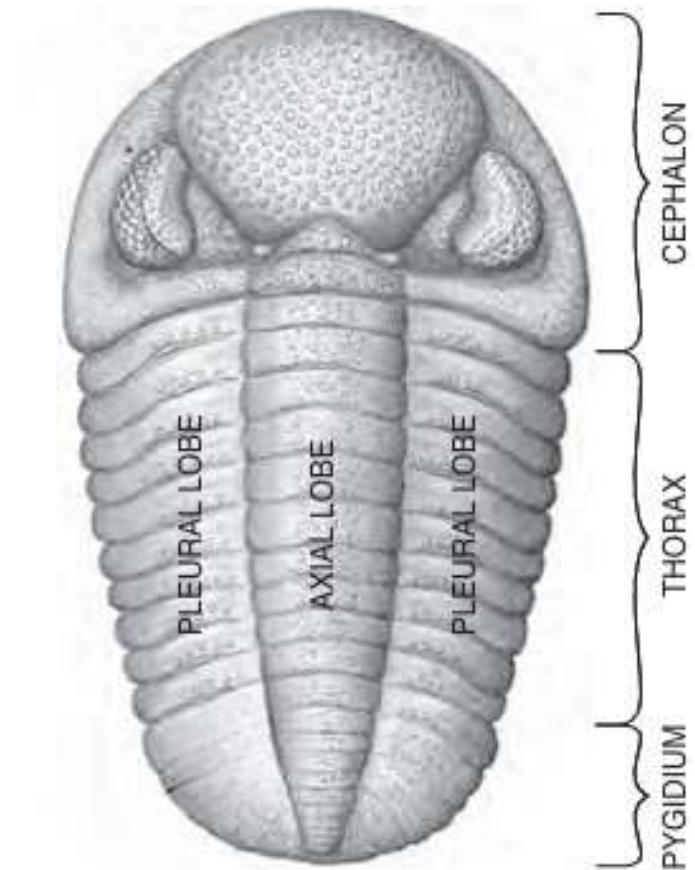


Regional Cincinnati Late Ordovician Trilobite Identification



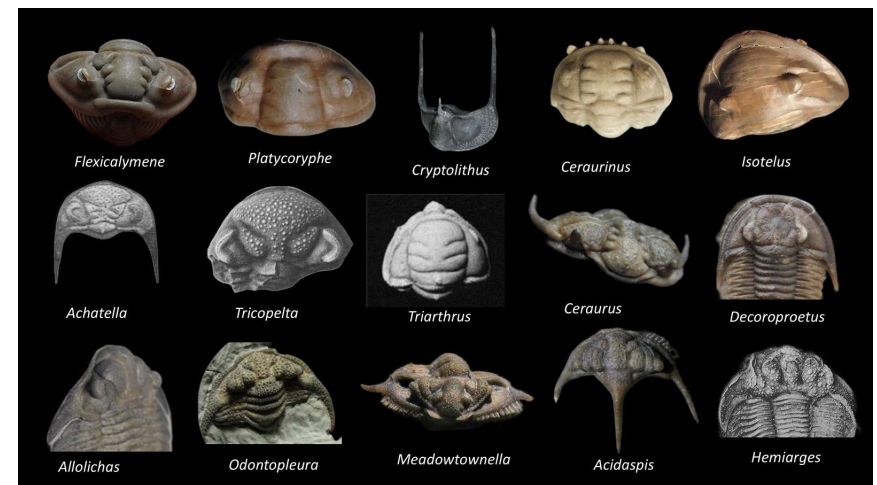
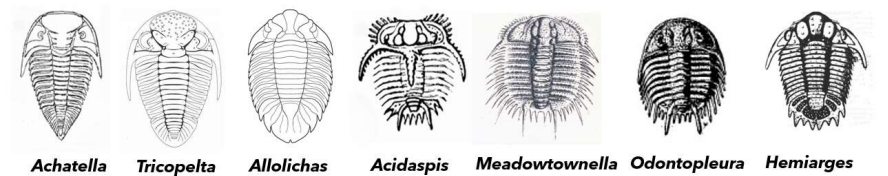
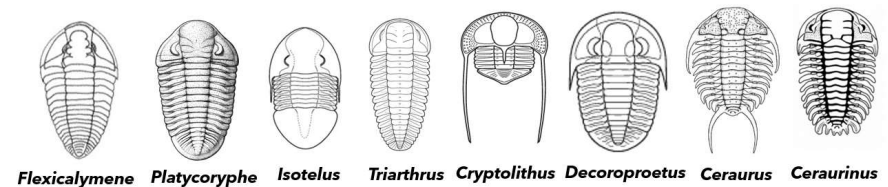
Introduction

- **Guidance is provided identifying regional Cincinnati Late Ordovician trilobites. Fifteen genera are covered. Ten genera have single species while five have multiple species for a total of 24 species.**
- **Trilobites are described first by genus and then species. Trilobite cephalon, thorax, pygidium, and axial/pleural lobe features are used for identification.**



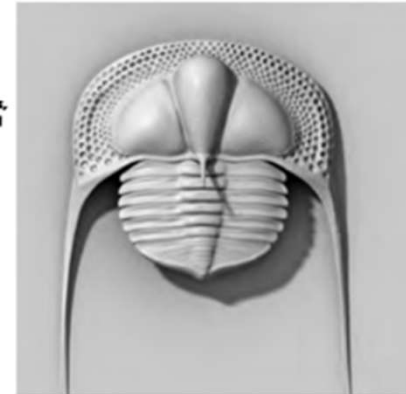
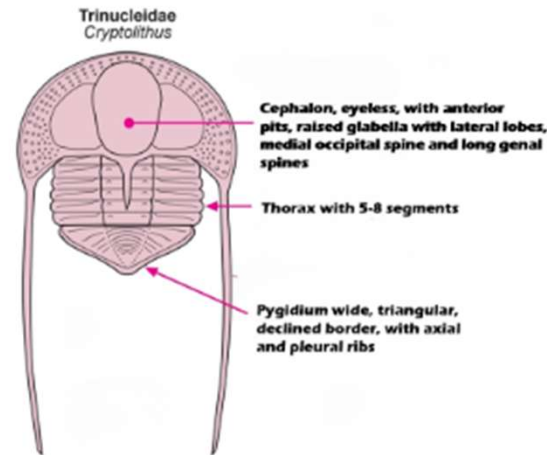
Approach

- **Identification uses several tools:**
 - **Exoskeleton and glabella matrices for identifying regional genera (see adjacent panels). These are readily memorized. Brief descriptions with high-quality reference images are included.**



Approach (Cont'd)

- **Descriptions in a style pioneered by (Gon, 2007) with integrated text, drawings, and photos are provided supplemented with high-quality images of cephalon and exoskeleton**
- **Trilobite cephalon, thorax, pygidium, and axial/pleural lobe features are used for identification**



Approach (Cont'd)

- **Trilobite stratigraphic distribution in lithostratigraphic & sequence stratigraphy formats are provided. Knowing your geologic horizon is the first step in identifying expected trilobite genera**
- **Supplemental Excel spreadsheets are used to relate genus to feature. Useful for examining feature overlap and potential auto-identification**

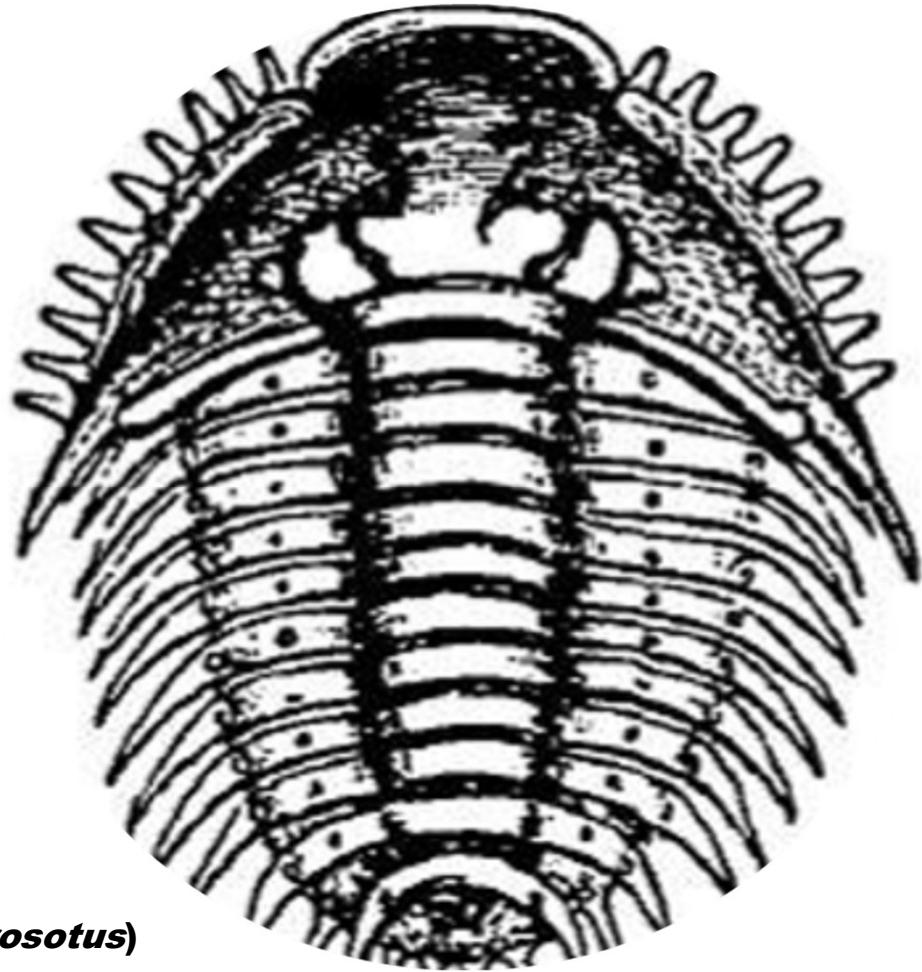
Species	C1	C2	C3	C4	C5	C6	C7	C8
	Edenian	Mayvillian	Mayvillian	Mayvillian	Mayvillian	Mayvillian	Mayvillian	Mayvillian
	Kape	Fairview	Grant Lake	Arnsheim	Waynesville	Liberty	Whitewater	Elkhorn
<i>Alloichas halli</i>			X					
<i>A. harrisi</i>					X			
<i>A. shideleri</i>						X	X	
<i>Hemilarges paulianus</i>						X		
<i>Acidaspis elmslathensis</i>	X	X	X	X	X			
<i>A. n. sp</i>	X							
<i>Meadowtownella cresatus</i>	X							
<i>Odontopleura n.sp</i>					X			
<i>Flexicalymene abbreviata</i>	X							
<i>F. granulosa</i>	X	X						
<i>F. meeki</i>		X	X					
<i>F. retrorsa</i>				X	X			
<i>F. retrorsa minus</i>						S	S	S
<i>Platycoryphe christyi</i>						X		
<i>Tricopelta breviceps</i>					X	X		
<i>Acharitella carterii</i>	X	X						
<i>Ceraurus isarus</i>					X	X	X	
<i>Ceraurus milleranus</i>	X	X	X	X	X			
<i>C. miseneri</i>						X		
<i>Decoroproetus parvusculus</i>	X							
<i>Isotelus maximus</i>	X	X	X	X	X	X	X	X
<i>I. gigas</i>	X	X	X	X	X			
<i>Cryptolithus tessellatus</i>	X							
<i>Triarthrus beckii</i>	X							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1 Feature/Genus	Flexicalymene	Cryptolithus	Platycoryphe	Isotelus	Ceraurus	Triarthrus	Decoroproetus	Ceraurus	Tricopelta	Acharitella	Alloichas	Odontopleura	Meadowtownella	Acidaspis	Hemilarges			
24 Blade-Like															X			
25 Eyes																		
26 Blind		X																
27 Holochroal								X	X									
28 Schizochroal	X	X	X	X	X	X	X			X	X	X	X	X	X			
29 Crescent Shaped	X	X	X	X	X			X	X	X					X			
30 Globose				X								X	X	X				
31 Hypostome																		
32 Natant		X				X												
33 Conterminant	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
34 Thorax																		
35 Number Segments	13	5	10	8	11	15	10	10	11	11	11	10	10	10	11			
36 Blunt Pleura	X	X	X	X														
37 Spiny Pleura					X	X		X	X	X	X	X	X	X	X			
38 Pygidium																		
39 Size																		

