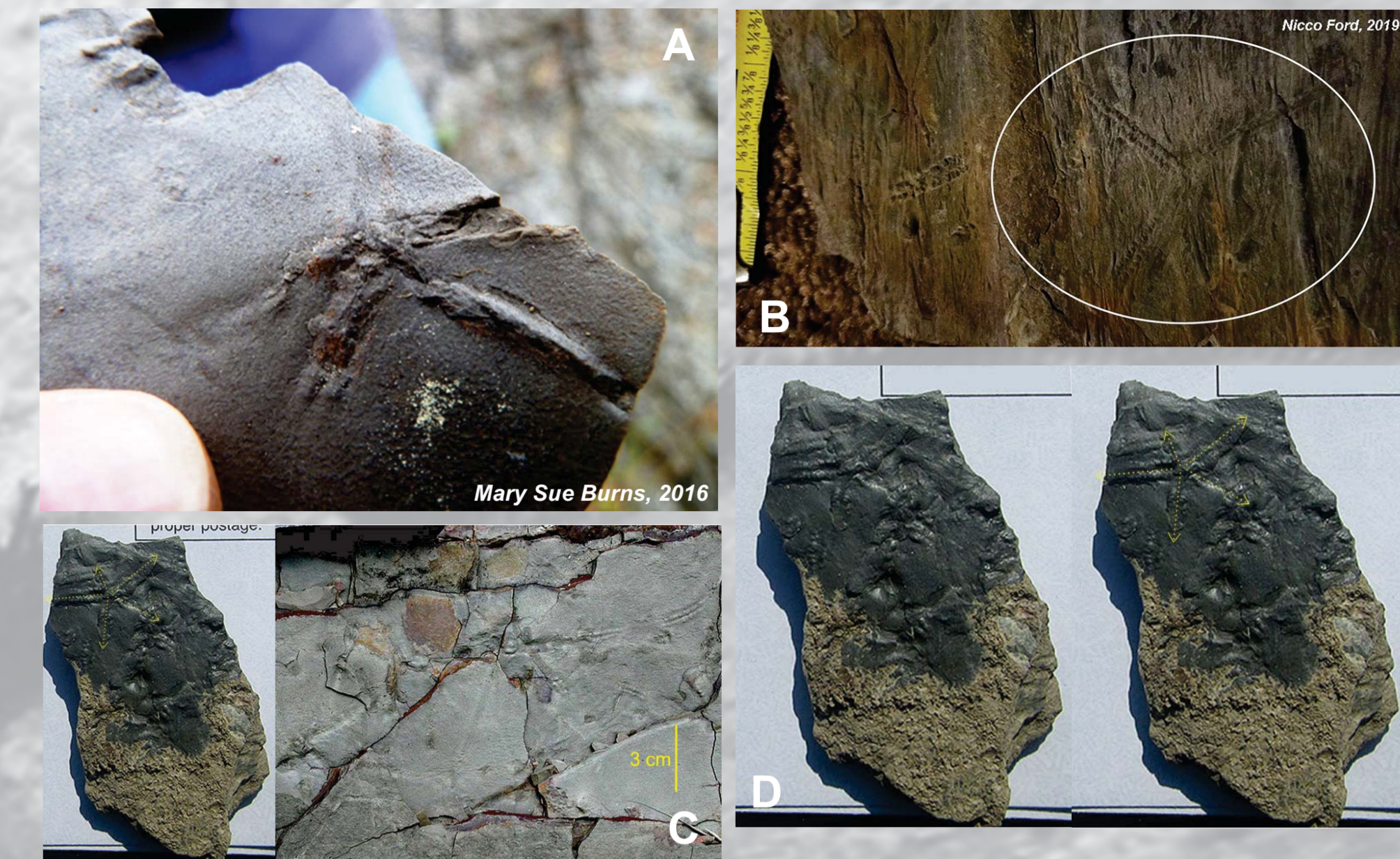
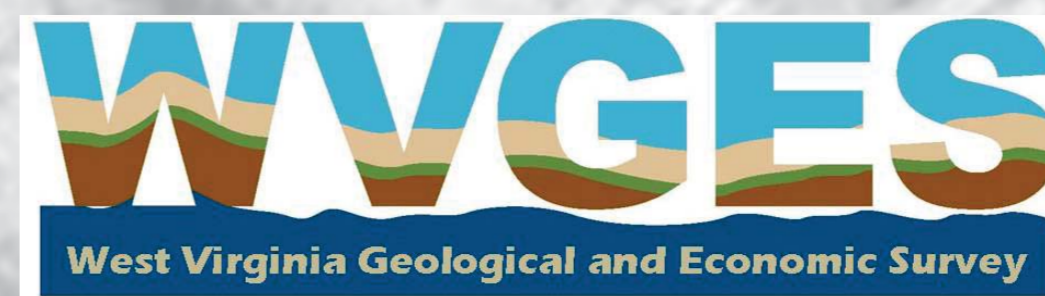


