovery Brassfield Formation of Kentucky has also been used, but specimens assigned to it are now referred to *P. equicostatus* (Sansom and Smith 2004). The elements of the apparatuses of *P. unicostatus* (Murdock and Smith 2021) and *P. equicostatus* (Sansom et al. 1994; Murdock et al. 2013, as *P. acostatus*) have been illustrated. The features distinguishing the two species have been mentioned, but not completely explained in publications (e.g., Sansom and Smith 2004; Waid and Cramer 2017). The two species are often reported as occurring alone, but both species have been reported from the same samples (e.g., Jeppsson 1983b; Jarochowska and Munnecke 2016; Waid and Cramer 2017), so care must be taken in identification. As explained by Jeppsson (1996, pers. comm.) elements of *P. equicostatus* are more uniformly curved through the length of the element, and a small area of white matter occupies the tip of the cusp. The truncatiform and aequaliform elements are very short and the former has a pronounced costa (see Sansom and Smith 2004, figs. 2C, F, L). Elements of *P. unicostatus* have a straight “posterior” margin and a sharp curve of the cusp, which is longer with significantly more white matter. The truncatiform and aequaliform elements are longer and straighter. The most reliable elements are the P elements (falciform elements) where the contrast in white matter in the cusp is more obvious (Jarochowska and Munnecke 2016, figs. 8, g, h, j, k) as is the difference in length in the truncatiform and aequaliform elements. Because of variation in the features of high-based sub-symmetrical graciliform elements in the apparatus these can be much more difficult to distinguish at the species level (compare Sansom and Smith 2004, fig. 2, *P. equicostatus*, with Murdock and Smith 2021, fig. 5, *P. unicostatus*).

The second major group, the *Panderodus recurvatus*-*P. panderi* group, has strongly recurved, larger flattened cusps and a more

pronounced elongation of the base. As Jeppsson (1983a, text-figure 7) noted, some *Panderodus* elements with a more recurved, but short rounded cusp have been incorrectly assigned to *P. recurvatus*-*P. panderi*. As far as we can determine the last member of the *P. recurvatus*-*P. panderi* lineage disappeared at the Lau Event.

Unlike many Silurian conodont faunas, *Panderodus* elements are uncommon in the upper Henryhouse where *Dapsilodus* or *Belodella* elements usually dominate. Most of the few samples with common elements, where the cusps of the element have not been broken and the truncatiform element was recovered, can be assigned to *P. unicostatus*. Only a few occurrences of *P. equicostatus* can be confirmed, all just above the Lau Event. In late Pridoli strata, another species of *Panderodus* similar to *P. unicostatus*, but with a longer, more recurved cusp, is described here as a new species.

***Panderodus cernuus* Barrick, Klapper and Peavey n. sp.**

Plate 2, figs. 19–26.

? *Panderodus* sp. SUTTNER 2007, pl. 5, figs. 7-9, 15

Panderodus recurvatus CORRADINI and CORRIGA 2010, p. 1, figs. 15-20.

Panderodus recurvatus CORRADINI and CORRIGA 2012, fig. 6A.

Panderodus sp. BARRICK and KLEFFNER 2022, pl. 3, figs. 12-16, 23-27.

Diagnosis: P₃ (falciform) element with a short base and a long recurved cusp filled with white matter. Arcuatiform (M) and asymmetrical graciliform (S) element have long rounded recurved cusps filled with white matter.

Holotype: falciform element, SUI149865, Pl. 2, fig. 25, H77-349AC.

Etymology: *cernuus* – Latin for bent downward

Description: P₃ (falciform) element has a short broad base and a long broad, cusp with a round cross-section that is entirely filled with white matter. The cusp length is about equal to base length and the cusp is recurved at an angle of about 40 degrees relative to the base. P₂ element (tortiform) like that of *Panderodus unicostatus*, but cusp is slightly longer. M (arcuatiform) element with short, rounded base and long rounded recurved cusp entirely filled with white matter. The cusp length equals about 35–40% of the element length and the cusp is recurved at angle of 25 to 40 degrees relative to the base. Asymmetrical graciliform elements (S) are like those of the M element, but with a slightly smaller cusp. Subsymmetrical graciliform elements are long and slender with a short cusp like that of *P. unicostatus*, but slightly more recurved. S₀ and P₁ elements were not recovered.

Remarks: Some elements of *Panderodus cernuus* n. sp. resemble the comparable elements in the apparatus of *P. unicostatus*, but the longer, more recurved cusps of the P₃, M, and asymmetrical S elements of *P. cernuus* serve to distinguish this species from *P. unicostatus*. Some elements of *P. cernuus* n. sp. have been previously identified as *P. recurvatus* based on the degree of curvature of the cusp. Unlike the elements of *P. recurvatus* that have a flattened cusp and an expanded base, the elements of *P. cernuus* n. sp. have rounded cusps and simple bases like those of *P.*

unicostatus, the probable ancestor. Corradini and Corrigan (2010, 2012) illustrated the more recurved elements of *P. cernuus* n. sp. from late Pridoli samples in the Carnic Alps as *P. recurvatus* in association with *P. unicostatus*. The elements assigned to *P. unicostatus* may be examples of the less diagnostic graciliform elements of *P. cernuus* n. sp. Suttner (2007) also illustrated a few elements of *Panderodus* from the late Pridoli Megaerella Formation in the Carnic Alps, at least one of which (pl. 5, fig. 15), appears to be a P₃ element of *P. cernuus*.

Because of small numbers and breakage it is not clear when *Panderodus cernuus* n. sp. replaces *P. unicostatus* in the upper Henryhouse faunas. *Panderodus cernuus* is certainly present in the late Pridoli *Belodella coarctata* fauna and appears shortly below the *B. coarctata* fauna, in the *O. elegans detortus* Zone. Corradini and Corrigan (2010) indicated that “*P. recurvatus*” may appear lower, but they did not illustrate the older specimens. The upper range of the species is undetermined.

Order PRIONIODONTIDA Dzik 1976

Family ICRIONODONTIDAE Müller and Müller 1957

Genus *Pedavis* Klapper and Philip 1971

Pedavis? latialata (Walliser 1964)

Plate 3, fig. 10.

Remarks: Few P₁ elements of *Pedavis? latialata* were recovered from the *Jeppssonina* interval in the upper Henryhouse. Determining whether these P₁ elements are actually *Pedavis* or should be placed in *Praeicriodus* Murphy 2016 will require a more complete reconstruction of the apparatuses.

Genus *Praeicriodus* Murphy 2016

Praeicriodus? sp.

Plate 3, figs. 8, 9, 11–13.

Remarks: A small number of P₁ element fragments and coniforms recovered from strata above the *Jeppssonina* interval and below the top of the upper Henryhouse are tentatively assigned to *Praeicriodus*. The coniforms resemble closely those of *Praeicriodus simpsoni* Barrick, Sundgren and McAdams 2021, thus supporting the tentative inclusion in *Praeicriodus*.

Order PRIONIODONTIDA Sweet 1988.

Family PRIONIODONTIDAE Bassler 1925

Genus *Oulodus* Branson and Mehl 1933

Oulodus elegans elegans (Walliser 1964)

Plate 3, figs. 1–7.

Remarks: Elements of *Oulodus e. elegans* appear well above the last occurrences of *Jeppssonina parasnajdri* and *J. crispa* and range up to near the top of the Henryhouse. The species occurs in many samples in the middle part of the upper Henryhouse but it is never abundant. Near the top of its range preservation is poor, making it difficult to determine the level of the first occurrence of *O. e. detortus*. In the lowest *O. e. detortus*, simple alternation of denticulation is seen only on the Sc

element and alternation of denticulation on other elements occurs higher. Just before the FAD of *Belodella coarctata*, the Sc element has two small denticles between the larger denticles. Carls et al. (2007) indicated that *O. e. detortus* appeared earlier in the Pridoli than previously reported, before the occurrence of *Zieglerodina eosteinhorrensensis* s.s. Manda et al. (2023) showed *O. e. detortus* as appearing in the upper part of the graptolite *Neocolonograptus lochkovensensis* Zone in Bohemia, much lower than in the “*Monograptus perneri*” Zone as shown in Melchin et al. (2020).

?*Oulodus*. sp.

Remarks: A few robust ramiforms, mostly Sc elements, occur in the lower part of the upper Henryhouse in the Lawrence Uplift sections that cannot be assigned to any other genus with confidence

Genus *Wurmiella* Murphy, Valenzuela-Ríos and Carls 2004

Remarks: Murphy et al. (2004) assigned *Wurmiella* to the Family Spathognathodontidae but did not consider how much the apparatus of *Wurmiella* species differs from that of other genera of the Spathognathodontidae. First, the P₂ element of *Wurmiella* is not the typical angulate compressed blade with a prominent cusp and processes with denticles decreasing uniformly in size away from the cusp. The *Wurmiella* P₂ element resembles strongly the P₁ element to such a degree that many workers cannot reliably separate the two elements (Jones et al. 2009). Second, the M element is strongly curved with a large open basal cavity, unlike the straighter, more erect M elements of the other species. Third, the other ramiform elements have discrete denticles that are rarely fused and of near equal size. Murphy et al. (2004) indicated that genera such as *Pterospathodus* and *Kockella*, as well as “*Ozarkodina*” *polinclinata* were closely related to *Wurmiella*, but these genera possess entirely different apparatus features, as indicated by Donoghue et al. (2008). Jeppsson (1972) described two apparatuses, “*Ligonodina excavata excavata*” and “*L. excavata novoexcavata*,” as having elements difficult to separate from those of *W. excavata*, except for the *Oulodus*-like P₁ and P₂ elements of the former taxa. We suggest that placement of *Wurmiella* within the Prioniodinida is better than placement within the Ozarkodinida.