Recommended Reading

- **Many unfamiliar terms are used to describe and classify trilobites. If you don't know the meaning of subisopygous, you should probably read the following:**
 - **“A Guide to the Orders of Trilobites” by Samuel M. Gon III. It's freely available online or can be downloaded at <http://www.trilobites.info>. Sections on Glossary of Trilobite Terms, Major Trilobite Features, Trilobite Dorsal and Ventral Morphology, and Pictorial Guide to the Orders of Trilobites are important.**
 - **The internet site <https://trilobite life-trilobite morphology.htm> provides a great glossary of trilobite terminology.**

Section 1 Historical Genera & Species



***Ceraurus crosotus*,**
Locke, 1841
(*Meadowtownella crosotus*)

Starting Point For Defining Current Trilobite Population is Holland's "Stratigraphy and Fossils of the Upper Ordovician near Cincinnati" (<http://stratigrafia.org/cincy/index.html>)

Holland's Original Listing

Lichida

Allolichas
Amphilichas
Acidaspis
Primaspis

Proetida

Decoroproetus

Asaphida

Isotelus
Cryptolithus

Phacopida

Flexicalymene
Gravicalymene
Platycoryphe
Pterygometopus
Tricopelta
Achatella
Ceraurus
Ceraurus

Ptychoparida

Triarthrus

Listing This Report

Lichida

Allolichas
Hemiarges

Odontopleurida

Acidaspis
Meadowtownella
Odontopleura

Phacopida

Flexicalymene
Platycoryphe
Tricopelta
Achatella
Ceraurus
Ceraurus

Proetida

Decoroproetus

Asaphida

Isotelus

Trinucleida

Cryptolithus

Ptychoparida

Triarthrus

*See slide 34 for taxonomic history

Regional Cincinnati **Trilobites - 15 Genera**

- *Cryptolithus*
- *Triarthrus*
- *Platycoryphe*
- *Achatella*
- *Tricopelta*
- *Ceraurinus*
- *Decoroproetus*
- *Meadowtownella*
- *Triarthrus*
- *Isotelus*
- *Flexicalymene*
- *Alloliches*
- *Ceraurus*
- *Hemiarges*
- *Odontopleura*



Genus & Species

Single Species

Genera

- *Cryptolithus*
- *Tricopelta*
- *Achatella*
- *Hemiarges*
- *Platycoryphe*
- *Ceraurinus*
- *Decoroproetus*
- *Triarthrus*
- *Meadowtownella*
- *Odontopleura*

10 Total

Multiple Species

Genera

- *Isotelus* (2)
- *Allolichas* (3)
- *Acidaspis* (2)
- *Flexicalymene* (5)
- *Ceraurus* (2)

5 Total

15 Genera - 24 Species

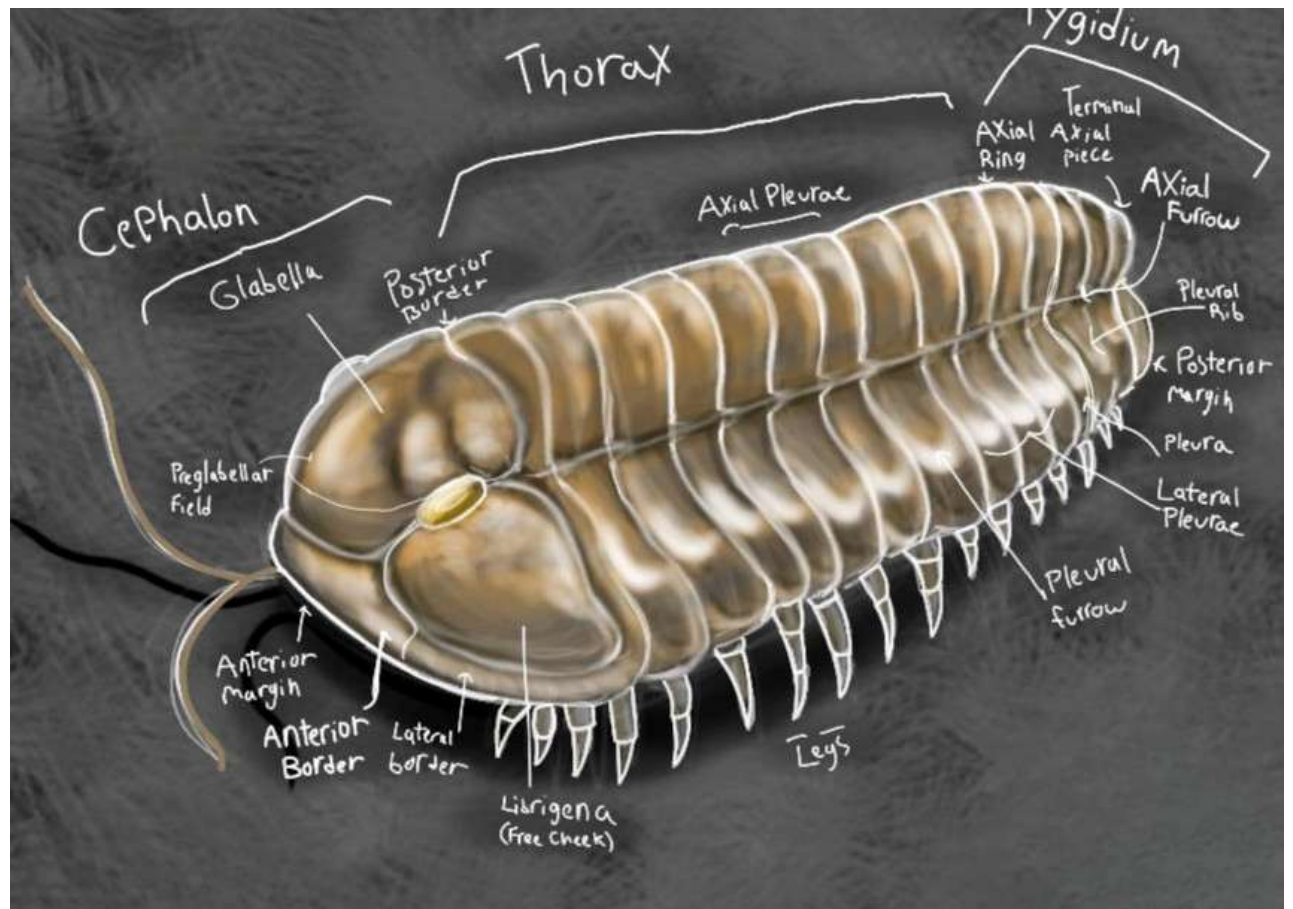
Count	Genus	Species	Species/Genus	Cum Species
1	Isotelus	<i>I. gigas</i> <i>I. maximus</i>	2	2
2	Allolichas	<i>A. halli</i> <i>A. harrisi</i> <i>A. shideleri</i>	3	5
3	Hemiarges	<i>H. cf. paulianus</i>	1	6
4	Acidaspis	<i>A. cincinnati</i> <i>A. n.sp.</i>	2	8
5	Meadowtownella	<i>M. crosotus</i>	1	9
6	Odontopleura	<i>O. n.sp.</i>	1	10
7	Flexicalymene	<i>F. abbreviata</i> <i>F. granulosa</i> <i>F. meeki</i> <i>F. retrorsa</i> <i>F. retrorsa minuens</i>	5	15
8	Platycoryphe	<i>P. christyi</i>	1	16
9	Tricopelta	<i>T. breviceps</i>	1	17
10	Achatella	<i>A. carleyi</i>	1	18
11	Ceraurinus	<i>C. icarus</i>	1	19
12	Ceraurus	<i>C. milleranus</i> <i>C. miseneri</i>	2	21
13	Decoroproetus	<i>D. parviusculus</i>	1	22
14	Triarthrus	<i>T. beckii</i>	1	23
15	Cryptolithus	<i>C. tesselatus</i>	1	24



- ***Ceraurus milleranus* (Cole Simpson)**
- ***Isotelus maximus* (Ron Fine)**
- ***Ceraurus milleranus* (Cole Simpson)**
- ***Platycoryphe chrystyi* (Joshua Bryant)**
- ***Acidaspis cincinnatiensis* & *Cryptolithus tessalatus* (Jerry Rush)**
- ***Decoroproetus parviusculus* (Cole Simpson)**
- ***Triarthrus beckii* (Dan Cooper)**
- ***Tricopelta breviceps* (Cole Simpson)**
- ***Isotelus maximus* (Cole Simpson)**
- ***Ceraurus miseneri* (Cole Simpson)**
- ***Isotelus maximus* (Nikki Zehler)**
- ***Amphilichas shideleri* hypostome (Connor Puritz)**
- ***Meadowtownella crosotus* (Ron Fine)**
- ***Tricopelta breviceps* (Nikki Zehler)**
- ***Ceraurinus icarus* (Kyle Hartshorn)**