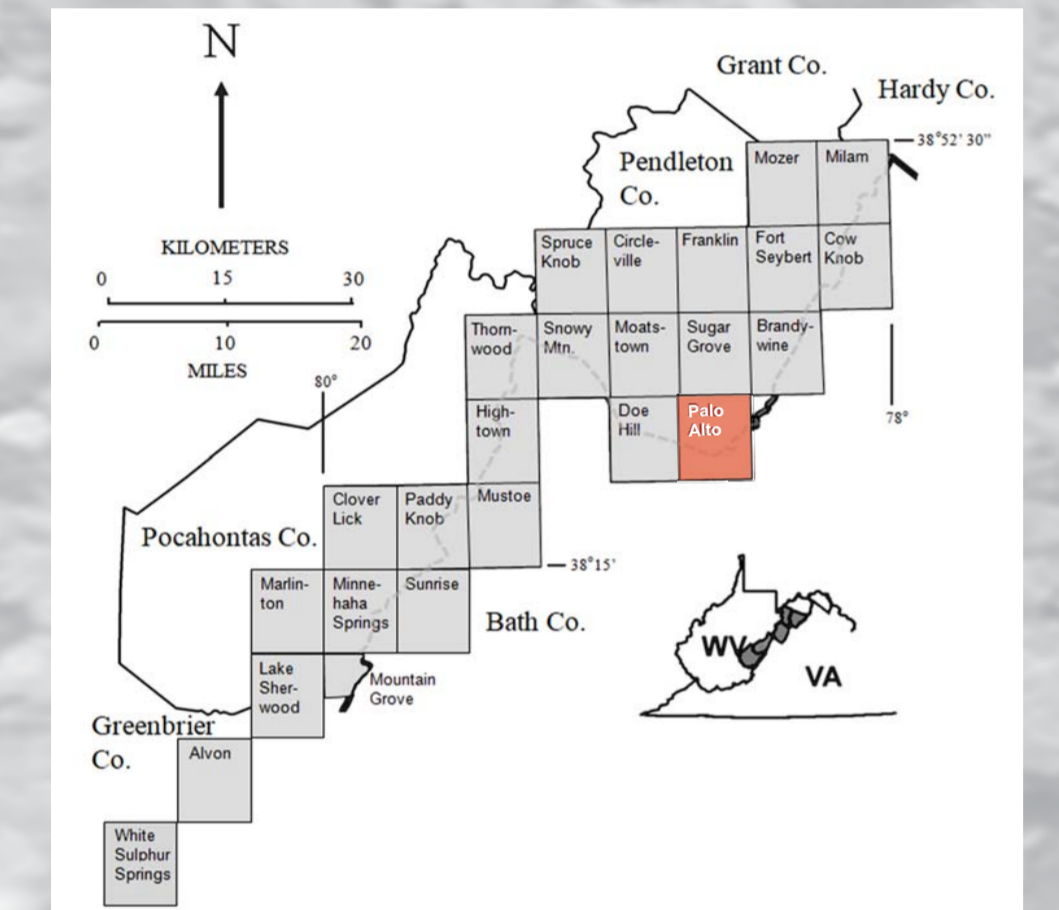
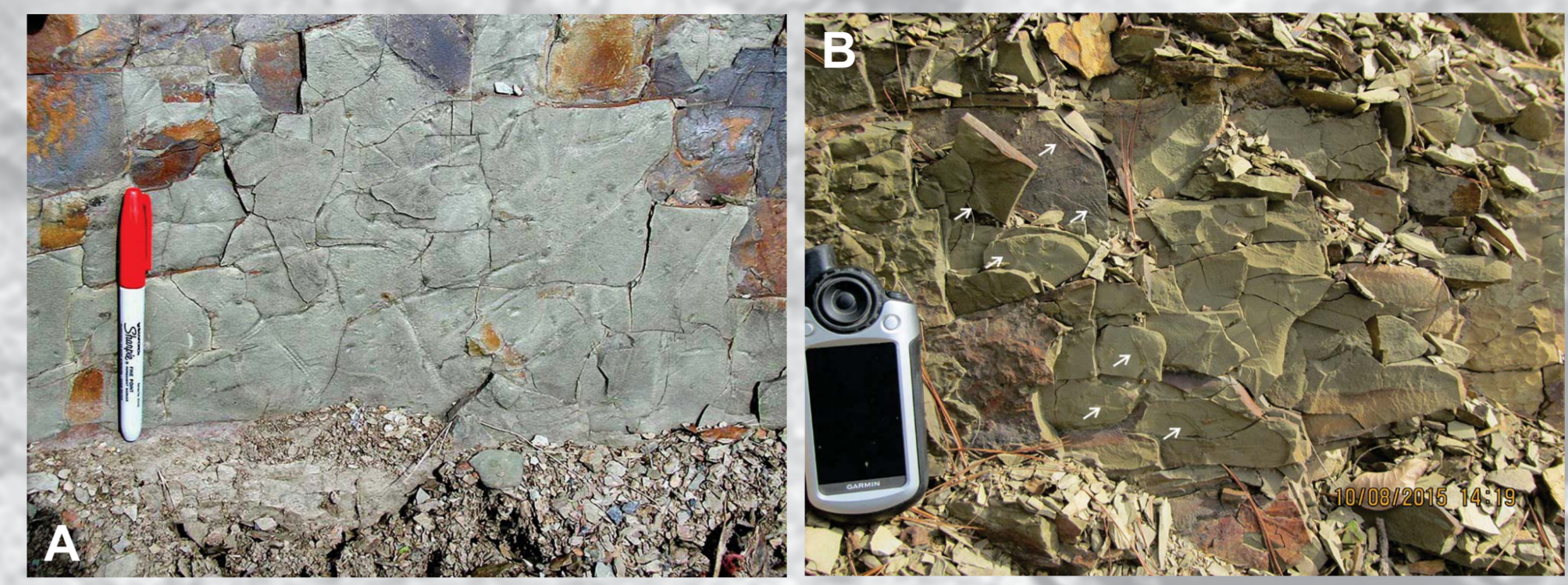
# PTERIDICHNITES BISERIATUS ABUNDANCE ZONE – 25 YEARS ON