Some Llandovery (Rhuddanian-early Aeronian) forms appear to be related to *Wurmiella*. The apparatus of the Llandovery genus *Rexroadus* Zhang and Barnes 2002, comprising *R. nathani* (McCracken and Barnes 1981) and *R. kentuckyensis* (Branson and Branson 1947), has a similar apparatus structure, but with more widely spaced denticles, and P₂ and M elements like those of *Wurmiella*. *Wurmiella puskuensis* (Männik 1994) also has a similar “*excavata*”-type apparatus. Zhang and Barnes (2004) placed *Rexroadus* with the prioniodonids and their analysis grouped the two *Rexroadus* species with *Oulodus sigmoideus* Zhang and Barnes 2002. Donoghue et al. (2008, p. 141) indicated that *W. excavata* did not fit neatly into their ozarkodinid groups, but it grouped best with the Ordovician genus *Yaoxianognathus* An 1985, a genus with few obvious similarities. Donoghue et al. (2008, p. 141) also suggested that the *W. excavata*-*Yaoxianognathus* group might be the basal clade of the Ozarkodinina. The association of these two genera

appears to be largely a result of the limited number of taxa used in the analyses.

Wurmiella excavata (Branson and Mehl 1933)

Plate 1, figs. 4–16.

Remarks: Murphy et al. (2004) discussed the nomenclatural and taxonomic problems surrounding the type material of *Wurmiella excavata* from the Lithium, Missouri section of Branson and Mehl (1933). Until these problems are solved, we will continue to use the species name “*excavata*.” Murphy et al (2004, tab. 1) gave a partial list of species of *Wurmiella* that included the names of three Ludlow species: *W. ‘excavata’* (Branson and Mehl 1933), *W. inclinata?* (Rhodes 1953) and *W. inflata* (Walliser, 1964). Murphy et al (2004) did not, however, provide a clear solution to the diagnostic species level characters for any of these Ludlow morphotypes. The holotypes of all three of these species were obtained from the Gorstian-early Ludfordian *Ancoradella ploeckensis* to *Polygnathoides siluricus* zones, the faunal zones before the extinction horizon of the Lau Event. No mention was made of late Ludfordian and Prídolí examples of *Wurmiella*.

Murphy et al. (2004) indicated that three morphotypes of the P₁ element, as well as minor differences in the ramiform elements, were illustrated by Rexroad and Craig (1971, pl. 80) in their restudy of the Lithium fauna. Jones et al. (2009) discussed how workers could confuse the P₁ and P₂ elements of *Wurmiella excavata*. Two of these morphotypes may be P₂ elements. One specimen from the Lithium locality illustrated by Murphy et al. (2004, fig. 2:31) as a P₁ element may be a P₂ element. Two morphotypes, the “*simplex*” and “*inclinata*” morphotypes were compared and discussed by Rexroad and Craig (1971). The “*simplex*” morphotype was described as having a more compressed blade, more fused denticles, and was more arched than the “*inclinata*” morphotype with a flexing of the dorsal blade. Rexroad and Craig (1971) suggested that the Lithium material included only the “*simplex*” P₁ element, and that the Lithium “*simplex*” was transitional to and ancestral to the examples of the “*inclinata*” morphotype. They may have included many P₂ elements in their description of the “*simplex*” morphotype. Also, Jeppsson (1975) reported that the type specimen of “*Ozarkodina simplex*” was a broken P₂ element. Rexroad and Craig (1971) had few examples of the “*inclinata*” morphotype from other faunas for comparison (only Rhodes 1953 and Jeppsson 1969, text-figure 3A; Lunnarna locality).

The abundant *Wurmiella* fauna in the upper Henryhouse Formation is confined to the lower part of the unit, where relatively hard biowackestones with small, clay-dominated insoluble residues occur. This interval is dominated by *Dapsilodus* elements and corresponds to the *Jeppssonina* interval. The P₁ elements vary somewhat in morphology, depending to a large degree on the size and robustness of the elements. The most typical P₁ form has a relatively long ventral blade with several (7–10) denticles partially fused at the bases. The denticles are relatively uniform in height, decreasing only slightly in height at the ventral end. The cusp is slightly wider and higher than the blade denticles. The dorsal process is shorter, bearing 4–5 denticles that are partially fused at the base and decline in height to the dorsal end. The blade is slightly

thickened just below the denticles, forming a light ledge. The lower surface of the blade is slightly arched to flat. The dorsal process may bend downward and inward slightly or remain in line with the ventral process. The small basal cavity expands slightly under the cusp as small semicircles on either side of the blade. This dominant morphotype corresponds well with the so-called “*inclinata*” morphotype. Smaller P_1 elements differ by having a higher blade, possessing fewer less fused denticles, especially on the ventral process, lacking the thickening of the blade, and having a less expanded basal cavity. A few specimens from just above the *Jeppsson* interval (Highway 77-336a) have a somewhat inflated basal cavity and resemble *W. inflatus* (Walliser 1964), which occurs in the *ploeckensis* Zone at Cellon (Corradini et al. 2014; Walliser 1964).

As Jeppsson (1975) noted, elements of *Wurmiella excavata* are uncommon in the Lithium faunas, as is the case in our large collections from the locality. The small number of better preserved Lithium P_1 elements we obtained fall within the range of variation of the upper Henryhouse faunas and we consider the same *Wurmiella* species to be present. Our P_1 elements are similar to those illustrated by Jeppsson (1969, fig. 3; 1975, plate 4) from Ludlow units in Scania and Gotland and in our collections from his localities.

Wurmiella sp. A

Plate 1, figs. 1–3.

Ozarkodina excavata subspecies A. BARRICK et al. 2005, p. 119, pl. 2, figs. 12–14.

Ozarkodina excavata subspecies A? BARRICK et al. 2005, pl. 2, fig. 11.

Remarks: A small number of *Wurmiella* P_1 elements from near the top of the Henryhouse differ from typical *W. excavata* P_1 elements. The ventral process bears 5–8 high triangular discrete denticles that are highest in the middle of the process. The dorsal process is arched and bears 3 to 4 triangular discrete inclined denticles. The P_2 element and ramiform elements are like those of *W. excavata*, but the denticles are broader and more widely spaced. The few ramiforms recovered have a few small denticles between the large ones. *Wurmiella* sp. A differs from *W. alternata* Corradini and Corrigan 2010 in the irregular pattern of denticulation. This uncommon form occurs in a narrow stratigraphic interval just below the first occurrence of *Oulodus elegans detortus*. Barrick et al. (2005) reported *W. sp. A* from the same stratigraphic position in the Frame Formation in West Texas.

Order OZARKODINIDA Dzik 1976

Family SPATHOGNATHODONTIDAE Hass 1959

Genus *Jeppsson* Barrick, Klapper and Peavey **n. gen.**

Type species: *Spathognathodus sagitta* Walliser 1964

Etymology: Named for Lennart Jeppsson in honor of his many contributions to Silurian conodont taxonomy and biostratigraphy.

Diagnosis: P_1 element carminiscaphate with an expanded sagittate to rounded basal cavity that extends to the dorsal end of the element under a simple blade. Angulate P_2 element is short with a distinct cusp with high, partially fused denticles dorsal of the cusp and lower partially fused denticles ventral of the cusp. The

dolabrate M and S elements are small typical “ozarkodinid” ramiform elements (S_0 - alate without posterior process; S_1 - extensiform digyrate; S_2 - bipennate) with delicate, uniform denticulation.

Remarks: *Jeppsson* n. gen. comprises several closely related species with a carminate P_1 element that were orphaned in the wake of the restriction of *Ozarkodina* by Murphy et al. (2004). This genus consists of a group of Wenlock to Ludlow species, many of which were originally named by Walliser (1964) and later assigned to *Ozarkodina*: *O. rhenana* (Walliser 1964), *O. sagitta* (Walliser 1964), *O. bohemia* (Walliser 1964), *O. snajdri* (Walliser 1964), and *O. crispa* (Walliser 1964). Other species, such as *O. parasnajdri* (Viira and Aldridge 1998), and *O. huenickeni* Gómez et al. (2021), belong to this genus. The blade above the basal cavity is denticulate in older (Sheinwoodian to early Homerian) species and partially to completely fused to a ridge in younger (Homerian-Ludfordian) species. The diagnosis is based mostly on reconstructions of the apparatus of Wenlock species (e. g., Aldridge 1975; Barrick and Klapper 1976). A phylogenetic analysis by Gómez et al. (2021) indicated that species we assign to *Jeppsson* n. gen. belong to a monophyletic group. Some Llandovery species such as *Ozarkodina oldhamensis* (Rexroad 1967) and *Ozarkodina clavula* Uyeno 1983 (in Uyeno and Barnes 1983) have P_2 and ramiform elements that resemble those of younger *Jeppsson* n. gen. species, but the basal cavities of the P_1 elements of these two species are constricted before reaching the dorsal tip (see Zhang and Barnes 2002, figs. 12 and 13).