Regional genera collected by Dry Dredger members

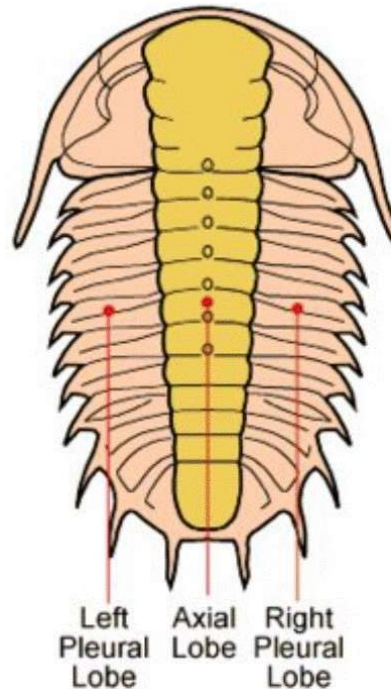
Section 2 Trilobite Description



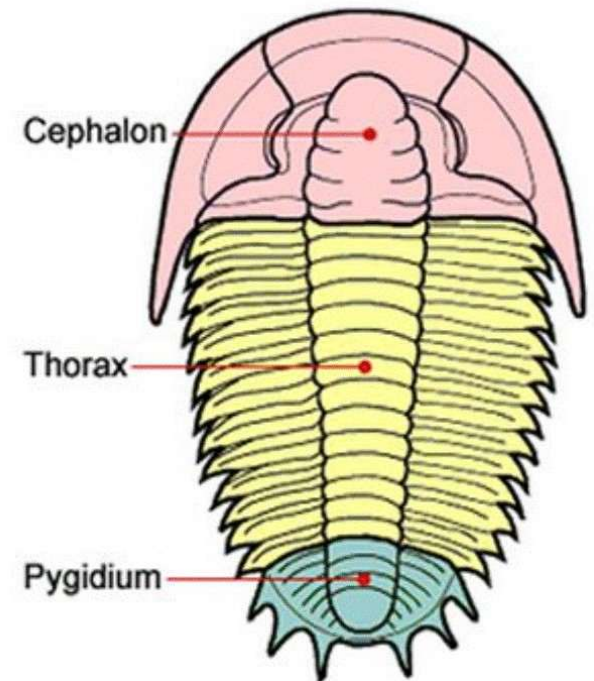
Describing Trilobites

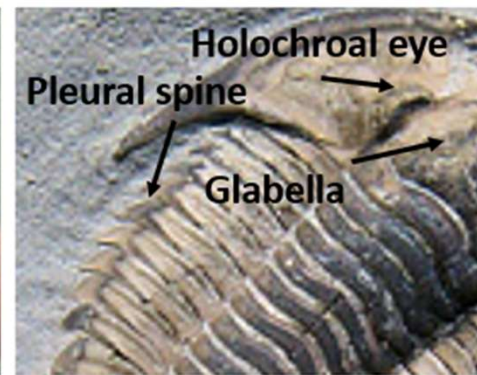
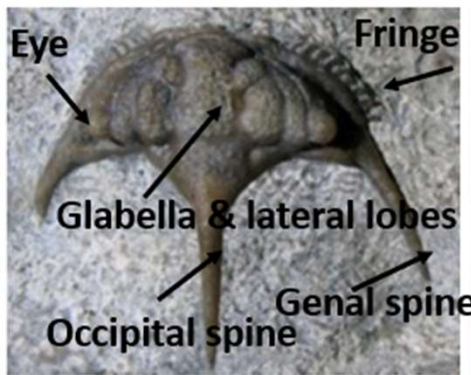
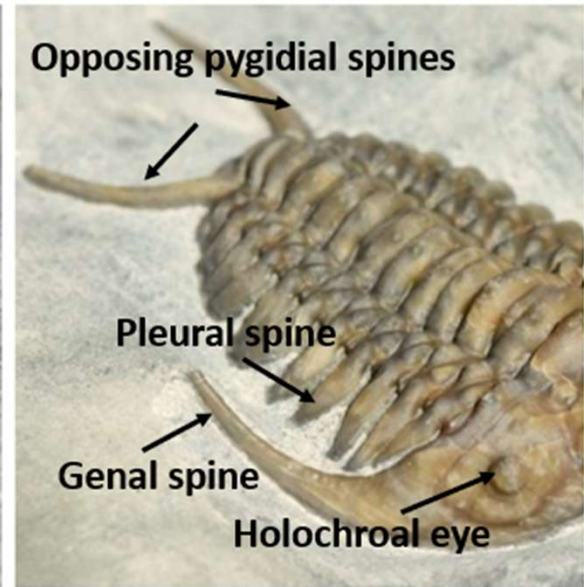
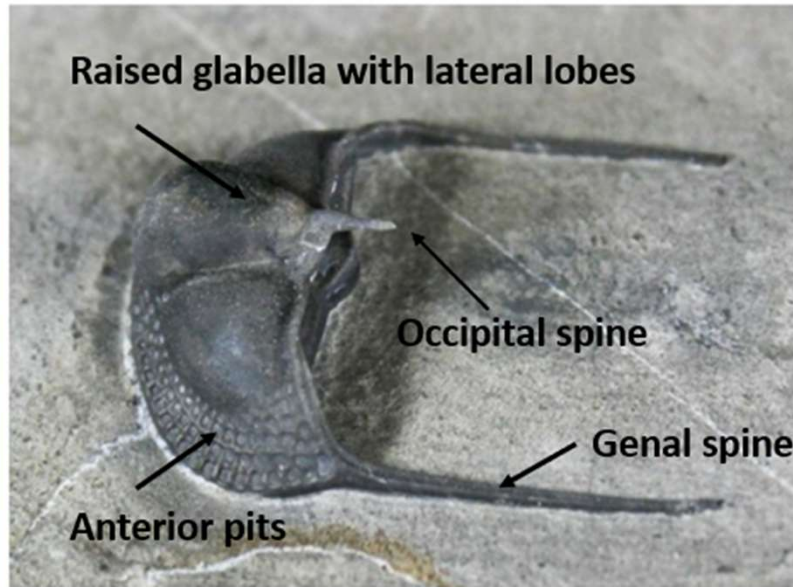
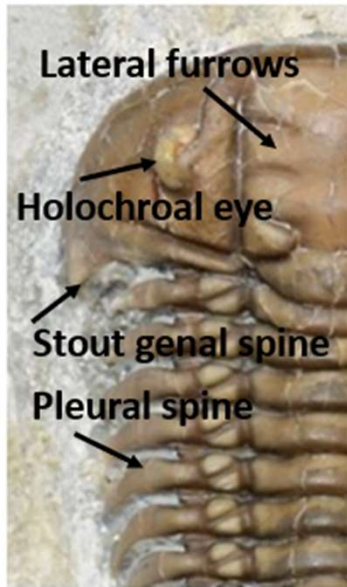
- **Trilobite body divided into axial and circumferential zones**
- **Features noted within each zone are used to create brief descriptions**

Axial Zones



Circumferential Zones

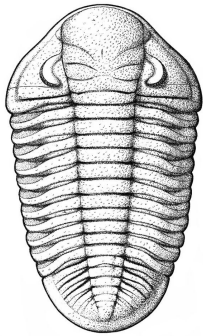




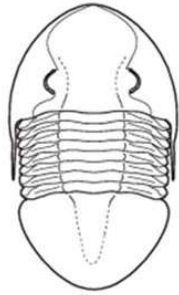
Example Features for Different Trilobite Genera



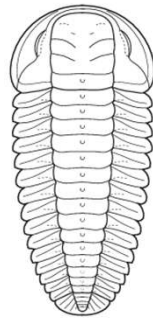
Flexicalymene



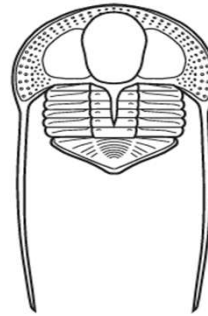
Platycoryphe



Isotelus



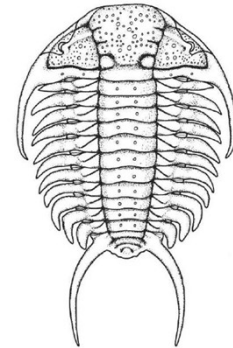
Triarthrus



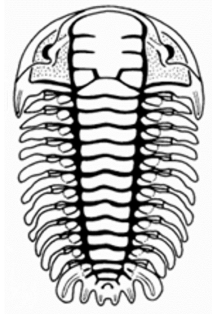
Cryptolithus



Decoroproetus



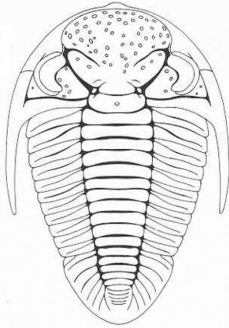
Ceraurus



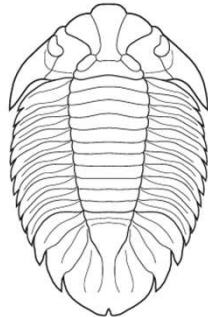
Ceraurinus



Achatella



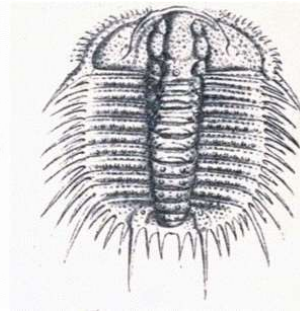
Tricopelta



Alolichas



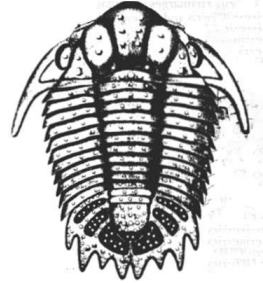
Acidaspis



Meadowtownella



Odontopleura



Hemiargus

Exoskeleton Matrix (All Genera)





Flexicalymene



Platycoryphe



Cryptolithus



Ceraurinus



Isotelus



Achatella



Tricopelta



Triarthrus



Ceraurus



Decoroproetus



Allolichas



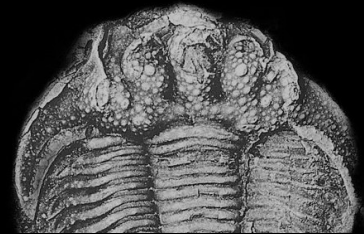
Odontopleura



Meadowtownella



Acidaspis



Hemiargus

Cephalon Matrix (All Genera)

Genus vs. Feature Matrix

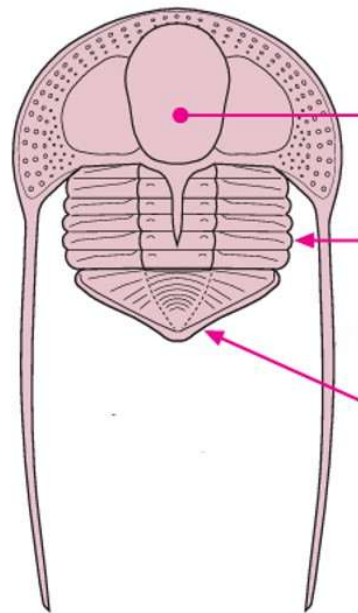
Genus/Feature	Circumferential Direction				Axial Direction		
	Cephalon			Thorax	Pygidium	Pleural Lobe	Axial Lobe
	Glabella	Eyes	Hypostome	Pleura			
Flexicalymene	Bell-shaped, narrows forward	Holochroal	Conterminant	13 blunt	Subisopygous	Blunt	
Platycoryphe	Sigmoidal furrows, narrows forward	Holochroal	Conterminant	10 blunt	Micropygous	Rounded	
Cryptolithus	Raised glabella, lateral lobes	Blind	Natant	5 blunt	Micropygous	Anterior fringe	Occipital Spine
Ceraurinus	Rectangular, Medial Furrows	Holochroal	Conterminant	10 spinose	Micropygous	Spine	Stout spines
Isotelus	Arrow-shaped	Holochroal	Conterminant	8 blunt	Isopygous	Blunt	
Achatella	Expands forward, lateral furrows	Shizochroal	Conterminant	11 spinose	Subisopygous	Spine	
Tricopelta	Inflated glabella, lateral lobes	Shizochroal	Conterminant	11 spinose	Micropygous	Pointed	
Triarthrus	Lateral sigmoidal furrows	Holochroal	Conterminant	15 blunt	Micropygous	Rounded	
Ceraurus	Widens forward	Holochroal	Conterminant	11 spinose	Micropygous	Pointed	Opposing spines
Decoroproetus	Vaulted, narrows forward	Holochroal	Natant	10 spinose	Subisopygous	Pointed	
Allolichas	Tripartite	Holochroal	Conterminant	11 spinose	Isopygous	Pointed	
Odontopleura	Raised glabella, lateral lobes	Holochroal	Conterminant	10 spinose	Micropygous	Anterior Fringe	
Meadowtownella	Raised glabella, lateral lobes	Holochroal	Conterminant	10 spinose	Micropygous	Anterior Fringe	
Acidaspis	Occipital spine	Holochroal	Conterminant	10 spinose	Micropygous	Anterior Fringe	Occipital Spine
Hemiarges	Tripartite	Holochroal	Conterminant	11 spinose	Subisopygous	Blade-like Genal	

Excel Spreadsheet Feature vs. Genus

- Shows examples of features unique or common to different genera
- Can be used to predict genus