MCDOWELL, Ronald<sup>1</sup>, HUNT, Paula J.<sup>1</sup>, BURNS, Mary Sue<sup>2</sup>, AVARY, Katharine L.<sup>3</sup> and BRITTON, James Q.<sup>4</sup>, (1)Geoscience Section, West Virginia Geological Survey, 1 Mont Chateau Road, Morgantown, WV 26508, (2)Pocahontas County High School - Retired, Dunmore, WV 24934, (3)Petroleum Geologist, 98 Rockley Road, Morgantown, WV 26508, (4)Coal Program, West Virginia Geological Survey, 1 Mont Chateau Road, Morgantown, WV 26508



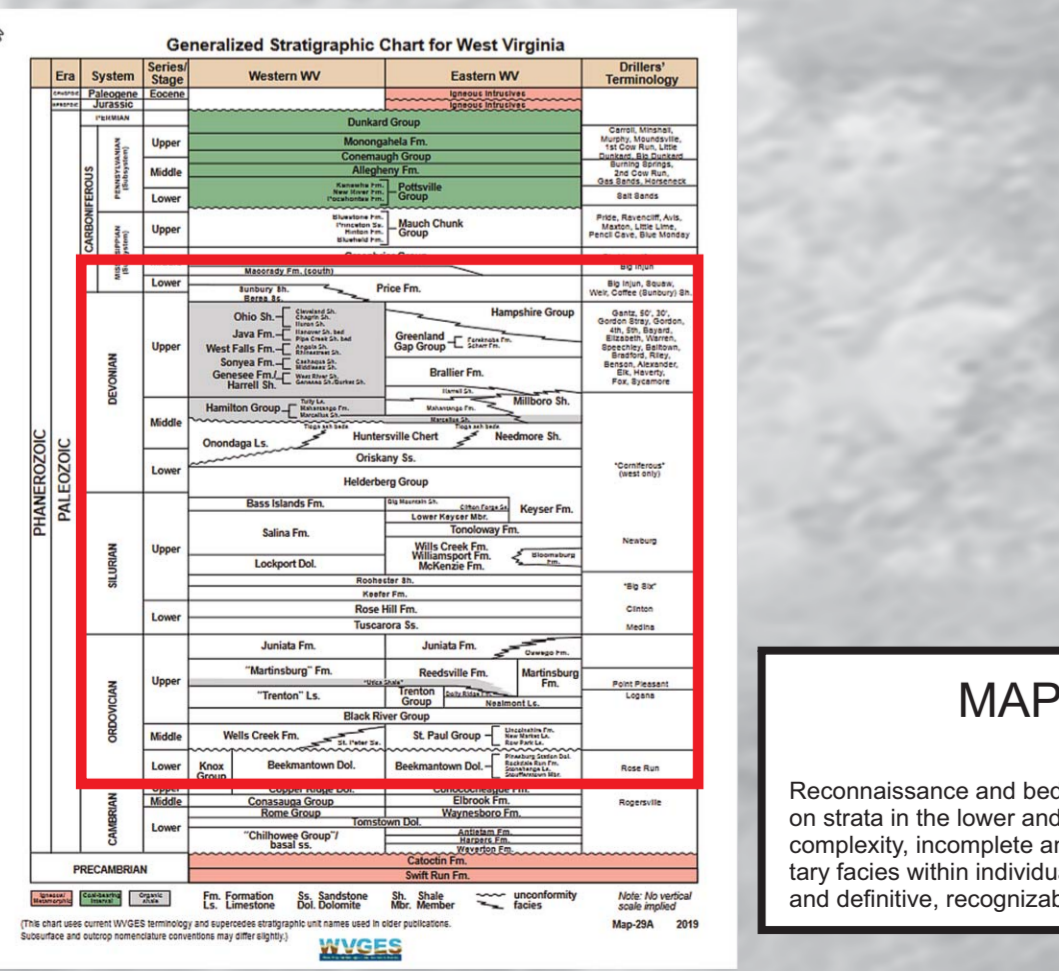
### ABSTRACT

In 1997, geologists from the West Virginia Geological and Economic Survey (WVGES), while performing bedrock mapping in the Devonian strata of Pendleton Co., West Virginia, noticed unusual numbers of the trace fossil, *Pteridichnites biseriatus*, in the lowermost Brallier Formation. Continued work extended the observed stratigraphic range of this trace fossil from the underlying Mahantango Formation, upwards through the Harrell (or Millboro), Brallier, and Foreknobs formations. However, the high abundance of *P. biseriatus* appeared to be restricted to a zone one to two meters above the base of the Brallier. In 2007, WVGES geologists proposed a *Pteridichnites biseriatus* "Abundance Zone" as a stratigraphic marker for the recognition of the Brallier and proximity to its base. Since that time, continued reconnaissance mapping along the eastern border of West Virginia has sought to trace the geographic extent of this biozone and to investigate alternative stratigraphic positions other than the lowermost Brallier. We have been able to recognize or tentatively recognize this "Abundance Zone" along the eastern outcrop belt of the Brallier Formation from Grant and Hardy counties in the north, southwards through Pendleton and Pocahontas counties, to Greenbrier County in the south and westward to Randolph County – a northeast-southwest distance of ~150 Km and an east-west distance of ~75 km. Although structural complexity makes finding continuous stratigraphic sections difficult in eastern West Virginia, the vertical stratigraphic position of the "Abundance Zone" appears consistently near the base of the Brallier. The mappable geographic extent and the consistent stratigraphic position suggest to the authors that formal recognition of this biozone may be warranted. Thus far, no distinctive, visible sedimentary characteristics other than an abundance of a single type of trace fossil have been noted for this biozone. Geochemical samples collected from the biozone may yet yield trends in trace elements or other chemical components of the sediment to help explain the occurrence of this feature. In addition, the extent of this biozone in adjacent states has yet to be investigated.