The characteristic pattern of hyaline and white matter in elements of *Ozarkodina* Branson and Mehl 1933, distinguishes *Ozarkodina* species from species of *Jeppsson* (Murphy et al. 2004). Elements of *Zieglerodina* Murphy, Valenzuela-Ríos and Carls 2004 resemble those of *Jeppsson*, but the ramiform elements of *Jeppsson* species possess uniform denticulation, in contrast to the irregular to alternating denticulation of ramiform elements of *Zieglerodina* species (Murphy et al. 2004).

Jeppsson *snajdri* (Walliser 1964)

Plate 3, figs. 22–25, 28.

Remarks: We follow the usage of Slavík and Carls (2012) and include only P_1 elements in which the partially fused blade over the expanded basal cavity retains some free denticle tips on the downward sloping dorsal end of the blade. *Jeppsson* *snajdri* is common in many samples of the lower fauna of the upper Henryhouse. Most P_1 elements are relatively small compared with those of the co-occurring P_1 elements of *Wurmiella excavata*. Few P_2 , M and S elements were recovered. A couple specimens have small nodes on the upper surface of the basal cavity.

Jeppsson *parasnajdri* (Viira and Aldridge 1998)

Plate 3, figs. 20, 21, 26.

Remarks: Slavík and Carls (2012) used the name *parasnajdri* Viira and Aldridge (1998) to designate P_1 elements like *Jeppsson* *snajdri* in which the blade above the expanded cavity was fused completely to the dorsal end. We adopt this usage but recognize that the diagnosis of Slavík and Carls (2012)

differs somewhat from that of Viira and Aldridge (1998). The P_1 elements of *J. parasnajttri* also tend to have a longer blade than *J. snajttri* and a greater length of the blade is fused than in *J. snajttri*. The dorsal margin at the end of the blade forms the dorsal end of the element. Transitional forms between *J. snajttri* and *J. parasnajttri* are common and juvenile specimens of these species are difficult to distinguish from each other. *Jeppsonia parasnajttri* appears above the first *J. snajttri* and occurs with *J. crispa*.

Jeppsonia crispa (Walliser 1964)

Plate 3, figs. 14–19, 27.

Remarks: *Jeppsonia crispa* is distinguished from *J. parasnajttri* in the possession of a blade that is fused to its dorsal end, but with a thin rim of the rounded basal cavity that extends dorsally to the end of the blade. This species occurs in only a few samples in the upper Henryhouse at the Highway 77 section, in the same stratigraphic interval as *J. parasnajttri*.

Genus *Ozarkodina* Branson and Mehl 1933

Remarks: Murphy et al. (2004) restricted the concept of *Ozarkodina* to taxa with the attributes of the type species, *O. typica* Branson and Mehl 1933, which excluded nearly all species previously assigned to *Ozarkodina*.

Ozarkodina typica Branson and Mehl 1933

Plate 4, fig. 9.

Remarks: We accept the argument of Murphy et al. (2004, p. 5) that the species name *O. typica* is the type species of *Ozarkodina*. This is regardless of the fact that *O. typica* was treated by the action of the first reviser (Jeppsson 1969) as a subjective junior synonym of *O. confluens*. The available online Fourth Edition of the ICZN (2000) states in Article 67.1.2 “The name of a type species remains unchanged even when it is a junior synonym ...”. Few elements of *O. typica* were recovered from the upper Henryhouse, all above the *Jeppsonia* faunal interval. The white matter distribution, enlarged ventral blade denticles, small lobed unconstricted basal cavity are diagnostic.

Ozarkodina? sp.

Plate 4, fig. 12.

Remarks: A small number of specimens from the upper part of the *Jeppsonia* faunal interval and the lower part of the undiagnostic fauna resemble morphotypes often attributed to *O. typica*. Slavík and Carls (2012) assigned morphotypes like these to either *O. ex. gr. typica*, *O. cornidentata* (Viira 1983), or *O. ambigua* (Viira 1983), depending on the configuration of the ventral denticles, even though most came from the same samples, PZ019 top and 20A, from high in their *crispa* Zone (see fig. 7 B, D, J-P). We agree that many of these specimens are not usual examples of *O. typica* (alpha morphotype of some authors; e.g., Klapper and Murphy 1975), but we possess too few upper Henryhouse examples to resolve their taxonomic placement.

Genus *Parazieglerodina* Carls et al. 2005

Remarks: Carls et al. (2005) erected the genus *Parazieglerodina* to designate a species of ozarkodinid with a short high P_1 element with a low cusp and laterally broad and downward deflected lobes of the basal cavity, with *P. plodowskii* as the type species. They emphasized that the ramiform elements of the genus possess “incipient development of alternating denticulation.” This description suggests that the ramiform elements are in the process of developing alternating denticulation, which is not apparent from the illustrations. The denticulation is irregular, with different sizes and spacing of denticles, but there is no evidence of the regularity in denticle size and spacing found in other taxa, such as *Zieglerodina*. The contention of Carls et al. (2005) that *P. plodowskii* is the oldest spathognathodontid with alternating denticulation appears to be unfounded. A form similar to *P. plodowskii* is “*Ozarkodina remscheidensis baccata*” Miller and Aldridge 1997. The outline of the blade and the medially located, vaulted, constricted basal cavity lobes (Miller and Aldridge 1997, pl. 1) fit easily into the concept of *Parazieglerodina* and *P. baccata* may be a senior synonym of *P. plodowskii*.

As Carls et al. (2005) noted, the relationship of *Parazieglerodina* to other genera is unclear. Simpson (2003) suggested that distribution of white matter in the P_1 element of the similar species *P. auriformis* (Simpson 2003) might help resolve how *P. auriformis* is related to other taxa, but his material is CAI 3.5 and higher. Carls et al. (2005) made no mention of white matter distribution. In our P_1 elements of *P. auriformis* from the upper Henryhouse, the denticles are filled with white matter and the bases of the white disappear about halfway into the depth of the blade. The specimens of Uyeno (1980, pl. 4, figs. 32–37) illustrate this well. This pattern is like that seen in species of *Zieglerodina* (e.g., Jeppsson 1975, pl. 11; Jeppsson 1990, pl. 2; Murphy et al. 2004, fig. 2: 37,39,40).

Parazieglerodina auriformis (Simpson 2003)

Plate 4, fig. 1–8, 10.

Ozarkodina martinsoni auriformis SIMPSON 2003, p. 75–78, pl. 1, figs. 1–20. (see for further synonymy).

Remarks: The P_1 element of *Parazieglerodina auriformis* is remarkably similar to that of *P. plodowskii*. Both elements are characterized by the laterally expanded vaulted lobes of the basal cavity that are constricted near the blade, giving the lobes an ear-like outline. The P_1 element of *P. auriformis* differs in having higher and coarser denticulation on the blade, a more discrete cusp, and a longer lower dorsal process than *P. plodowskii*. Neither Simpson (2003) nor Carls et al. (2005) recovered sufficient complete elements for complete reconstruction of the apparatus, but these authors illustrated S elements with irregular denticulation.

Parazieglerodina auriformis was originally assigned an Early Devonian age based on its occurrence with ‘*I. woschmidtii hesperius*’ by Simpson (2003). Barrick et al. (2021) interpreted ‘*I. woschmidtii hesperius*’ to be a Silurian example of *Praecriodus*. *Parazieglerodina auriformis* has been reported from upper Ludlow–lower Pridoli beds in Australia (e.g., Jeppsson et al. 2007; Talent et al. 2005) and in North America, where it occurs in association with

Pedavis? latialata in Nevada (Klapper and Murphy 1975) and the Canadian Arctic (Uyeno 1980). Klapper and Murphy (1975, p. 15) reported that this species was observed in two of Walliser's (1964) samples from Cellon, C25 and C27, from the *Pe.? latialata* Zone.

Genus **Zieglerodina** Murphy, Valenzuela-Ríos and Carls 2004

Remarks: Murphy et al. (2004) carefully characterized *Zieglerodina* and subsequent workers have provided more details about Silurian and Early Devonian *Zieglerodina* species (e.g., Carls et al. 2007; Drygant and Szaniawski 2012). Numerous species of *Zieglerodina* have been described from different geographic regions that are based in the pattern of denticulation, location and shape of the basal cavity, and shape of the aboral surface (Peavey 2013). However, we are concerned about the variable nature of these characters, especially denticulation, and the tendency for local populations to form reflecting environmental conditions, especially in near-shore settings (e.g., Barrick and Kleffner 2022; Jeppsson 1989).

Carls et al. (2007), Vacek et al. (2018), and Manda et al. (2023) used a series of three *Zieglerodina* species as part of their zonation of the Pridoli in Bohemia: *Z.? zellmeri* (= *Z.? scanica* (Jeppsson 1975), see below) (lowermost Pridoli; Jarovian Stage); *Z. ivochlupaci* (lower Pridoli; Jarovian Stage), and *Z. klonkensis* (uppermost Pridoli; uppermost Radotinian Stage to basal Devonian Lochkovian Stage).