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Feature/Genus	Flexicalymene	Cryptolithus	Platycoryphe	Isotelus	Ceraurus	Triarthrus	Decoroproetus	Ceraurus	Tricopelta	Achatella	Allolichas	Odontopleura	Meadowtownella	Acidaspis	Hemiargus		
24	Blade-Like															X		
25	Eyes																	
26	Blind		X															
27	Holochroal									X	X							
28	Schizochroal	X		X	X	X	X		X			X	X	X	X	X		
29	Crescent Shaped	X		X	X		X			X	X	X				X		
30	Globose					X							X	X	X			
31	Hypostome																	
32	Natant		X					X										
33	Conterminant	X		X	X	X	X		X	X	X	X	X	X	X	X		
34	Thorax																	
35	Number Segments	13	5	10	8	11	15	10	10	11	11	11	10	10	10	11		
36	Blunt Pleura	X	X	X	X													
37	Spiny Pleura					X	X		X	X	X	X	X	X	X	X		
38	Pygidium																	
39	Size																	

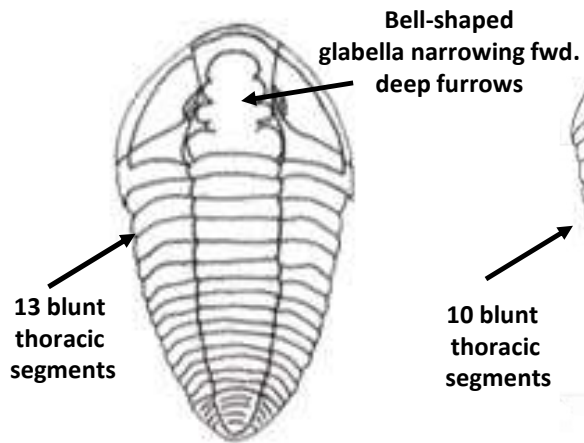
Section 3 Trilobite Identification By Genus



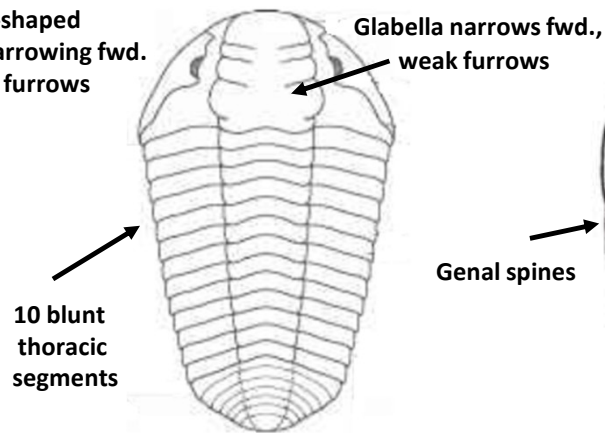
Cephalon with raised central glabella, lateral attachments, concentric rows of pits, medial occipital spine with long genal spines