### STATEMAP PROJECTS ALONG THE BORDER

In 1997, the lead author and colleagues from the West Virginia Geological and Economic Survey (WVGES) began mapping the bedrock along the West Virginia/Virginia border in Pendleton Co., WV. Quadrangle reconnaissance under the auspices of the United States Geological Survey's STATEMAP program began with the Palo Alto 7 1/2 Minute Quadrangle. The location of this Quadrangle and all subsequent mapping projects are shown on the above map.



### MAPPING PALEOZOIC STRATA

Reconnaissance and bedrock mapping along the West Virginia/Virginia border has concentrated on strata in the lower and middle portion of the Paleozoic (outlined in red to the left). Structural complexity, incomplete and poor outcrop exposure, and variations in the expression of sedimentary facies within individual units complicated the recognition of several formations. Marker beds and definitive, recognizable index fossils were frequently lacking in these units.

### DIFFERENTIATING THE UPPER DEVONIAN

Two Upper Devonian units, the Brallier Formation and overlying Foreknobs Formation proved difficult to tell apart, especially in small or poor, discontinuous exposures. Both units contain an abundance of shale of similar color and lithologic character. In fortuitous outcrop exposures, body fossils and a diverse collection of trace fossils can help to identify the Foreknobs. Unfortunately, the Brallier is mostly devoid of body fossils and is not noted for trace fossil content.

In 1997, reconnaissance of exposures of Brallier in Pendleton Co., WV began to yield a peculiar trace fossil that neither the lead author or co-workers had seen before. The fossil was eventually identified as *Pteridichnites biseriatus*. An early work of the Maryland Geological Survey listed *P. biseriatus* as a characteristic fossil of the Jennings Formation (Clarke and Swartz, 1913a, b) which is the stratigraphic equivalent of the Brallier of West Virginia. Additional research and field work extended the stratigraphic range of *P. biseriatus* from the Mahantango Formation to the uppermost Foreknobs Formation. One trend that did begin to emerge was the concentration of relatively large numbers of *P. biseriatus* near the base of the Brallier. The recurrence of this trend in other locations with Pendleton, Randolph, and Pocahontas counties in West Virginia and the consistent positioning of this accumulation of traces near the base of the Brallier led McDowell and others (2007) to suggest that this *P. biseriatus* accumulation might act as a marker for the lowermost Brallier - a *Pteridichnites biseriatus* abundance zone.