The primary difference between *Zieglerodina? scanica* and true *Zieglerodina* species is the presence of distinctly alternating denticulation on the ramiforms, including the M element in true *Zieglerodina*. (e.g., *Z. ivochlupaci* and *Z. klonkensis*). Jeppsson (1975, p. 37-38) proposed that the appearance of clearly alternating denticulation on the ramiform elements was a significant evolutionary event, a feature later used by Murphy et al. (2004) and Carls et al. (2007) to characterize species of *Zieglerodina*. Jeppsson (1975) indicated that alternating denticulation appeared at Cellon (C39A), where the form species *Hindeodella priscilla* Stauffer 1938, first occurs, well above the LAD of *Jeppssonina crispa* (see also Corradini et al. 2014). Jeppsson (1975) noted that alternating denticulation could have appeared earlier in time, as does Carls et al. (2005). In the Požár quarry and Hvízdálka section in Bohemia, *Z.? scanica* (= *Z.? zellmeri*) occurs at the base of the Pridoli and *Z. ivochlupaci*, which has distinct alternating denticulation on all ramiforms, appears slightly higher in the Pridoli (Manda et al. 2023; Vacek et al. 2018). A similar succession occurs in the Carnic Alps and Sardinia above the LAD of *J. crispa* (Corradini and Corriga 2012). Several authors (e.g., Barrick and Kleffner 2022; Corradini and Corriga 2012; Corradini et al. 2014, 2019) have used the name *Z.? zellmeri* to designate middle to late Pridoli P₁ elements like those formerly termed "*Ozarkodina eosteinhornensis*" (e.g., Barrick and Klapper 1992). Because these younger forms possess ramiform elements with alternating denticulation, including the M element, the name *Z.? zellmeri*, or its senior synonym *Z.? scanica*, are not appropriate to designate these forms.

P₁ elements of *Zieglerodina* are not common through most of the upper Henryhouse and many specimens are small or broken, which complicates species characterization. Near the top of the upper Henryhouse, in the *Oulodus elegans detortus* interval and above, P₁ elements become more common and comprise a

significant part of the faunal assemblage (Barrick and Klapper 1992). The P₁ elements from the upper Henryhouse appear to comprise a range of variation different from that described elsewhere. The most important attribute is the configuration of the dorsal blade. The common European Pridoli species are described as having a dorsal blade that slopes downward from the cusp (*Z.? scanica/zellmeri*, *Z. ivochlupaci*, *Z. klonkensis*; Carls et al. 2007). In contrast, the Henryhouse *Zieglerodina* P₁ elements have a dorsal blade with one or two broader and higher denticles dorsally. A review of illustrations of *Zieglerodina* species from Nevada (Klapper and Murphy 1975) and Tennessee (Barrick and Kleffner 2022) shows that this is a characteristic feature of many North America specimens. This type of dorsal blade is also listed as a diagnostic feature for the younger species *Z.? planilingua* Murphy and Valenzuela-Ríos 1999, which was based on Nevada specimens (See also Barrick et al. 2005, pl. 1, figs. 3, 12 for examples from West Texas). We suspect that the difference in dorsal blade configuration between Europe and North America may be reflection of provincialism, as was described for the basal Lochkovian *Caudicriodus* species (Barrick et al. 2021).

Donoghue et al. (2008) suggested because *Zieglerodina remscheidensis* (Ziegler 1960), the type species of *Zieglerodina* Murphy et al. 2004, grouped together in a series of cladistic analyses with *Nicollidina brevis* (Bischoff and Ziegler 1957), the type species of *Nicollidina* Dzik 2002, that *Nicollidina* would have priority if the two species were included in the same genus. However, the morphologies of the elements of the two genera are strikingly different, as is clearly stated in their respective diagnoses. We suspect that the grouping is an artifact of coding and selection of taxa in the cladistic analyses.

***Zieglerodina? scanica* (Jeppsson 1975)**

Hindeodella steinhornensis scanica n. ssp. JEPSSON 1975, p. 39-43, pls. 9 and 10.

Zieglerodina? zellmeri CARLS et al. 2007, p. 162-163, figs. 6A-G, J-N, 8M-P.

Remarks: *Hindeodella steinhornensis scanica* Jeppsson 1975, was described from early Pridoli? (post-*crispa* beds) on Scania. The P₁ element resembles that of *Zieglerodina? zellmeri* so closely that we cannot separate them based on the descriptions or illustrations. Jeppsson (1975, p. 43) reported that the Sa-Sc elements bear equal denticulation, but some of his illustrations (e.g., pl. 10, figs. 7B, 7C, 9B) display the irregular denticulation like that shown for *Z. zellmeri* (Carls et al. 2007, fig. 6, C, D, E). Also, both *Z.? zellmeri* and *H. s. scanica* possess an M element with even denticulation, unlike younger *Zieglerodina* species. We consider Jeppsson's species *Z.? scanica* to be a precursor to true *Zieglerodina* and suggest that it is a senior synonym of *Z.? zellmeri*. Jeppsson (1975, p. 39) did not select a holotype and recommended that when a lectotype was selected it should be one of the figured specimens from a locality with a measured section from which good topotype material could be obtained. We select the P₁ element illustrated on Jeppsson (1975, pl. 9, fig. 5) as the lectotype, from sample K1 67-5, the Klinta section, from which other elements of the apparatus were obtained and illustrated (P₂-pl. 9, fig. 13; M-pl. 10, fig. 1, S0-pl. 10, fig. 11, S₁-pl. 10, fig. 9, S₂-pl. 10, fig. 6). We have examined material from Tullésbo I (Jeppsson 1975), which yielded abundant, well preserved elements, and can confirm the observations of Jeppsson.

The irregular denticulation in the ramiform elements of *Zieglerodina*? species from the Upper Whitcliffe Formation, Welsh Borderland of England (Miller and Aldridge 1997, fig. 5), and the late Ludlow age suggests a close relationship for these taxa to *Z.?* *scanica*. Jeppsson and Aldridge (2000) show *Z.?* *scanica* as occurring in the late Ludlow below *J. crista* and just above the Lau Event. Our lowest samples from the upper Henryhouse that bear rare *Zieglerodina* P₁ elements did not yield ramiform elements and thus we cannot be certain if any are examples of *Z.?* *scanica*.

***Zieglerodina altidens* Barrick, Klapper and Peavey n. sp.**

Plate 5, figs. 1–18, 21–27.

Spathognathodus eosteinhornensis Walliser 1964. –REXROAD and CRAIG 1971, p. 700, pl. 82, figs. 18, 19.

Ozarkodina remscheidensis eosteinhornensis (Walliser 1964). –KLAPPER and MURPHY 1975, p. 40–41, pl. 7, figs. 11–21, 23, 24.

Ozarkodina remscheidensis eosteinhornensis (Walliser 1964). –BARRICK and KLAPPER 1992, p. 48, pl. 6, figs. 2–4.

Zieglerodina zellmeri Carls et al. 2007. –BARRICK and KLEFFNER 2022, p. 18, pl. 1, figs. 1, 8, 13?, 19, 20.

Holotype: SUI 64778, Section P1, sample 28, Barrick and Klapper, 1992, pl. 6, fig. 3.

Derivation of name: Latin *altidens* = high denticles, in reference to the higher denticles at the end of the dorsal blade.

Diagnosis: P₁ element with a straight thin blade. Long ventral blade possesses 7 to 10 erect denticles, the most ventral 1 to 2 major denticles are slightly higher and wider. Short dorsal blade possesses 3 to 6 denticles that incline slightly dorsally, the second to third major ones from the dorsal end are slightly higher and wider. Cusp is only slightly higher and wider than adjacent denticles. Aboral margin is almost straight. Basal cavity oval to heart-shaped and unconstricted. Its upper surface is smooth to slightly vaulted.

Description: Blade of the P₁ element is relatively long and evenly denticulated. The ventral blade is longer than the dorsal blade. The ventral blade bears 7 to 10 denticles that are mostly erect; the most ventral ones may tilt very slightly ventrally. A tiny denticle lies at the ventral tip followed by one or two slightly higher and wider denticles, which are followed by 4 to 7 smaller denticles. The cusp is only slightly higher and wider than the adjacent denticles and inclined slightly dorsally. The dorsal process bears 3 to 6 denticles that are inclined slightly dorsally. The dorsal tip may bear a tiny denticle. The next 1 to 2 denticles are slightly higher and wider than the others. The aboral surface of the element is almost flat, with the dorsal process elevated just a little behind the basal cavity. The basal cavity is oval to heart-shaped and unconstricted. Its upper surface is generally smooth, but in larger specimens it may be slightly vaulted. The P₂ elements appear to be typical for the genus. The M and S elements are relatively small and bear well developed alternating denticulation.

Remarks: *Zieglerodina altidens* n. sp. includes P₁ elements from Midcontinent and western North America that previously were assigned to *Ozarkodina remscheidensis eosteinhornensis*, or more recently *Z.?* *zellmeri*. The pattern of denticulation of the P₁ element is like that described for the slightly younger species *Z. planilingua* (Murphy and Valenzuela-Ríos 1999),

but in the latter species a small terrace occurs on top of the slightly constricted lobes of the basal cavity. The overall pattern of denticulation in *Z. altidens* varies from sample to sample and within samples and the more common specimens conform to the description given above. The more extreme variants are described separately as *Z. denticulata*? and *Z.* morphotypes A, B, and C. Each morphotype appears to grade into the general *Z. altidens* population. Pridoli *Zieglerodina* P₁ elements from the Appalachian Basin (e.g., Barnett 1971; Helfrich 1978) include a variety of morphotypes, some of which are similar to *Z. altidens* n. sp. These faunas need to be restudied to better ascertain which species are present.