Thorax with 6 pleura

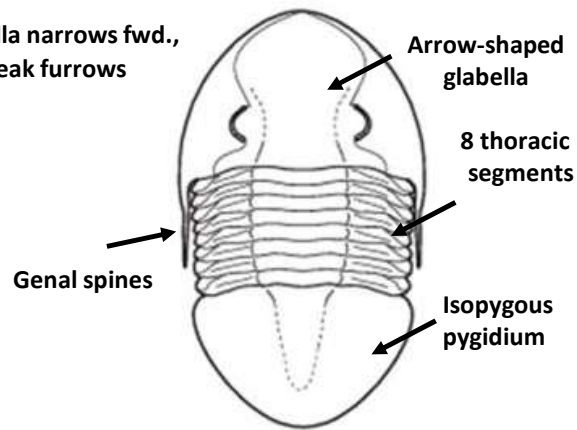
Pygidium with axial and pleural ribs



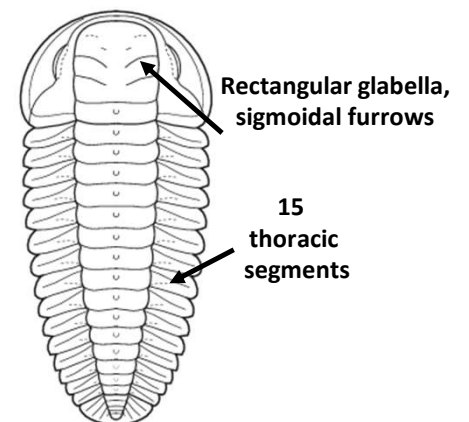
Flexicalymene



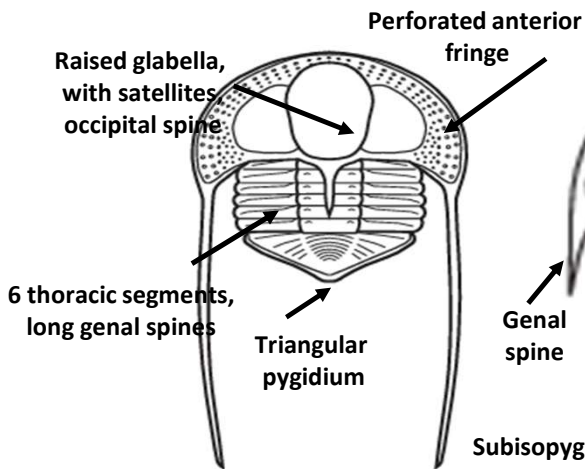
Platycoryphe



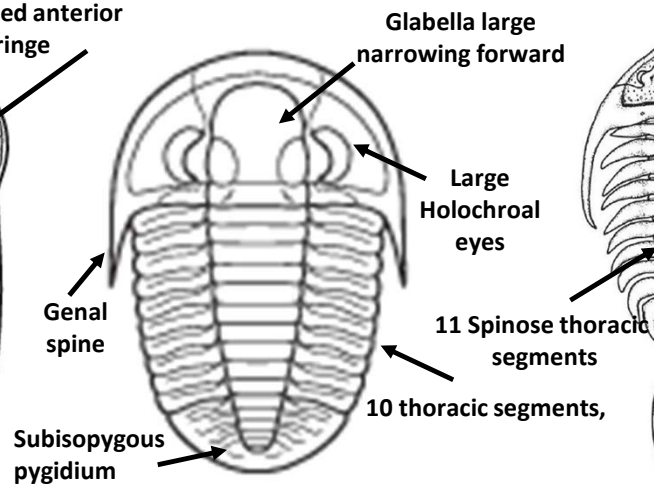
Isotelus



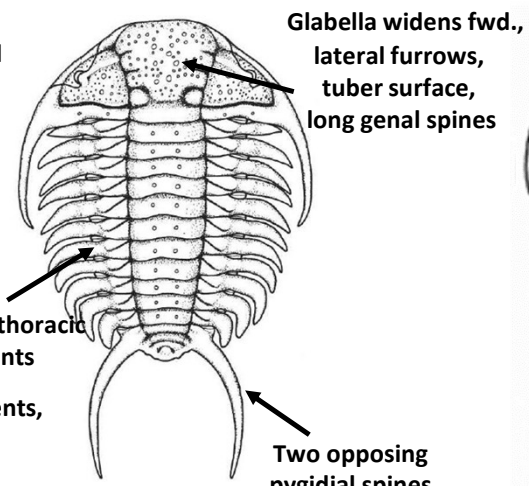
Triarthrus



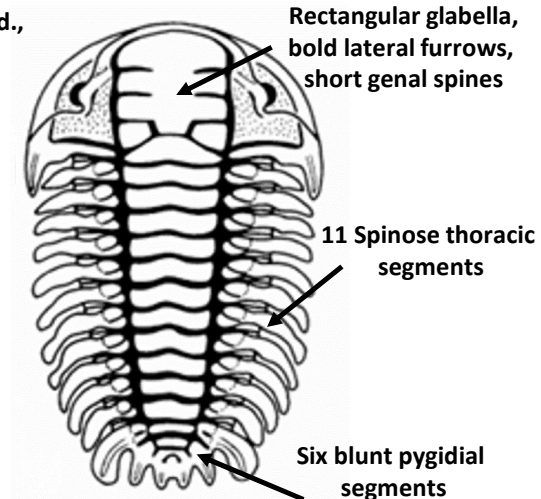
Cryptolithus



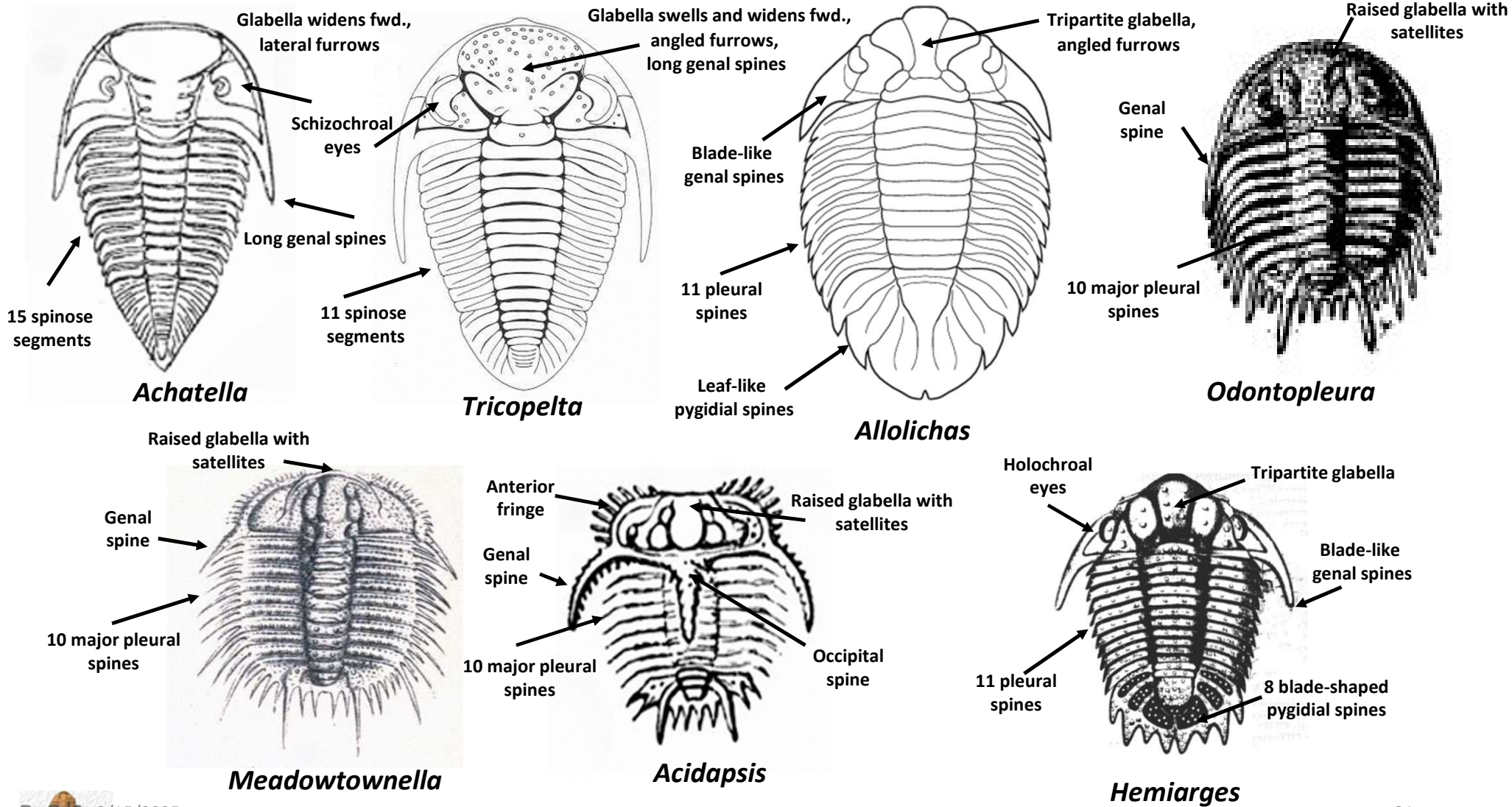
Decoroproetus



Ceraurus



Ceraurus



Section 4 Species Identification

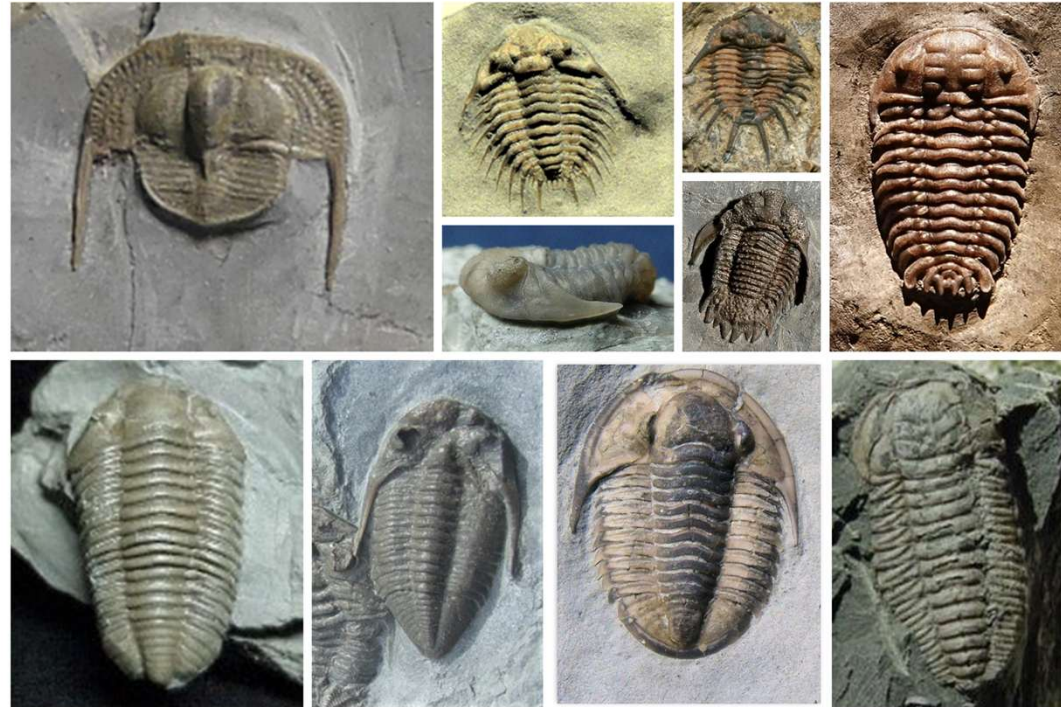
***Flexicalymene* and its five species**



10 Genera Have Single Species

- ***Cryptolithus***
 - ***C. tessellatus***
- ***Triarthrus***
 - ***T. beckii***
- ***Platycoryphe***
 - ***P. christyi***
- ***Achatella***
 - ***A. carleyi***
- ***Tricopelta***
 - ***T. breviceps***
- ***Meadowtownella***
 - ***M. crosotus***
- ***Decoroproetus***
 - ***D. parviusculus***
- ***Ceraurinus***
 - ***C. icarus***
- ***Odontopleura***
 - ***O. n.sp.***
- ***Hemiarges***
 - ***H. cf. paulianus***

10 Species Total



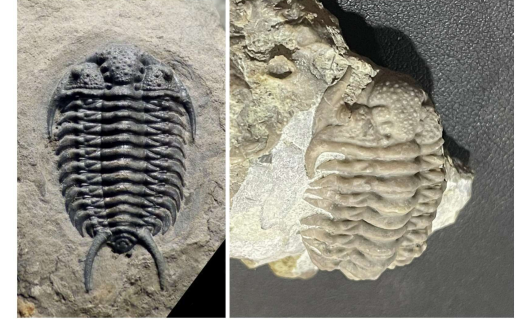
5 Genera Have Multiple Species

- ***Isotelus***
 - *I. maximus*
 - *I. gigas*
- ***Flexicalymene***
 - *F. abbreviata*
 - *F. granulosa*
 - *F. retrorsa*
 - *F. meeki*
 - *F. retrorsa minuens*
- ***Allolichas***
 - *A. halli*
 - *A. harrisi*
 - *A. shideleri*
- ***Acidaspis***
 - *A. cincinnatiensis*
 - *A. n.sp.*
- ***Ceraurus***
 - *C. milleranus*
 - *C. miseneri*

14 Species Total



Isotelus



Ceraurus



Acidaspis



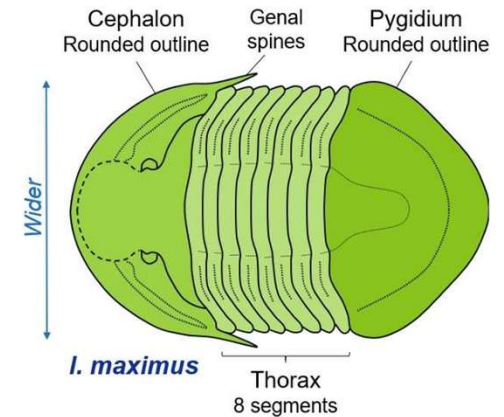
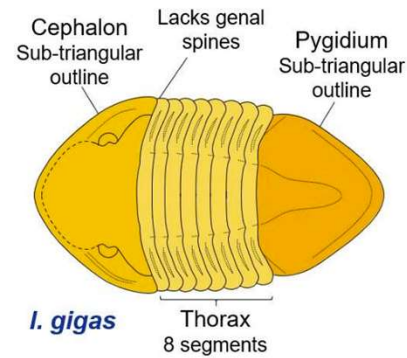
Flexicalymene



Allolichas

Isotelus Species

- ***I. maximus***
 - Cephalon and pygidium with rounded outline
 - Tends to be wide bodied
 - Genal spines
- ***I. gigas***
 - Cephalon and pygidium sub – triangular outline
 - Genal spines usually absent



(Fossil of the month: Isotelus (uky.edu))



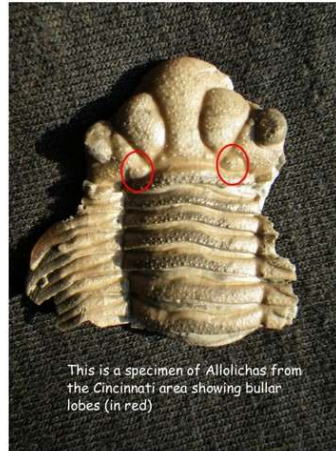
I. gigas
 White Oak Creek
 Waynesville Fm.
 Highland County, OH



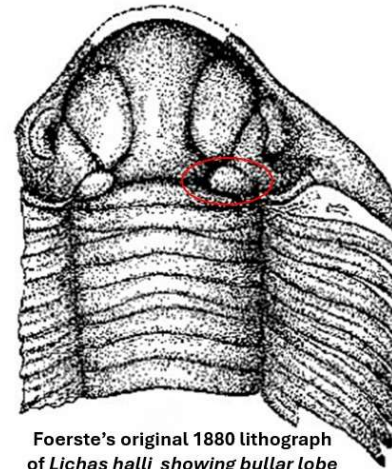
I. maximus
 T. Johnson collector
 Waynesville Fm.
 Adams County, OH

Allolichas Species

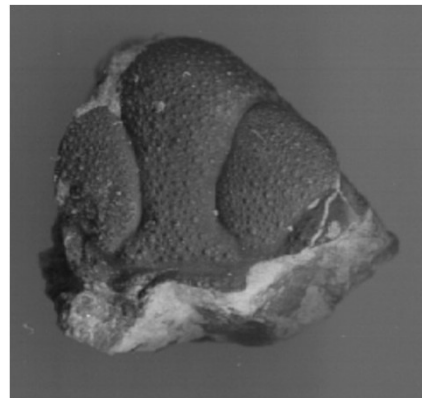
- *A. halli*
 - Bullar lobes below eyes
 - Maysvillian Stage
- *A. harrisi*
 - Bullar lobes below eyes
 - Waynesville Formation
- *A. cf. shideleri* (provisional)
 - Bullar lobes not evident in available specimens
 - Species originally defined based on pustulose surface
 - Richmondian Stage



A. halli showing bullar lobes
(Courtesy Al Scheer)



Ray Bassler photo of Foerste, Grabau, and Ulrich in the latter's office at the Smithsonian, circa 1933



A. shideleri glabella showing pustulose surface

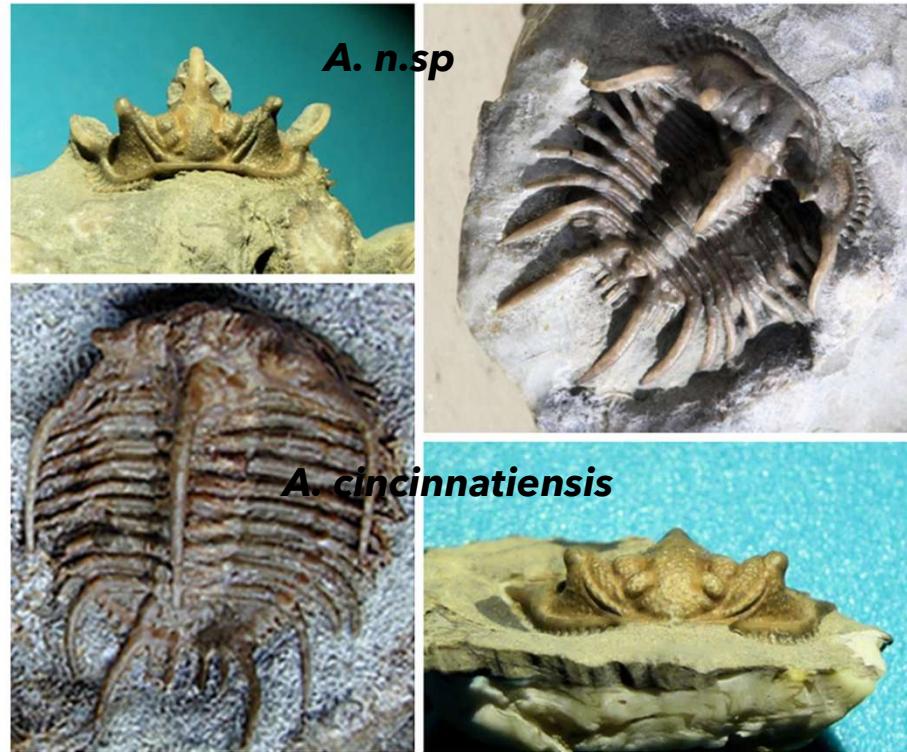


A. shideleri librigena in lower right panel collected by Shideler

Acidaspis

Species

- ***A. cincinnatiensis* (Lower photos)**
 - Large prominent genal and occipital spines
 - Anterior fringe
 - Occurs throughout Cincinnatian
- ***A. n.sp.* (Upper photos)**
 - Compound curve genal spines
 - Occipital spine with spinelets
 - Elevated eye sockets
 - Restricted to Kope Formation



**J. Rush collector
Bracken County, KY**

Flexicalymene Species

- ***F. retrorsa***
 - Can be large, ~2"
 - No genal spines
 - Arnheim & Waynesville
- ***F. meeki***
 - Can be quite large, ~2 3/4 "
 - Has genal spines
 - Corryville
- ***F. granulosa***
 - Grainy surface texture
 - No genal spines
 - Lower Kope
- ***F. abbreviata***
 - No genal spines
 - Smaller eyes than other Flex species
 - Entire Kope
- ***F. retrorsa minuens***
 - Small size, < 1"
 - No genal spines
 - Liberty to Elkhorn*