Series	Stage	Stratigraphic Units	General Lithology	Occurrence of <i>P. biseriatus</i>	
Devonian	Famennian	Hampshire Formation	Sandstone, red sandstones, shales, and sandstones with occasional plant fossils.	I	
		Foreknobs Formation	Red Lick member		Fossiliferous massive sandstones and sandstones passing into coarsely-grained sandstones.
			Pound member		Compactioned medium to coarse-grained sandstone.
			Blizzard member		Very fossiliferous, massive sandstones, sandstones, and some shales. Several thick sand beds in the middle of the unit.
			Bitter Gap member		Compactioned fine to coarse-grained sandstone.
	Frasnian	Brallier Formation	Mallow member	Fossiliferous massive sandstones and sandstones. Base is marked by first occurrence of corals in coarse sandstone.	
			Harrell Shale	Marine, turbiditic, dark grey to light olive grey shales with unbedded siltstones. Rare acorn-bean fossils.	
			Millboro Shale	Marine, micaceous, black, carbonaceous, silty shale with calcareous lenses and nodules. Contains a large number of acorn-bean fossils.	
			Marcellus Shale	Marine, micaceous, black, carbonaceous, silty shale with calcareous lenses and nodules. Contains a large number of acorn-bean fossils.	
		Acme Zone			II



### WHAT IS PTERIDICHNITES?

A. - a scan of the illustrated type specimen of *Pteridichnites biseriatus* modified from Clarke and Swartz (1913b, Plate XLVI - 6). Specimen is preserved as a cast on the underside of a bed from the Upper Devonian Jennings Formation exposed at Tonoloway, Maryland.

B. - a photo of *Pteridichnites biseriatus* from the Upper Devonian Brallier Formation exposed north of Elkins, West Virginia. Specimen is preserved as a cast on the underside of a bed and has been photographed at the same scale as the illustration of the type specimen.

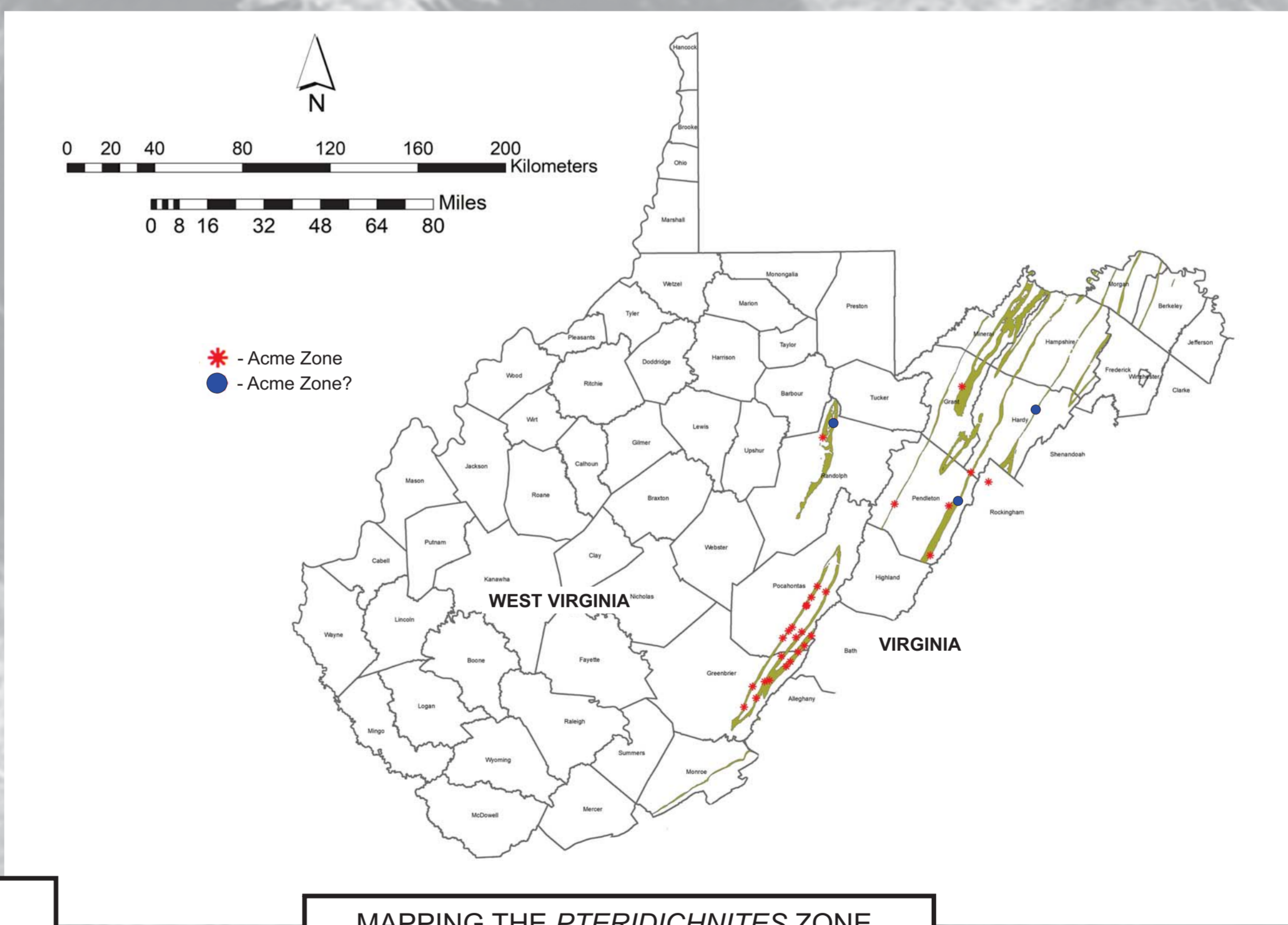
*P. biseriatus* was interpreted as "a crawling trail of arthropod or annelid" (Häntzschel, 1975, p. W99). McDowell and others, 2007 offered an alternative interpretation of *P. biseriatus* as the locomotion or sediment-anchoring efforts of the tube feet of ophiuroids (brittle starfish).