The denticulation on the dorsal process of the P₁ element distinguishes *Z. altidens* n. sp. from Silurian *Zieglerodina* species based on European material. The high dorsal denticulation is apparent in very small specimens (Pl. 5, figs. 1, 2, 5, 6), but may be less obvious in the largest specimens. European species are described as having denticles on the dorsal process that decrease in height behind the cusp, whereas in North American species the dorsal process usually bears a few higher denticles near the end of the process. The P₁ element of *Z.?* *scanica* (Jeppsson 1975) is similar in possessing relatively even denticulation, but the ramiform elements have poorly developed alternating denticulation. The dorsal process of the P₁ element also slopes downward and appears to lack the higher, wider denticles found near the end of the dorsal blade of *Z. altidens* (see Carls et al. 2007, figs. 6, 8; as *Z. zellmeri*). The denticulation of *Z. altidens* n. sp. is finer and more evenly spaced than that of the *Z. ivochlupaci* Carls et al. 2007. *Zieglerodina klonkensis* Carls et al. 2007 has a dorsal blade that slopes downward with a curved profile, unlike the high denticles at the end of the dorsal blade of *Z. altidens*.

Klapper and Murphy (1975) and Barrick and Klapper (1992) documented a change in denticulation from specimens here called *Z. altidens* n. sp. to specimens they called *Ozarkodina remscheidensis remscheidensis* (Ziegler 1960) near the Silurian-Devonian boundary. In both Nevada and Oklahoma, the denticulation on the P₁ element of the latter becomes more irregular. The cusp is enlarged, 2–3 denticles near the end of the ventral blade become higher and wider, and 1–2 denticles near the end of the dorsal blade become higher and wider. Also, there is tendency for the blade outline to appear longer and lower than in typical *Z. altidens* n. sp. Some forms display the transition to *Z. planilingua* in the formation of a terrace on the upper surface of the basal cavity (*Zieglerodina* morphotype D, Pl. 4, figs. 21, 22, 24, 25, from I35–2E, Haragan Formation; Jacobi et al. 2009, text-fig. 3). We exclude these “*remscheidensis*”-like P₁ elements from *Z. altidens* n. sp. but recognize that the two forms may occur together in an interval of transition. Additional comparisons with other Lochkovian *Zieglerodina* species will be needed to determine the best name for them.

***Zieglerodina denticulata* (Viira 2000)?**

Plate 4, figs. 13, 14.

Ozarkodina remscheidensis (Ziegler 1960)? –BARRICK et al. 2005, pl. 1, fig. 1.

Remarks: A small number of P₁ elements from the upper Henryhouse in the *Oulodus elegans* faunal interval have a high blade that bears numerous fine, closely spaced compressed denticles of near equal height. The dorsal process is about the

same height as the ventral process and cusp is indistinct. The dorsal process is angled upward. The basal cavity is small, biconvex, and located just dorsal of mid-length. The upper Henryhouse forms resemble the late Pridoli forms illustrated as *Ozarkodina denticulata* by Viira (2000, pl. 3, figs. 6-8), but too few specimens were recovered for confident assignment to this species.

***Zieglerodina eosteinhornensis* (Walliser 1964)**

Plate 4, fig. 17.

Remarks: Only a few specimens of *Z. eosteinhornensis* were recovered from one sample, SW Davis 13B. The *Zieglerodina*-like basal cavity bears a short ridge on one platform lobe, the diagnostic feature of this species. Otherwise the P₁ element is like that of *Z. altidens* new species.

***Zieglerodina* morphotype A**

Plate 4, figs. 18–20.

Remarks: A few P₁ elements resemble *Zieglerodina altidens*, but differ in having fewer, more widely spaced denticles, and one to three large, high denticles on the ventral process. *Zieglerodina* species A resembles *Z. ivochlupaci* Carls et al. 2007 in that the blade comprises only a few larger denticles in both forms. In contrast, the dorsal blade denticles of *Z. ivochlupaci* decrease in height dorsal of the cusp, whereas the dorsal denticles of *Z. morphotype A* become wider and higher. The lower surface of *Z. ivochlupaci* is nearly flat and that of *Z. morphotype A* rises dorsally. This morphotype occurs above the appearance of *Oulodus elegans elegans* and below the appearance of *O. e. detortus*.

***Zieglerodina* morphotype B**

Plate 4, figs. 23, 26; Plate 5, figs. 19?, 20?

Ozarkodina remscheidensis remscheidensis (Walliser). –KLAPPER and MURPHY 1975, pl. 7, fig. 14 (only).

Remarks: Occurring with typical examples of *Zieglerodina altidens* n. sp. are P₁ elements that possess a short, high dorsal process. The dorsal process bears 2 high, wide denticles and the lower surface of the process is angled sharply upward. Forms occurring below the FAD of *Oulodus elegans detortus* are little different than *Z. altidens* n. sp. in having 1-2 tiny denticles dorsal of the cusp before two large denticles (Pl. 5, figs. 19, 20), but ones in the upper range of *Z. altidens* n. sp. are more distinct in having just 2 large dorsal denticles.

***Zieglerodina?* morphotype C**

Plate 4, figs. 15, 16.

Remarks: A small number of P₁ elements occur in several samples in the *Oulodus elegans elegans* fauna that are similar to *Zieglerodina altidens* n. sp., but differ by having a very short dorsal blade. The P₁ element is characterized by a high blade bearing numerous denticles along the entire length of the element, which is slightly curved. The dorsal blade is short, high, denticulate and the end of the blade is nearly vertical. The narrow dorsal

biconvex basal cavity differs from the wider sagittate basal cavity typical of *Jeppsonia* and from the medial lobed basal cavity of *Zieglerodina*. No ramiform elements could be distinguished to help resolve the generic assignment: *Jeppsonia* has uniform denticulation on the ramiform elements and *Zieglerodina* has alternating denticulation.

Family UNKNOWN

Genus ***Decoriconus*** Cooper 1975

Decoriconus fragilis (Branson and Mehl 1933)

Plate 1, figs. 25–28.

Remarks: Elements of *Decoriconus fragilis* occur in small numbers through the upper Henryhouse. The morphology of the elements appears to be identical with older Ludlow and Wenlock elements.

Genus ***Pseudooneotodus*** Drygant 1974

***Pseudooneotodus* sp.**

Plate 1, figs. 31–35.

Pseudooneotodus sp. BARRICK and KLEFFNER 2022, p. 20, pl. 4, fig. 1-17.

Remarks: The *Pseudooneotodus* elements recovered from the upper Henryhouse are similar to those described by Barrick and Kleffner (2022) from the Pridoli Decatur Formation in Tennessee. See their description and discussion.