*(Foerste, 1910,1919)



J. Rush collector



Juvenile *F. granulosa*
J. Rush collector
S. Brown collection



F. abbreviata
J. Rush collector
S. Brown collection

Ceraurus Species

- *C. milleranus*
 - Beady eyes with mid-body length genal spines
 - Opposing pygidial spines
 - Maysvillian Stage
- *C. miseneri*
 - Heavily pustulose glabella
 - Genal spines only extend a few thoracic segments
 - Richmondian Stage



C. milleranus
J. Rush collector
S. Brown collection
Kope Fm.
Bracken County, KY



C. miseneri
J. Rush collector (1983)
S. Brown collection
Whitewater Fm.
Preble County, OH

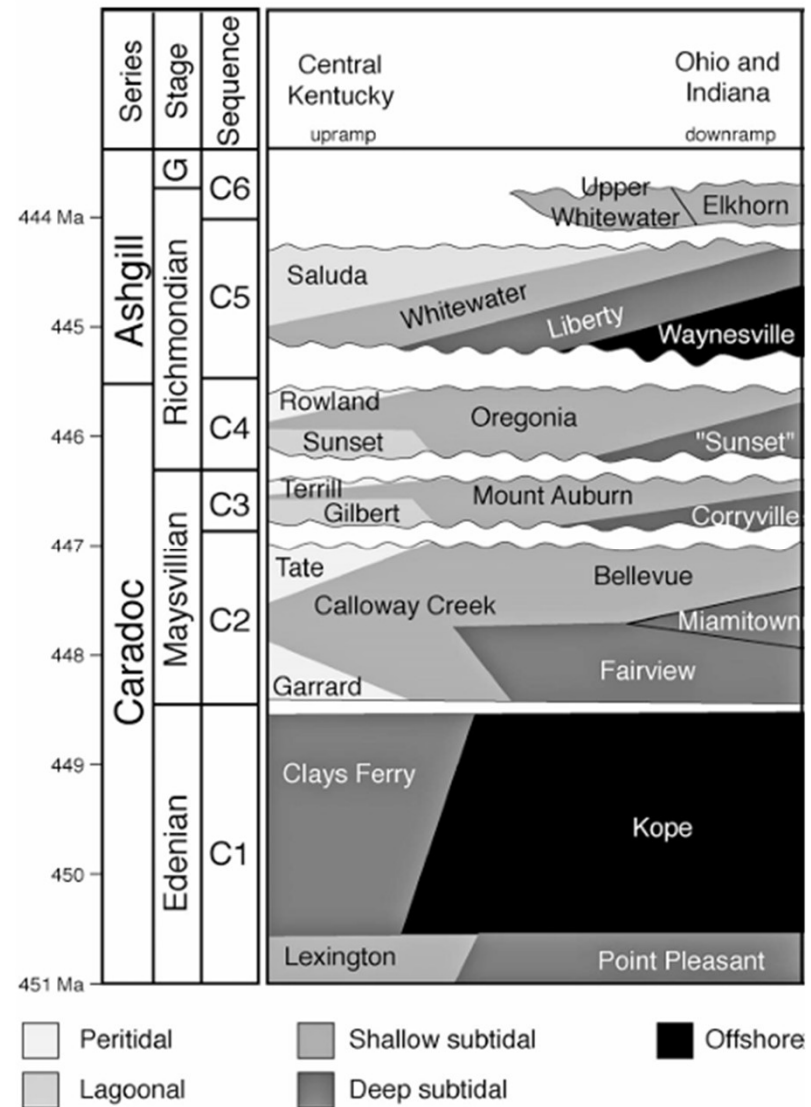


August F. Foerste
(1862-1936)

August Foerste
C. miseneri
circa 1930

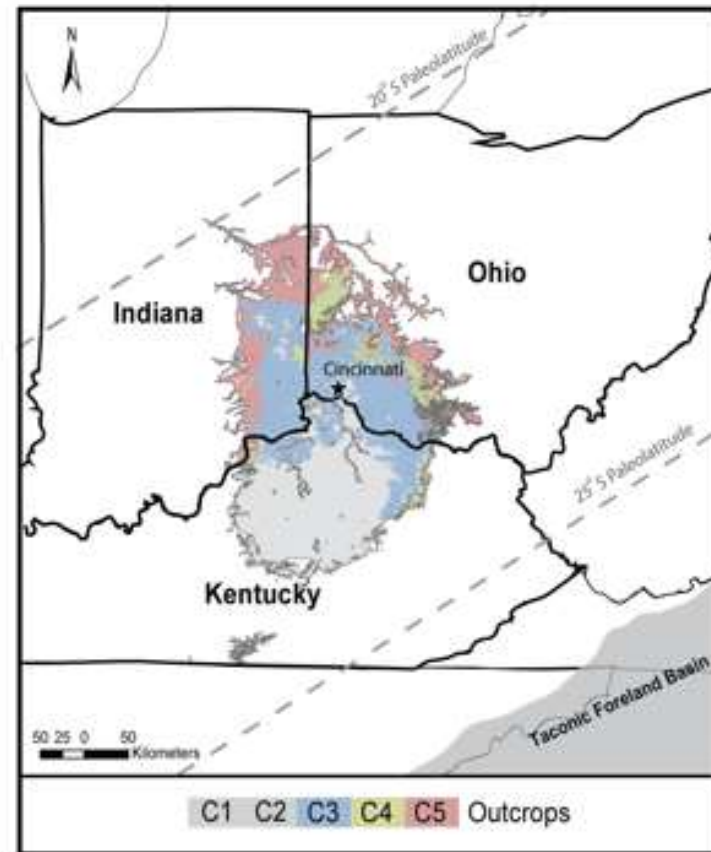
Section 5 Cincinnatian Stratigraphy

(Holland, 2007)



Formations described using Fossil/Lithography vs. Sequence Stratigraphy

SERIES	STAGES	SUBDIVISIONS BASED ON LITHOLOGY AND FOSSILS	1st ORDER SEQUENCES
CINCINNATIAN	RICHMONDIAN	ELKHORN	C6
		UPPER WHITEWATER	C5
		SALUDA	
		LOWER WHITEWATER	
		LIBERTY	
		BLANCHESTER	C4
		CLARKSVILLE	
		FORT ANCIENT	
		OREGONIA	C3
		SUNSET	
	MAYSVILLIAN	MOUNT AUBURN	C2
		CORRYVILLE	
		BELLEVUE	C1
		FAIRMOUNT	
		WESSELMAN SHALE	C1
		NORTH BEND	
		TAYLOR MILL	
		GRAND AVENUE	
		GRAND VIEW	
		ALEXANDRIA	
		SNAG CREEK	
		PIONEER VALLEY	
		BRENT	
		FULTON	



(Hunda, 2014), (Holland, 2007)

(Stigal, 2015)

Section 6 Species Timeline

Trilobite Species	C1	C2	C3	C4	C5			C6
	Edenian	Maysvillian		Richmondian				
	Kope	Fairview	Grant Lake	Arnheim	Waynesville	Liberty	Whitewater	Elkhorn
<i>Allolichas halli</i>			X					
<i>A. harrisi</i>					X			
<i>A. shideleri</i>						X	X	
<i>Hemiarges paulianus</i>						X		
<i>Acidaspis cincinnatiensis</i>	X	X	X	X	X			
<i>A. n. sp</i>	X							
<i>Meadowtownella crosotus</i>	X							
<i>Odontopleura n.sp</i>			X	X	X	X		
<i>Flexicalymene abbreviata</i>	X							
<i>F. granulosa</i>	X	X						
<i>F. meeki</i>		X	X					
<i>F. retrorsa</i>				X	X	X		
<i>F. retrorsa minuens</i>						X	X	X
<i>Platycoryphe christyi</i>					X			
<i>Tricopelta breviceps</i>					X	X		
<i>Achatella carleyi</i>	X	X						
<i>Ceraurus icarus</i>					X	X	X	
<i>Ceraurus milleranus</i>	X	X	X	X	X	X	X	
<i>C. miseneri</i>						X		
<i>Decoroproetus parviusculus</i>	X							
<i>Isotelus maximus</i>	X	X	X	X	X	X	X	X
<i>I. gigas</i>	X	X	X	X	X			
<i>Cryptolithus tessellatus</i>	X							
<i>Triarthrus beckii</i>	X							

Section 6 Taxonomic History

	Family	Genus	Species	Comments
Asaphida	ASAPHIDAE	Isotelus	<i>I. gigas</i> <i>I. maximus</i> <i>I. brachycephalus</i>	<i>I. brachycephalus</i> junior synonym of <i>I. maximus</i> (Hall, 1993). (Babcock, 1996), (Phelps, 2013)
Lichida	LICHIDAE	<i>Allolichas</i>	<i>A. halli</i> <i>A. harrisi</i> <i>A. shideleri</i>	<i>Amphilichas</i> with bullar condition renamed <i>Allolichas</i> (Holloway, 1988, 2002)
		<i>Hemiarges</i>	<i>H. cf. paulianus</i>	Page 66 & 79 (Marak, 1995)
Odontopleurida	ODONTOPLEUTIDAE	<i>Acidaspis</i>	<i>A. cincinnatiensis</i>	
		<i>Meadowtownella</i>	<i>M. crosotus</i>	(Conway, 2011)
		<i>Odontopleura</i>	<i>O. n.sp</i>	(Miami University 1968)
Phacopida	GRAVICALYMENIDAE	<i>Gravicalymene</i>	<i>G. hagani</i>	(Brandt and Davis, 2007)
	CALYMENIDAE	<i>Flexicalymene</i>	<i>G. truncatus</i> -> <i>F. abbreviata</i>	(Brandt and Davis, 2007)
			<i>F. granulosa</i>	
			<i>F. griphus</i>	(Brandt and Davis, 2007)
			<i>F. meeki</i>	
			<i>F. retrorsa</i>	
			<i>F. retrorsa minuens</i>	(Foerste, 1910, 1919)
	HOMALONOTIDAE	<i>Platycoryphe</i>	<i>P. christyi</i>	
	PTERYGOMETOPIDAE	<i>Tricopelta</i>	<i>T. breviceps</i>	
		<i>Achatella</i>	<i>A. carleyi</i>	(Swisher et. al, 2016)
	CHEIRURIDAE	<i>Ceraurinus</i>	<i>C. icarus</i>	
		<i>Ceraurus</i>	<i>C. milleranus</i> <i>C. miseneri</i>	
Proetida	PROETIDAE	<i>Decoroproetus</i>	<i>D. parviusculus</i>	
Ptychoparida	OLENIDAE	<i>Triarthrus</i>	<i>T. beckii</i>	(Kim, et. al, 2009)
Trinucleida	TRINUCLEIDAE	<i>Cryptolithus</i>	<i>C. tessellatus</i>	(Babcock, 1996)

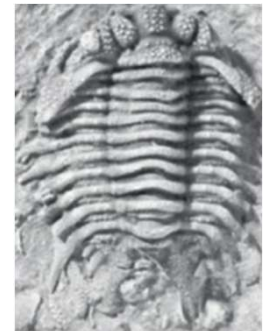
Major Changes

- ***I. brachycephalus* junior synonym for *I. maximus* (Hall, 1993), (Babcock, 1996), (KY Geological Survey, 2013)**
- **The genus *Gravicalymene* deleted. *G. truncatus* moved to *F. abbreviata* (Brandt & Davis, 2007)**
- ***Primaspis* moved to *Meadowtownella* (Conway, 2011)**
- ***Amphilichas* with bullar lobe condition moved to *Allolichas* (Holloway, 2002) See slide 26.**
- ***Hemiarges* found at Beasley Run, Camden, OH by Sheidler in 1930s (Marak, 1995). See slide 37**
- ***Odontopleura* collected in 1968 during construction at Miami University. See slide 38**