### THE PTERIDICHNITES ABUNDANCE ZONE

The *Pteridichnites biseriatus* abundance zone is exactly as the name implies - a zone of strata marked by the presence of numerous examples of the trace fossil. The zone is never more than one or two meters thick and is typically characterized by thin shale beds with low silt content. This usually produces traces with exceptionally fine preservation of detail.

A. - *P. biseriatus* abundance zone preserved on the bottom of a bedding surface in the lowermost Brallier Formation. Taken near Circleville, WV in Pendleton County, WV - pen is 10 cm in length.

B. - *P. biseriatus* abundance zone preserved on the top of bedding surface in the lowermost Brallier Formation. Taken southeast of Neola, WV in Greenbrier County, WV - GPS unit is 10 cm in length.



### MAPPING THE PTERIDICHNITES ZONE

At the suggestion of one reviewer (John Dennison, 2006) of the paper introducing *P. biseriatus* and discussing its use as a stratigraphic marker (McDowell and others, 2007), geologists mapping in the Devonian of eastern West Virginia have been recording the locations of occurrences of the *Pteridichnites biseriatus* abundance zone whenever encountered during mapping reconnaissance. Shown above is a map of West Virginia and adjacent portions of Virginia with the outcrop pattern of the Upper Devonian Brallier Formation superimposed (Cardwell and others, 2023 rev.) on it. The locations where the *P. biseriatus* abundance zone has positively or tentatively identified have been marked. The geographic range for this zone thus far extends more than 150 Km (95 mi) from northeast to southwest includes six counties in West Virginia and one in Virginia.