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REFERENCES

- ADRRAIN, J. M., 1996. A new otarionine trilobite from the Henryhouse Formation (Silurian, Ludlow) of Oklahoma. *Journal of Paleontology*, 70 (4): 611–614.
- ALDRIDGE, R. J., 1975. The Silurian conodont *Ozarkodina sagitta* and its value in correlation. *Palaeontology*, 18: 323–332.
- AL-SHAIEB, Z., FRITZ, R. D., BARRICK, J. E., MEDLOCK, P. L. and PUCKETTE, J., 1993. Hunton Group field trip to the Arbuckle Mountains, Oklahoma. In: Johnson, K. S., Ed., *Hunton Group core workshop and field trip*, 183–212. Oklahoma Geological Survey, Special Publication 93-4.
- AMSDEN, T. W., 1949. *Stratigraphy and Paleontology of the Brown-sport Formation (Silurian) of Western Tennessee*. Peabody Museum of Natural History, Bulletin, 5: 126 pp.
- , 1951. Brachiopods of the Henryhouse Formation (Silurian) of Oklahoma. *Journal of Paleontology*, 25: 69–96.
- , 1957. *Stratigraphy and paleontology of the Hunton Group in the Arbuckle Mountain region. Part I. Introduction to stratigraphy*. Oklahoma Geological Survey, Circular, 44: 57 pp.
- , 1958. *Stratigraphy and paleontology of the Hunton Group in the Arbuckle Mountain region. Part II, Haragan articulate brachiopods. Part III, Supplement to the Henryhouse brachiopods. Part IV (with A.J. Boucot), New genera of brachiopods*. Oklahoma Geological Survey, Bulletin, 78: 157 pp.
- , 1960. *Stratigraphy and paleontology of the Hunton Group in the Arbuckle Mountain region. Part VI. Hunton stratigraphy*. Oklahoma Geological Survey, Bulletin, 84: 311 pp.
- , 1969. A widespread zone of pentamerid brachiopods in subsurface Silurian strata of Oklahoma and the Texas Panhandle. *Journal of Paleontology*, 43: 961–975.
- , 1975. *Hunton Group (Late Ordovician, Silurian and Early Devonian) in the Anadarko basin of Oklahoma*. Oklahoma Geological Survey, Bulletin, 121: 214 pp.
- , 1980. *Hunton Group (Late Ordovician, Silurian and Early Devonian) in the Arkoma basin of Oklahoma*. Oklahoma Geological Survey Bulletin, 129: 136 pp.
- , 1988. *Late Ordovician through Early Devonian annotated correlation chart and brachiopod range charts for the southern Midcontinent region, USA. Part I*. Oklahoma Geological Survey Bulletin, 143: 1–53.
- AN, T.-X., ZHANG, A. T. and XU, J.-M., 1985. Ordovician conodonts from Yaoxian and Fuping, Shaanxi Province and their stratigraphic significance. *Acta Geologica Sinica*, 59: 97–108. [in Chinese, with English abstract].
- BARNETT, S. G., 1971. Biometric determination of the evolution of *Spathognathodus remscheidensis*: A method for precise intrabasinal time correlations in the Northern Appalachians. *Journal of Paleontology*, 45: 274–300.
- BARRICK, J. E., 1977. Multielement simple-cone conodonts from the Clarita Formation (Silurian), Arbuckle Mountains, Oklahoma. *Geologica et Palaeontologica*, 11: 47–68.
- , 1988. Silurian-Early Devonian conodont succession in the Hunton Group, southern Oklahoma. Part II. *Oklahoma Geological Survey, Bulletin*, 143: 54–56.
- BARRICK, J. E. and KLAPPER, G., 1976. Multielement Silurian (late Llandoveryan-Wenlockian) conodonts of the Clarita Formation, Arbuckle Mountains, Oklahoma, and phylogeny of *Kockella*. *Geologica et Palaeontologica*, 10: 59–100.
- , 1992. *Late Silurian-Early Devonian conodonts from the Hunton Group (Upper Henryhouse, Haragan, and Bois d'Arc formations), south-central Oklahoma*. Oklahoma Geological Survey, Bulletin, 145: 19–65.
- BARRICK, J. E., KLAPPER, G. and AMSDEN, T. W., 1990. Late Ordovician-Early Devonian conodont succession in the Hunton Group, Arbuckle Mountains and Anadarko Basin. Oklahoma. *Guidebook (Oklahoma Geological Survey)*, 27: 55–95.
- BARRICK, J. E., KLAPPER, G., KLEFFNER, M. A. and KARLSSON, H. R., 2010a. Conodont biostratigraphy and stable isotope chemostratigraphy of the lower Henryhouse Formation (Gorstian-early Ludfordian, Ludlow, Silurian), southern Oklahoma, USA, *Memoirs of the Association of Australasian Palaeontologists*, 39: 51–70.
- BARRICK, J. E. and KLEFFNER, M. A., 2022. Pridoli (Silurian) to Lochkovian (Early Devonian) conodonts and the Silurian-Devonian boundary interval in the Decatur Limestone and Ross Formation in the Western Valley of Tennessee, USA. *Stratigraphy*, 19 (1): 1–25.
- BARRICK, J. E., KLEFFNER, M. A., GIBSON, M. A., PEAVEY, F. N. and KARLSSON, H. R., 2010b. The mid-Ludfordian Lau Event and carbon isotope excursion (Ludlow, Silurian) in southern Laurentia—preliminary results. *Bollettino della Società Paleontologica Italiana*, 49: 13–33.
- BARRICK, J. E. and MEYER, B. D., 2019. Silurian-Devonian conodont biostratigraphy in the southern Midcontinent region of North America. In: Ruppel, S.C., Ed., *Anatomy of a Paleozoic Basin: The Permian Basin, USA*, 1, 137–165. The University of Texas at Austin, Bureau of Economic Geology, Report of Investigation 285; American Association of Petroleum Geologists, Memoir, 118.
- BARRICK, J. E., MEYER, B. D. and RUPPEL, S. C., 2005. The Silurian-Devonian boundary and the Klonk event in the Frame Formation, subsurface west Texas. *Bulletins of American Paleontology*, 369: 105–122.
- BARRICK, J. E., SUNDGREN, J. R. and MCADAMS, N. E. B., 2021. Endemic earliest Lochkovian species of *Caudicriodus* (conodont) from southern Laurentia and the Silurian-Devonian boundary. *Papers in Palaeontology*, 7 (3): 1585–1600.
- BASSLER, R. S., 1925. Classification and stratigraphic use of the conodonts. *Geological Society of America, Bulletin*, 36: 218–220.
- BISCHOFF, G. and ZIEGLER, W., 1957. Die Conodonten-chronologie des Mitteldevons und des tiefsten Oberdevons. *Abhandlungen des Hessischen Landesamtes für Bodenforschung*, 136 pp.
- BOUCOT, A. J., 1999. Some Wenlockian-Gedinnian, chiefly brachiopod dominated, communities of North America. In: Boucot, A. J. and Lawson, J. D., Eds., *Palaeocommunities: A case study from the Silurian and Lower Devonian*, 549–591. Cambridge: Cambridge University Press.
- BRANSON, E. B., 1938. *Stratigraphy and paleontology of the Lower Mississippian of Missouri, Part I*. The University of Missouri Studies, 13 (3): 205 pp.
- BRANSON, E. B. and BRANSON, C. C., 1947. Lower Silurian conodonts from Kentucky. *Journal of Paleontology*, 21: 549–556.

- BRANSON, E. B. and MEHL, M. G., 1933. Conodonts from the Bainbridge (Silurian) of Missouri. *The University of Missouri Studies*, 8: 39–52.
- CAMPBELL, K. S. W., 1967. *Trilobites of the Henryhouse Formation (Silurian) in Oklahoma*. Oklahoma Geological Survey, Bulletin, 115: 68 pp.
- , 1977. *Trilobites of the Haragan, Bois d'Arc and Frisco formations (Early Devonian), Arbuckle Mountains region, Oklahoma*. Oklahoma Geological Survey, Bulletin, 123: 227 pp.
- CARLS, P., SLAVÍK, L. and VALENZUELA-RÍOS, J. I., 2005. A new Ludlow (Late Silurian) Spathognathodontidae (Conodonta) from Bohemia with incipient alternating denticulation. *Neues Jahrbuch für Geologie und Paläontologie - Monatshefte*, 2005 (9): 547–564.
- , 2007. Revisions of conodont biostratigraphy across the Silurian-Devonian boundary. *Bulletin of Geosciences*, 82: 145–164.
- COOPER, B. J., 1975. Multielement conodonts from the Brassfield Limestone (Silurian) of southern Ohio. *Journal of Paleontology*, 49: 984–1008.
- , 1976. Multielement conodonts from the St. Clair limestone (Silurian) of southern Illinois. *Journal of Paleontology*, 50: 205–217.
- CORRADINI, C. and CORRIGA, M. G., 2010. Silurian and lowermost conodonts from the Passo Volaja area (Carnic Alps, Italy). *Bollettino della Società Paleontologica Italiana*, 49: 237–253.
- , 2012. A Přidoli–Lochkovian conodont zonation in Sardinia and the Carnic Alps: implications for a global zonation scheme. *Bulletin of Geosciences*, 87: 635–650.
- CORRADINI, C., CORRIGA, M. G., MÄNNIK, P. and SCHÖNLAUB, H. P., 2014. Revised conodont biostratigraphy of the Cellon section (Silurian, Carnic Alps). *Lethaia*, 48 (1): 56–71.
- CORRADINI, C., CORRIGA, M. G., PONDRELLI, M., SERVENTI, P., SIMONETTO, L. and FERRETTI, A., 2019. Lochkovian (Lower Devonian) marine deposits from the Rio Malinfier West section (Carnic Alps, Italy). *Italian Journal of Geosciences*, 138 (2): 153–170.
- CORRADINI, C., HENDERSON, C., BARRICK, J. E. and FERRETTI, A., 2024. Conodont biostratigraphy. A 300-million-years long journey through geologic time. *Newsletters on Stratigraphy*. DOI [10.1127/nos/2024/0822](https://doi.org/10.1127/nos/2024/0822)
- CRAMER, B. D., BRETT, C. E., MELCHIN, M. J., MÄNNIK, P., KLEFFNER, M. A., MCLAUGHLIN, P. I., LOYDELL, D. K., MUNNECKE, A., JEPPSSON, L., CORRADINI, C., BRUNTON, F. R. and SALTZMAN, M. R., 2011. Revised correlation of Silurian Provincial series of North America with global and regional chronostratigraphic units and $\delta^{13}\text{C}$ carb chemostratigraphy. *Lethaia*, 44 (2): 185–202.
- DeKOSTER, R., 2021. “Revision of the trilobites of the Silurian Henryhouse Formation of Oklahoma.” Unpublished M.Sc. thesis, University of Iowa, Iowa City, 260 pp. <https://doi.org/10.17077/etd.005912>.
- DONOGHUE, P. C. J., PURNELL, M. A., ALDRIDGE, R. J. and ZHANG, S., 2008. The interrelationships of ‘complex’ conodonts (vertebrata). *Journal of Systematic Palaeontology*, 6 (2): 119–153.
- DRYGANT, D. M., 1974. Simple conodonts of the Silurian and lowermost Devonian of the Volyn-Podolian area. *Paleontologeskij Sbornik*, 10: 64–70. [in Russian].
- DRYGANT, D. M. and SZANIAWSKI, H., 2012. Lochkovian conodonts from Podolia, Ukraine, and their stratigraphic significance. *Acta Palaeontologica Polonica*, 57: 833–861.
- DZIK, J., 1976. Remarks on the evolution of Ordovician conodonts. *Acta Palaeontologica Polonica*, 23: 51–72.
- , 2002. Emergence and collapse of the Frasnian conodont and ammonoid communities in the Holy Cross Mountains, Poland. *Acta Palaeontologica Polonica*, 47: 565–650.
- ETHINGTON, R. L., 1959. Conodonts of the Galena Formation. *Journal of Paleontology*, 33: 257–292.
- FREST, T. J., BRETT, C. E. and WITZKE, B. J., 1999. Caradocian–Gedinnian echinoderm associations of central and eastern North America. In: Boucot, A. J. and Lawson, J. D., Eds., *Palaeocommunities: A case study from the Silurian and Lower Devonian*, 638–783. Cambridge: Cambridge University Press.
- GÓMEZ, M. J., MESTRE, A., CORRADINI, C. and HEREDIA, S., 2021. A new species, *Ozarkodina huenicken*, from the upper Silurian-Lower Devonian in San Juan Precordillera, South America. *Journal of South American Earth Sciences*, 108: 103174.
- HASS, W. H., 1959. Conodonts from the Chappel Limestone of Texas. *US Geological Survey, Professional Paper*, 294-J: 365–400.
- HELFRICH, C. T., 1978. A conodont fauna from the Keyser Limestone of Virginia and West Virginia. *Journal of Paleontology*, 52: 1133–1142.
- INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE, 2000. *International Code of Zoological Nomenclature*. Fourth edition. London: International Trust for Zoological Nomenclature. 273 pp. <https://www.iczn.org/the-code/the-code-online/>
- JACOBI, D. J., BARRICK, J. E., KLEFFNER, M. A. and KARLSSON, H. R., 2009. Stable isotope chemostratigraphy and conodont biostratigraphy across the Silurian-Devonian boundary in southwestern Laurentia. *Paleontographica Americana*, 63: 9–31.
- JAROCHOWSKA, E. and MUNNECKE, A., 2016. Late Wenlock carbon isotope excursions and associated conodont fauna in the Podlasie Depression, eastern Poland: A not-so-big crisis? *Geological Journal*, 51 (5): 683–703.
- JEPPSSON, L., 1969. Notes on some Upper Silurian multielement conodonts. *Geologiska Föreningen i Stockholm Förhandlingar*, 91 (1): 12–24.
- , 1972. Some Silurian conodont apparatuses and possible conodont dimorphism. *Geologica et Palaeontologica*, 6: 51–69.
- , 1975 (imprint 1974). *Aspects of Late Silurian conodonts. Fossils and Strata*, Oslo: Universitetsforlaget, 79 pp.
- , 1983a. Silurian conodont faunas from Gotland. *Fossils and Strata*, 15: 121–144. Oslo: Universitetsforlaget.
- , 1983b. Simple-cone studies: some provocative thoughts. *Fossils and Strata*, 15: 86.
- , 1989. Latest Silurian conodonts from Klonk, Czechoslovakia. *Geologica et Palaeontologica*, 23: 21–37.