Whitewater Trilobite Fauna
For Beasley Run Composite Section

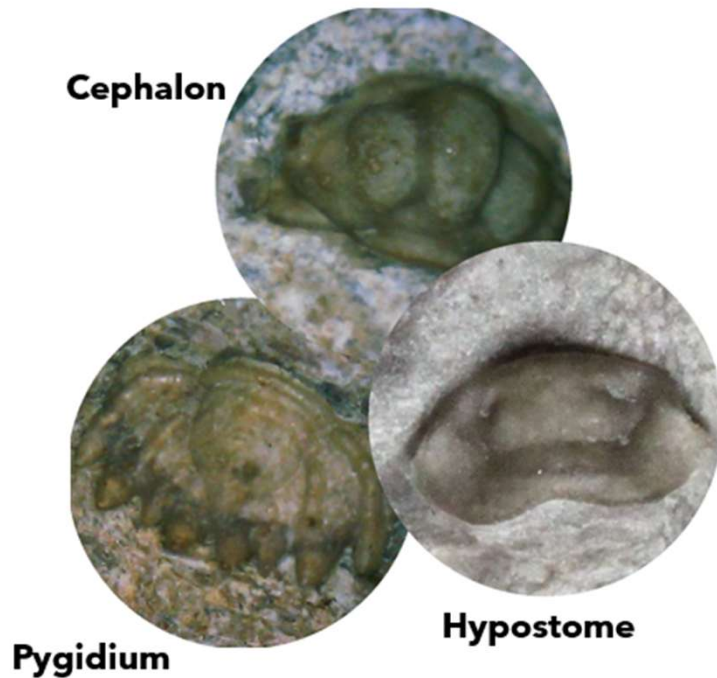
16	17a	17b	18	
				Trilobita
				<i>Calymene meeki</i> Foerste
				<i>Ceraurus icarus</i> (Billings)
				<i>Ceraurus miseneri</i> Foerste
				<i>Chasmops breviceps</i> (Hall)
				<i>Hemiarges arcutus</i> Ulrich Mss.
				<i>Isotelus maximus</i> Locke
				<i>Odontopleura onealli</i> (Miller)

Hughes Hall
MUGM29056
Liberty Formation
Butler County, OH



Dry Dredgers Bulletin May & June 1999, "St. John's New Trilobite" identifies a new species of trilobite... "It's a very spiny odontopleurid"

Hemiarges



***Hemiarges* sclerites**
Preble County, OH
J. Rush collector
S. Brown collection



Al Scheer Collection
Tom Whiteley Photograph

Hemiarges cf. pauliensis
Upper Ordovician
Platteville Formation
Grant County, WI

Odontopleura



- **Sclerites collected by Jerry Rush in the 1980s compared with his sketch of complete trilobite. He's collected many pygidiums, cephalons, and hypostomes over the years.**



**Two *Odontopleura* cephalons adjacent to *Flexicalymene* glabella. Justin Menard, collector
Waynesville Formation**

Odontopleura (Cont'd)

Acidaspis cincinnatiensis



Acidaspis cincinnatiensis (Meek, 1873)
Ordovician
Dillsboro Formation
Indiana, U.S.A.
2.0 cm



***Odontopleura* in AMNH collection where it's incorrectly identified as *Acidaspis*. Waynesville Fm. Oldenburg, IN**

Juvenile and adult examples from Oldenburg IN. Probably collected by the Cooper family. Upper Ordovician Waynesville Fm. Franklin County, IN

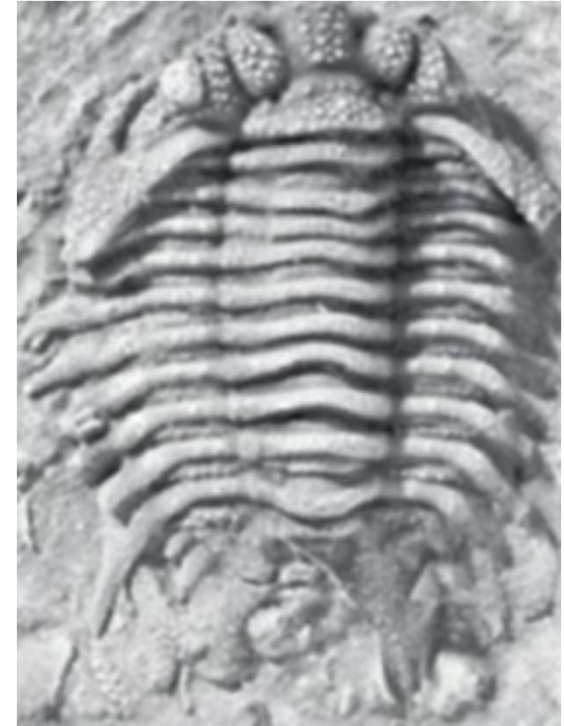
***Odontopleura* (Cont'd)**



Cole Simpson, collector
Corryville Formation
Northern Kentucky



Enrolled *Odontopleura*
Justin Menard, collector
Waynesville Formation



One of two *Odontopleura*
collected at Miami
University at Hughes
Hall construction.
Liberty Formation
Butler County, OH

Section 6 References

AUSTIN, G. M. 1927. " Richmond faunal zones in Warren and Clinton Counties, Ohio." *Proceedings of the United States National Museum*. 70 (2671):1-18.

BABCOCK, L.W. 1996, in, *Fossils of Ohio*. Ohio Division of Geological Survey Bulletin 70, p. 90-113.

BRANDT, D.S., & DAVIS, R.A. 2007. Trilobites, Cincinnati, and the "Cincinnati School of Paleontology". 29-50. *Fabulous Fossils—300 years of Worldwide Research on Trilobites*. New York State Museum Bulletin 507.

BRETT, C.E., HARTSHORN, K.R., YOUNG, A.L., SCHWALBACH, C.E., STIGALL, A.L., 2018. The Classic Upper Ordovician Stratigraphy and Paleontology of the Eastern Cincinnati Arch. International Geoscience Programme (IGCP) Project 653 Third Annual Meeting Field Trip Guidebook, Athens, Ohio. (162 p).

CHESTNUT, A.J. 2009, Using Morphometrics, Phylogenetic Systematics and Parsimony Analysis to Gain Insight into the Evolutionary Affinities of the Calymenidae Trilobites. MSc Thesis, Wright State University. 93 pp.

CONWAY, T.M., & BOTTING, J 2011., Description and ecology of a new Middle Ordovician (Llanvirn) odontopleurid from the British Inlier of Mid-Wales, with a review of the genus *Meadowtownella*., *Geological Magazine*, May 2012, 1-15

FOERSTE, A.F. 1910, Preliminary Notes on Cincinnati and Lexington Fossils of Ohio, Indiana, Kentucky, and Tennessee: Denison University, Bulletin of the Scientific Laboratories, v.16, p.17-87.

FOERSTE, A.F. 1919. Note of Isotelus, Acrolichas, Calymene, and Encrinurus. Bulletin of the Scientific Laboratories, v.19, p.65-81.

GON III, S.M., 2007, A pictorial guide to the orders of trilobites

HALL, C.P., 1993 Biometric and Taxonomic Analysis of the Genus Isotelus (Trilobites) from Cincinnati (Upper Ordovician) Rocks of Ohio, Kentucky, and Indiana. A Thesis Presented in Partial Fulfillment of the Requirements for the degree Bachelor of Science in Geological Sciences, The Ohio State University

HAND, G. editor, 1999, Dry Dredgers Bulletin May – June

STEVEN M. HOLLAND, MARK E. PATZKOWSKY, 2007; Gradient Ecology Of A Biotic Invasion: Biofacies Of The Type Cincinnati Series (Upper Ordovician), Cincinnati, Ohio Region, USA. *PALAIOS*; 22 (4): 392-407

HOLLOWAY, D., & THOMAS, A. 2002, Hoplolichoides, Allolichas, Autoloxolichas and Akantharges, and the classification of Lichid trilobites, *Geobios* 35, 111-125

HUNDA, B. R., N. C. HUGHES, AND K. W. FLESSA. 2006. Trilobite taphonomy and temporal resolution in the Mt. Orab shale bed (Upper Ordovician, Ohio, U.S.A.). *Palaio*, 21:26-45.

HANKE, B. R. 2004. Flexicalymene (Trilobites) from the Cincinnati Series (Upper Ordovician) of Ohio, Indiana, and Kentucky: a case study of microevolutionary pattern within a single species lineage in a sequence stratigraphic framework. Unpublished PhD thesis

MARAK, J.H., 1995, The Richmond Group of the Cincinnati Province, an unpublished manuscript by Dr. William Henry Shideler. edited by Joe H. Marak, Dept. of Geology, Miami University, Oxford Ohio . Ohio Geological Survey Open File Report OFR-95-1

ROSS, J. R. JR. 1967. Calymenid and other Ordovician trilobites from Kentucky and Ohio. US Geological Survey Professional Paper 583-B, pp. B1-B18

RUDKIN, D.M., TRIPP, R.P., & LUDVIGSEN, R. 1994, The Ordovician trilobite genus Hemiargus (Lichidae, Trochurinae) from North America and Greenland In Landing E., editor) *Studies in Stratigraphy and Paleontology in Honor of Donald W. Fisher* Bulletin Number 481, 289-306. New York State Museum

SCHWALBACH, C.E., 2017, THE CLASSIC UPPER ORDOVICIAN STRATIGRAPHY AND PALEONTOLOGY OF THE EASTERN CINCINNATI ARCH THE CLASSIC UPPER ORDOVICIAN STRATIGRAPHY AND PALEONTOLOGY OF THE EASTERN CINCINNATI ARCH. Unpublished PhD thesis

Stigall, A. L. 2013-2015. Atlas of Ordovician Life. www.ordovicianatlas.org

WHITELEY, T.E., KLOC, G.J., BRETT, C.E., 2002, Trilobites of New York, an illustrated guide, Cornell University Press

Acknowledgements

- **Jerry Rush deserves special recognition for his contributions. His collecting knowledge, experience, preparation, and photographic skills are unparalleled**
- **Gerald Kloc steered me in the direction of a lichid expert**
- **Al Scheer provided important insights into lichid classification and photos of available specimens for *A. shideleri***
- **Thanks to many individuals who shared photos of their trilobites!**



Appendices

- **A. Regional Genera**
- **B. *F. minuens* Collecting Experience**
- **C. Hypostomes**
- **D. Enrolled Examples**
- **E. Eye Types**
- **F. Dorsal/Ventral Views**

A. Regional Genera



Triarthrus model showing exites (gills) and telopodites (walking legs)

Flexicalymene

Cephalon

- Convex glabella, parabolic outline, and broad trough-shaped furrows. Three pairs of lateral glabellar lobes decreasing in size anteriorly
- Holochroal eyes
- Conterminant hypostome