### UPDATE ON THE TRACEMAKER!

McDowell and others (2007) broke with Häntzschel (1975) by attributing *Pteridichnites biseriatus* to the activities of an ophiuroid as opposed to an arthropod or annelid. Miller and others (2009) countered that *Pteridichnites* was, in fact, a synonymous form of the trace *Psamminchites*. However, examples of *P. biseriatus* in direct association with specimens exhibiting 5-arm, radial arrangement of impressions very much resemble the imprint of the oral surface of an unknown ophiuroid. The authors of this presentation take that as sufficient evidence of the origin of *P. biseriatus* by brittle star as originally proposed.

A. - an example from the Brallier of Pocahontas Co., WV collected in 2016 by co-author Mary Sue Burns.

B. - photo of a specimen from the Devonian Genesee Group exposed in the Finger Lakes area of NY. Submitted in 2019 by Nicco Ford in response to a WVGES website request for evidence of *P. biseriatus* occurrences.

C. - a 5-arm example from Randolph Co., WV compared to a possible example from Pendleton Co., WV.

D. - an excellent example recovered in 2019 from a Brallier exposure in Randolph Co., WV. Photo without and with enhancement of the 5-arm arrangement.

### DISCUSSION

Over the past twenty-five years, geologists from WVGES have been noting and documenting occurrences of the trace fossil *Pteridichnites biseriatus* in the Devonian strata of eastern West Virginia. The stratigraphic range of the fossil has been extended down into the black shales of Marcellus-equivalent strata but, thus far, has not reached the redbeds of the Hampshire Formation.

The presence of a monogeneric, ichnofossil abundance zone near the base of the Devonian Brallier Formation has been confirmed over a geographic range of greater than 150 Km and covering portions of six counties in eastern West Virginia and a single county in western Virginia. The presence of this abundance zone in other parts of Virginia, Pennsylvania, Maryland, and New York is yet to be verified but the zone is more than a localized facies occurrence and has shown its utility during a number of mapping projects involving Upper Devonian strata.

At present, the Brallier strata within the *P. biseriatus* abundance zone have not yielded any clues as to why this prolific trace-making activity was concentrated within this interval. Not enough geochemical sampling and analyses have been done within the interval to delineate any unusual chemical trends. The fine-grained, clay shale within the interval is not visually different from similar sedimentary layers above and below.

### REFERENCES

Cardwell, D., Erwin, R., and Woodward, H., 2023. Geologic Map of West Virginia-GEMSrev., West Virginia Geological and Economic Survey, MAP-1 revised as GIS product.

Clarke, J. M. and Swartz, C. K., 1913a, Systematic paleontology of the Upper Devonian deposits of Maryland: in Maryland Geological Survey, Middle and Upper Devonian Volume, p. 535-701.

Clarke, J. M. and Swartz, C. K., 1913b, Systematic paleontology of the Upper Devonian deposits of Maryland: in Maryland Geological Survey, Devonian Plates, 156 p.

Häntzschel, W., 1975, Treatise on Invertebrate Paleontology, Part W - Miscellanea, Supplement 1, Trace Fossils and Problematica, The Geological Society of America and The University of Kansas, 269 p.

McDowell, R., Avary, K., Matchen, D., and Britton, J., 2007, The stratigraphic utility of the trace fossil *Pteridichnites biseriatus* in the Upper Devonian of eastern West Virginia and western Virginia, USA: Southeastern Geology, V. 44, No. 4, p. 191-201.

Miller, W., Webb, F., Raymond, L., 2009, "Pteridichnites" (=Psamminchites) from the Upper Devonian Brallier Formation of Southwestern Virginia, USA: Ichnoaxonomic Status, Constructional Morphology, and Paleocology: Southeastern Geology V. 46, # 4, p. 187-99.

### ACKNOWLEDGEMENTS

The authors acknowledge funding from the United States Geological Survey for many years of STATEMAP mapping and research. Matching support from the West Virginia Geological and Economic Survey has always kept the work progressing. The authors would also like to thank a number of people no longer associated with WVGES who worked on these mapping projects in the early years - in particular, Dr. David Matchen and Paula Waggy.