- , 1990. An oceanic model for lithological and faunal changes, tested on the Silurian record. *Journal of the Geological Society*, 147 (4): 663–674.
- JEPPSSON, L. and ALDRIDGE, R. J., 2000. Ludlow (late Silurian) oceanic episodes and events. *Journal of the Geological Society, London*, 157 (6): 1137–1148.
- JEPPSSON, L., ERIKSSON, M. E. and CALNER, M., 2006. A latest Llandovery to latest Ludlow high-resolution biostratigraphy based on the Silurian of Gotland—A summary. *GFF*, 128 (2): 109–114.
- JEPPSSON, L., TALENT, J. A., MAWSON, R., SIMPSON, A. J., ANDREW, A. S., CALNER, M., WHITFORD, D. J., TROTTER, J. A., SANDSTRÖM, O. and CALDON, H.-J., 2007. High-resolution Late Silurian correlations between Gotland, Sweden, and the Broken River region, NE Australia: lithologies, conodonts, and isotopes. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 245 (1-2): 115–137.
- JONES, D., PURNELL, M. A. and VON BITTER, P. H., 2009. Morphological criteria for recognizing homology in isolated skeletal elements: comparison of traditional and morphometric approaches in conodonts. *Palaeontology*, 52 (6): 1243–1256.
- KHODALEVICH, A. N. and TSCHERNICH, V. V., 1973. New subfamily Belodellinae (Conodont). *Trudy Sverdlovskogo Gornogo Instituta*, 93: 42–47. [in Russian].
- KLAPPER, G. and BARRICK, J. E., 1983. Middle Devonian (Eifelian) conodonts from the Spillville Formation in northern Iowa and southern Minnesota. *Journal of Paleontology*, 57: 1212–1243.
- KLAPPER, G. and MURPHY, M. A., 1975 (imprint 1974). *Silurian–Lower Devonian conodont sequence in the Roberts Mountains Formation of central Nevada*, Berkeley: University of California, Publications in Geological Sciences, 111: 62 pp.
- KLAPPER, G. and PHILIP, G. M., 1971. Devonian conodont apparatuses and their vicarious skeletal elements. *Lethaia*, 4 (4): 429–452.
- LINDSTRÖM, M., 1970. A suprageneric taxonomy of conodonts. *Lethaia*, 3 (4): 427–445.
- LUNDIN, R. F., 1965. *Ostracodes of the Henryhouse Formation (Silurian) in Oklahoma*. Oklahoma Geological Survey, Bulletin, 108: 104 pp.
- , 1968. *Ostracodes of the Haragan Formation (Devonian) in Oklahoma*. Oklahoma Geological Survey, Bulletin, 116: 121 pp.
- MANDA, Š., SLAVÍK, L., ŠTORCH, P., TASÁRYOVÁ, Z. and ČÁP, P., 2023. Division of Přidolí Series in Central Bohemia: graptolite and conodont biostratigraphy, faunal changes, and geochemical record. *Newsletters on Stratigraphy*, 56 (1): 89–123.
- MÄNNIK, P., 1994. Conodonts from the Pusku Quarry, Lower Llandovery, Estonia. *Proceedings of the Academy of Sciences of Estonia, Geology*, 43 (4): 183–191.
- MAXWELL, R. A., 1936. “The stratigraphy and areal distribution of the ‘Hunton Formation’.” Summaries of Doctoral dissertations, Northwestern University, 4: 131–136 [Summary of 1931 unpublished thesis, Northwestern University, Evanston, Illinois].
- MCADAMS, N. E. B., CRAMER, B. D., BANCROFT, A. M., MELCHIN, M. J., DEVERA, J. A. and DAY, J. E., 2018. Integrated $\delta^{13}\text{C}_{\text{carb}}$, conodont, and graptolite biochemostratigraphy of the Silurian from the Illinois Basin and stratigraphic revision of the Bainbridge Group. *GSA Bulletin*, 131 (1-2): 335–352.
- MCCRACKEN, A. D. and BARNES, C. R., 1981. Conodont biostratigraphy and paleoecology of the Ellis Bay Formation, Anticosti Island, Quebec, with special reference to Late Ordovician–Early Silurian chronostratigraphy and the systemic boundary. *Geological Survey of Canada, Bulletin*, 329 (part 2): 51–134.
- MELCHIN, M. J., SADLER, P. M. and CRAMER, B. D., 2020. The Silurian period. In: Gradstein, F. M., Ogg, J. G., Schmitz, M. D. and Ogg, G. M., Eds., *Geologic Time Scale 2020*, 695–732. Amsterdam: Elsevier.
- MILLER, C. G. and ALDRIDGE, R. J., 1997. *Ozarkodina remscheldensis* plexus conodonts from the upper Ludlow (Silurian) of the Welsh Borderland and Wales. *Journal of Micropalaeontology*, 16 (1): 41–49.
- MÜLLER, K. J. and MÜLLER, E. M., 1957. Early Upper Devonian (Independence) conodonts from Iowa, Part 1. *Journal of Paleontology*, 31: 1069–1108.
- MURDOCK, D. J. E., SANSOM, I. J. and DONOGHUE, P. C. J., 2013. Cutting the first ‘teeth’: a new approach to functional analysis of conodont elements. *Proceedings of the Royal Society B: Biological Sciences*, 280 (1768): 20131524. <http://dx.doi.org/10.1098/rspb.2013.1524>
- MURDOCK, D. J. E. and SMITH, M. P., 2021. *Panderodus* from the Waukesha lagerstätte of Wisconsin, USA: a primitive macrophagous vertebrate predator. *Papers in Palaeontology*, 7 (4): 1977–1993.
- MURPHY, M. A., 2016. *Cypricriodus hesperius (Klapper and Murphy, 1975) taxonomy and biostratigraphy*. Riverside: University of California, Riverside, Campus Museum Contributions, 8: 27 pp.
- MURPHY, M. A. and VALENZUELA-RÍOS, J. I., 1999. *Lanea* new genus, lineage of Early Devonian conodonts. *Bollettino della Società Paleontologica Italiana*, 37: 321–334.
- MURPHY, M. A., VALENZUELA-RÍOS, J. I. and CARLS, P., 2004. *On classification of Přidolí (Silurian)–Lochkovian Spathognathodontidae (conodonts)*. Riverside: University of California, Riverside Campus Museum Contribution, 6: 25 pp.
- OLIVER, W. A., Jr, 1999. The principal Pridolian and Lochkovian rugose coral assemblages or communities in eastern North America. In: Boucot, A. J. and Lawson, J. D., Eds., *Palaecommunities: A case study from the Silurian and lower Devonian*, 800–805. Cambridge: Cambridge University Press.
- PANDER, C. H., 1856. *Monographie der fossilen Fische des Silurischen System der Russisch-Baltischen Gouvernements*. St. Petersburg: Buchdruckerei Kaiserlichen Akademie des Wissenschaften, 91 pp.
- PEAVEY, F. N. R., 2013. “Review, revision, and paleobiogeography of Ludlow (Silurian) to Lochkovian (Devonian) spathognathodontid conodont taxa.” Unpublished Ph.D. dissertation, Texas Tech University, Lubbock, 121 pp.
- REEDS, C. A., 1911. The Hunton Formation of Oklahoma. *American Journal of Sciences*, 4th series, 32: 256–268.
- REXROAD, C. B., 1967. *Stratigraphy and conodont paleontology of the Brassfield (Silurian) in the Cincinnati Arch Area*. Indiana Geological Survey Bulletin, 36: 64 pp.

- REXROAD, C. B. and CRAIG, W. W., 1971. Restudy of conodonts from the Bainbridge Formation (Silurian) at Lithium, Missouri. *Journal of Paleontology*, 45: 684–703.
- RHODES, F. H. T., 1953. Some British lower Palaeozoic conodont faunas. *Royal Society of London Philosophical Transactions, Series B*, 237: 261–334.
- SALTZMAN, M. R., 2001. Silurian $\delta^{13}\text{C}$ stratigraphy: a view from North America. *Geology*, 29 (8): 671–674.
- , 2002. Carbon isotope ($\delta^{13}\text{C}$) stratigraphy across the Silurian–Devonian transition in North America: evidence for a perturbation of the global carbon cycle. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 187 (1–2): 83–100.
- SANSOM, I. J., ARMSTRONG, H. A. and SMITH, M. P., 1994. The apparatus architecture of *Panderodus* and its implications for coniform conodont classification. *Palaeontology*, 37: 781–799.
- SANSOM, I. J. and SMITH, M. P., 2004. Late Ordovician vertebrates from the Bighorn Mountains of Wyoming, USA. *Palaeontology*, 48 (1): 31–48.
- SIMPSON, A., 2003. A new subspecies of the conodont genus *Ozarkodina* and its correlative value. *Courier Forschungsinstitut Senckenberg*, 245: 75–81.
- SLAVÍK, L. and CARLS, P., 2012. Post-Lau Event (late Ludfordian, Silurian) recovery of conodont faunas of Bohemia. *Bulletin of Geosciences*, 87: 815–832.
- SLAVÍK, L., KRÍŽ, J. and CARLS, P., 2010. Reflection of the mid-Ludfordian Lau Event in conodont faunas of Bohemia. *Bulletin of Geosciences*, 85: 395–414.
- SPIRIDONOV, A., SAMSONÉ, J., BRAZAUSKAS, A., STANKEVIČ, R., MEIDLA, T., AINSAAR, L. and RADZEVIČIUS, S., 2020a. Quantifying the community turnover of the uppermost Wenlock and Ludlow (Silurian) conodonts in the Baltic Basin. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 549: 109–128.
- SPIRIDONOV, A., STANKEVIČ, R., GEČAS, T., ŠILINSKAS, T., BRAZAUSKAS, A., KAMINSKAS, D., MUSTEIKIS, P., TOMAS KAVECKAS, T., MEIDLA, T., BICKAUSKAS, G., AINSAAR, L. and RADZEVIČIUS, S., 2020b. Ultra-high resolution multivariate record and multiscale causal analysis of Pridoli (late Silurian): implications for global stratigraphy, turnover events, and climate-biota interactions. *Gondwana Research*, 86: 222–249.
- SPIRIDONOV, A., STANKEVIČ, R., GEČAS, T., ŠILINSKAS, T., BRAZAUSKAS, A., MEIDLA, T., AINSAAR, L., MUSTEIKIS, P. and RADZEVIČIUS, S., 2017. Integrated record of Ludlow (Upper Silurian) oceanic geobioevents—Coordination of changes in conodont, and brachiopod faunas, and stable isotopes. *Gondwana Research*, 51: 272–288.
- STANLEY, T. M., 2001. *Stratigraphy and facies relationships of the Hunton Group, northern Arbuckle Mountains and Lawrence Uplift, Oklahoma*. Oklahoma Geological Survey, Guidebook, 33: 73 pp.
- STRIMPLE, H. L., 1963. *Crinoids of the Hunton Group*. Oklahoma Geological Survey, Bulletin, 100: 169 pp.
- SUTHERLAND, P. K., 1965. *Rugose corals of the Henryhouse Formation (Silurian) in Oklahoma*. Oklahoma Geological Survey, Bulletin, 109: 92 pp.
- SUTTNER, T. J., 2007. *Conodont stratigraphy, facies-related distribution patterns and stable isotopes (carbon and oxygen) of the uppermost Silurian to Lower Devonian Seewarte section (Carnic Alps, Carinthia, Austria)*. Abhandlungen der Geologischen Bundesanstalt, 59: 111 pp.
- SWEET, W. C., 1988. *The Conodonta: Morphology, Taxonomy, Paleocology, and evolutionary history of a long-extinct animal phylum*. Oxford Monographs on Geology and Geophysics, 10. New York, Oxford: Clarendon Press, 212 pp.
- TALENT, J. A., SIMPSON, A. J., MOLLOU, P. D. and MAWSON, R., 2005. Conodonts from the Wombat Creek Group and “Wibenduck Limestone” (Silurian) of eastern Australia. *Proceedings of the Royal Society of Victoria*, 115: 265–291.
- THEILING, B. P., ELRICK, M. and ASMEROM, Y., 2017. Constraining the timing and provenance of trans-Laurentian transport using Nd and Sm isotopes from Silurian and Devonian marine carbonates. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 466: 392–405.
- THEILING, B. P., 2013. “Orbital-scale fluctuations in Continental Weathering Flux and Continental Ice-volume during Greenhouse and Icehouse climate intervals: Evidence from oxygen and neodymium isotopes.” Unpublished Ph.D. dissertation, University of New Mexico, New Mexico, 125 pp.
- UYENO, T. T., 1980. *Stratigraphy and conodonts of Upper Silurian and Lower Devonian rocks in the environs of the Boothia Uplift, Canadian Arctic Archipelago. Part Two: Systematic study of conodonts*. Geological Survey of Canada Bulletin, 292: 39–75.
- UYENO, T. T. and BARNES, C. R., 1983. *Conodonts of the Jupiter and Chicotte formations (Lower Silurian), Anticosti Island, Québec*. Geological Survey of Canada Bulletin, 355: 49 pp.
- VACEK, F., SLAVÍK, L., SOBIENÍ, K. and ČÁP, P., 2018. Refining the late Silurian sea-level history of the Prague Syncline—A case study based on the Pridoli GSSP (Czech Republic). *Facies*, 64 (4): 1–16.
- VIIRA, V., 1983. Upper Silurian *Spathognathodus* (Conodonts) of the East Baltic (Ohesaare, Kunkoai, Ukmerge, etc. borings). In: Klaamann, E., Ed., *Paleontology of the early Paleozoic of the East Baltic and Podolia*, 41–71. Tallinn: Academy of Science of the Estonian Institute of Geology. [in Russian].
- , 2000. Latest Silurian (Ohesaare Stage) conodonts and the *detorta* Zone in the northern East Baltic. *Proceedings of the Estonian Academy of Sciences Geology*, 49 (1): 44–62.
- VIIRA, V. and ALDRIDGE, R. J., 1998. Upper Wenlock to Lower Pridoli (Silurian) conodont biostratigraphy of Saaremaa, Estonia, and a correlation with Britain. *Journal of Micropalaeontology*, 17 (1): 33–50.
- WAID, C. B. T. and CRAMER, B. D., 2017. Telychian (Llandovery, Silurian) conodonts from the LaPorte City Formation of eastern Iowa, USA (East-Central Iowa Basin) and their implications for global Telychian conodont biostratigraphic correlation. *Palaeontologia Electronica*, 20 (2): 20.2.39A.
- WALLISER, O. H., 1964. *Conodonten des Silurs*. Hessisches Land-samtes für Bodenforschung, Abhandlungen, 41: 106 pp.
- ZHANG, S. and BARNES, C. R., 2002. *A new Llandovery (Early Silurian) conodont biozonation and conodonts from the Becscie, Merrimack, and Gun River formations, Anticosti Island, Québec*. The Paleontological Society Memoir, 57: 46 pp.

———, 2004. Conodont bio-events, cladistics and response to glacio-eustasy, Ordovician-Silurian boundary through Llandovery, Anticosti Basin, Québec. *Geological Society, London, Special Publications*, 230 (1): 73–104.

ZIEGLER, W., 1960. Conodonten aus dem Rheinischen Unterdevon (Gedinnium) des Remscheider Sattels (Rheinisches Schiefergebirge). *Paläontologische Zeitschrift*, 34 (2): 169–201.

LOCALITY APPENDIX:

Ca2 section (34°21'08.08"N; 97°08'43.37"W).

I35 section (34°21'10.16"N, 97°08'59.47"W).

Hickory Creek (HC) section (34°20'45.44"N; 97°17'01.25"W).

Highway 77 section (34°26'46.53"N, 97°05'08.88"W).

Southwest Davis section (34°28'42"N, 97°10'04"W approximately; subsequent industrial construction has greatly modified this area).

Dougherty West section (34°24'41.71"N, 97° 05'03.92"W).

Goddard Youth Camp (GYC) section (34°25'20.54"N; 96° 59'57.36"W).

P1H section (34°40'12.72"N, 96°41'12.97"W).

910 section (34°39'17.33"N, 96°40'14.47"W).