Thorax

- 13 blunt pleura

Pygidium

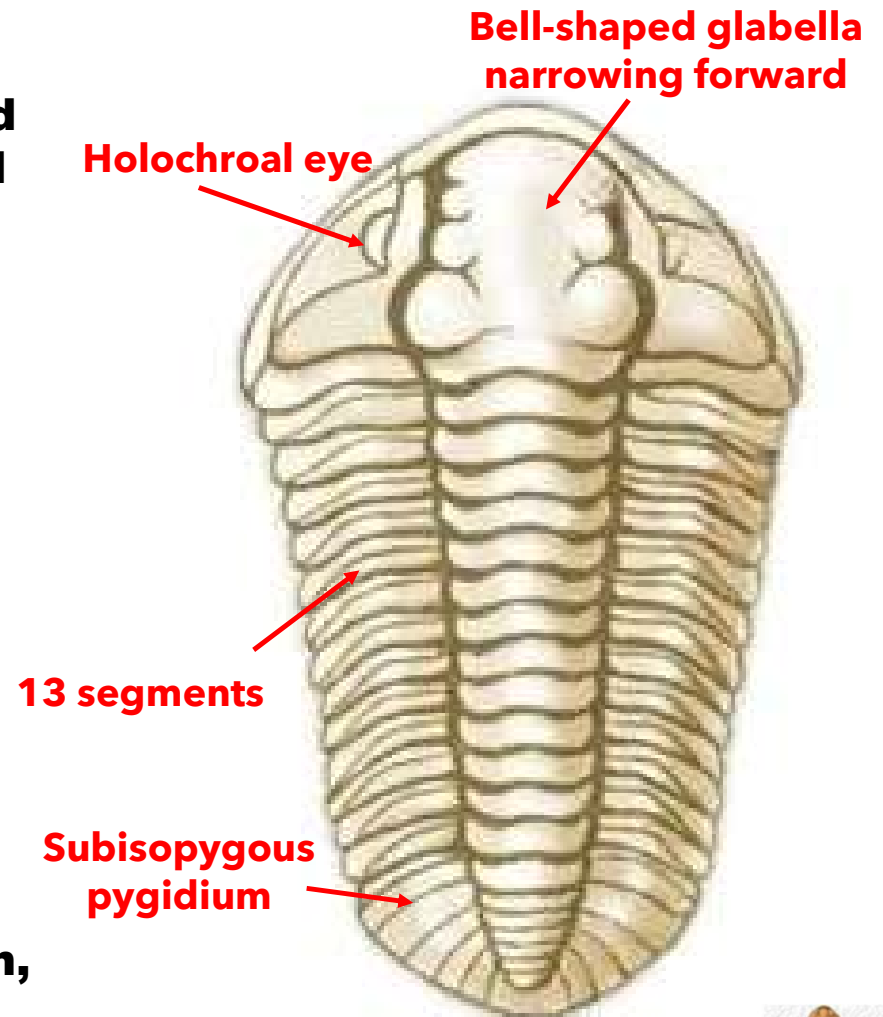
- Subisopygous

Species/variety

- *F. abbreviata*
- *F. granulosa*
- *F. meeki*
- *F. retrorsa*
- *F. retrorsa minuens*

Collecting Sites

- Caesars Creek, Rt 125 Georgetown, St. Leon, Stonelick Creek, Flat-Run, Miamisburg, Oldenburg, etc.



**Inverted bell-shaped glabella with broad furrows.
Three pairs of lateral glabellar lobes
decreasing in size anteriorly**



Cephalon

**J. Rush collector
Bull Fork Fm.
Mason County, KY**

**Spectacular *Flexicalymene meeki*
showing thoracic pleura details**



Body

**D. Cooper collector
Corryville Fm.
Richwood KY**

Platycoryphe

Cephalon

- Glabellar sigmoidal furrows

- Holochroal eyes

Thorax

- 13 blunt segments

Pygidium

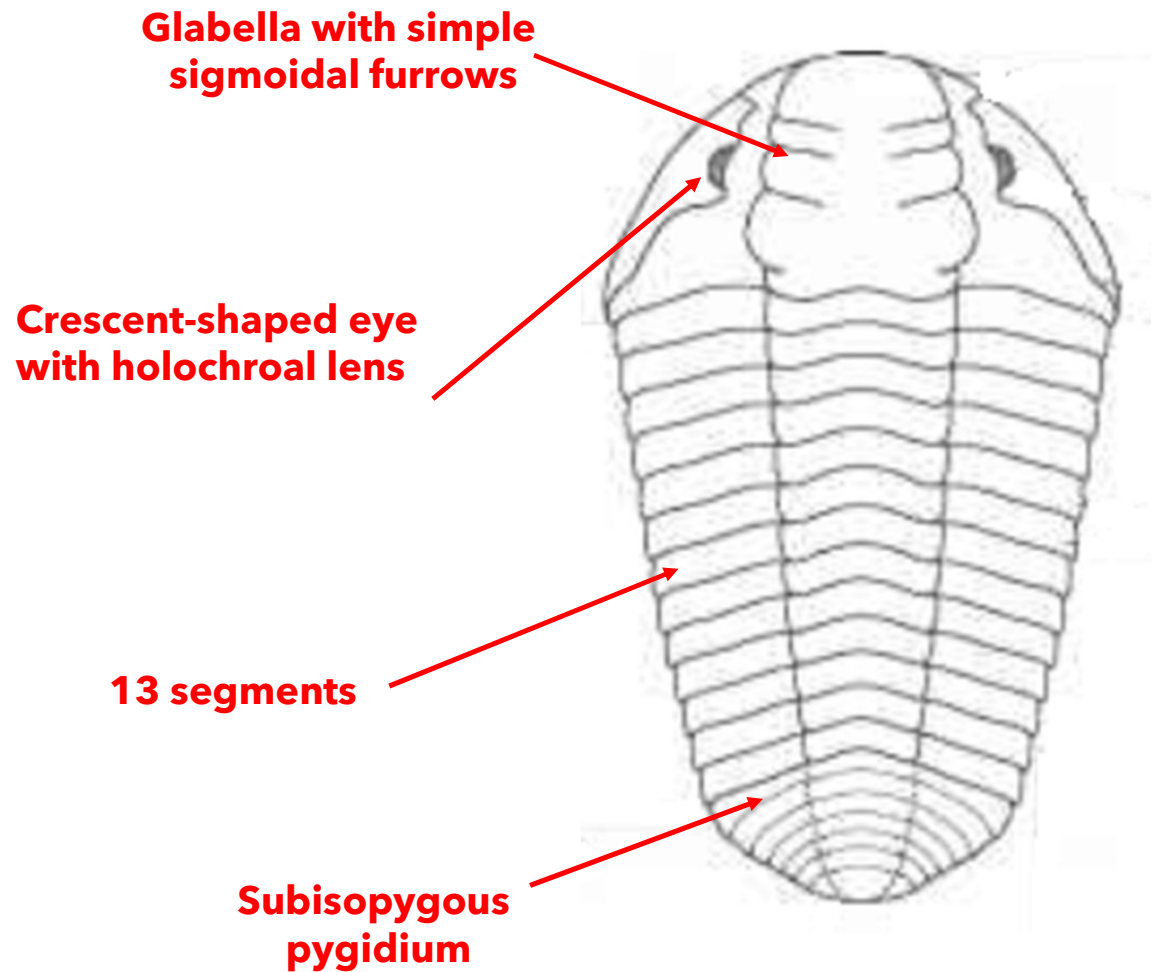
- Subisopygous

Species

- *P. christyi*

Collecting Sites

- Waynesville Formation,
Franklin County, IN;
Centerville, OH.



Tapered glabella with weak sigmoidal furrows



Cephalon

**J. Rush collector
Waynesville Fm.
Franklin County, IN**



Body

**J. Bryant collector
Waynesville Fm.
Franklin County, IN**

Triarthrus

Cephalon

- Two pairs of lateral glabellar furrows
- Holochroal eyes
- Conterminant hypostome

Thorax

- 15 segments

Pygidium

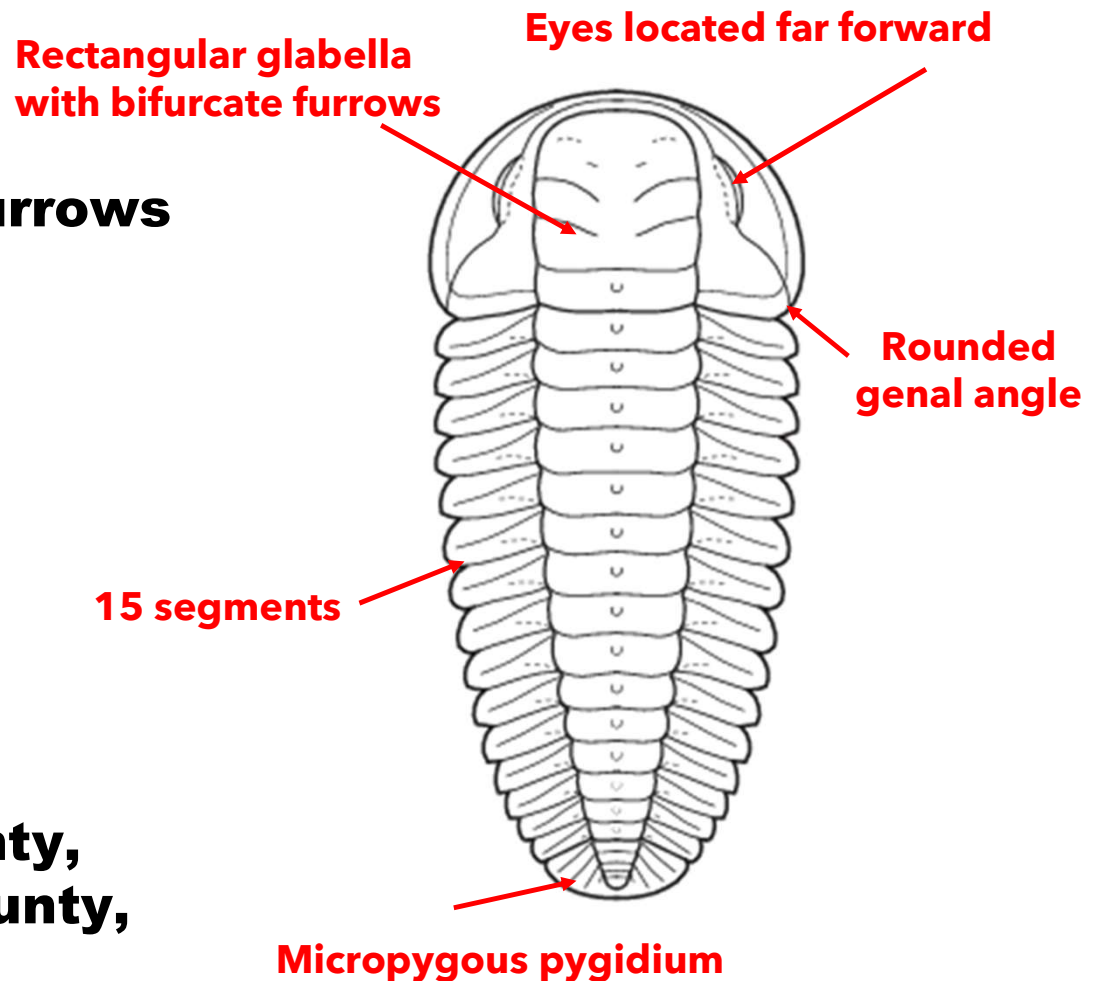
- Micropygous

Species

- *T. beckii*

Collecting Sites

- Kope formation. Hamilton County, Sycamore Creek; Clermont County, Twelve-Mile Creek at Rt.52.



**Sigmoidal glabellar furrows &
forward shizochroal eyes**



Cephalon

**UC Collection
Kope Fm. KY**



Body

**D. Cooper collector
S. Brown collection
Kope Fm. Sycamore Creek
Hamilton County, OH⁵¹**

Ceraurinus

Cephalon

- Rectangular, inflated glabella with three pairs of deep straight lateral furrows
- Short stout genal spines
- Holochroal eyes
- Conterminant hypostome

Thorax

- 11 spinose segments

Pygidium

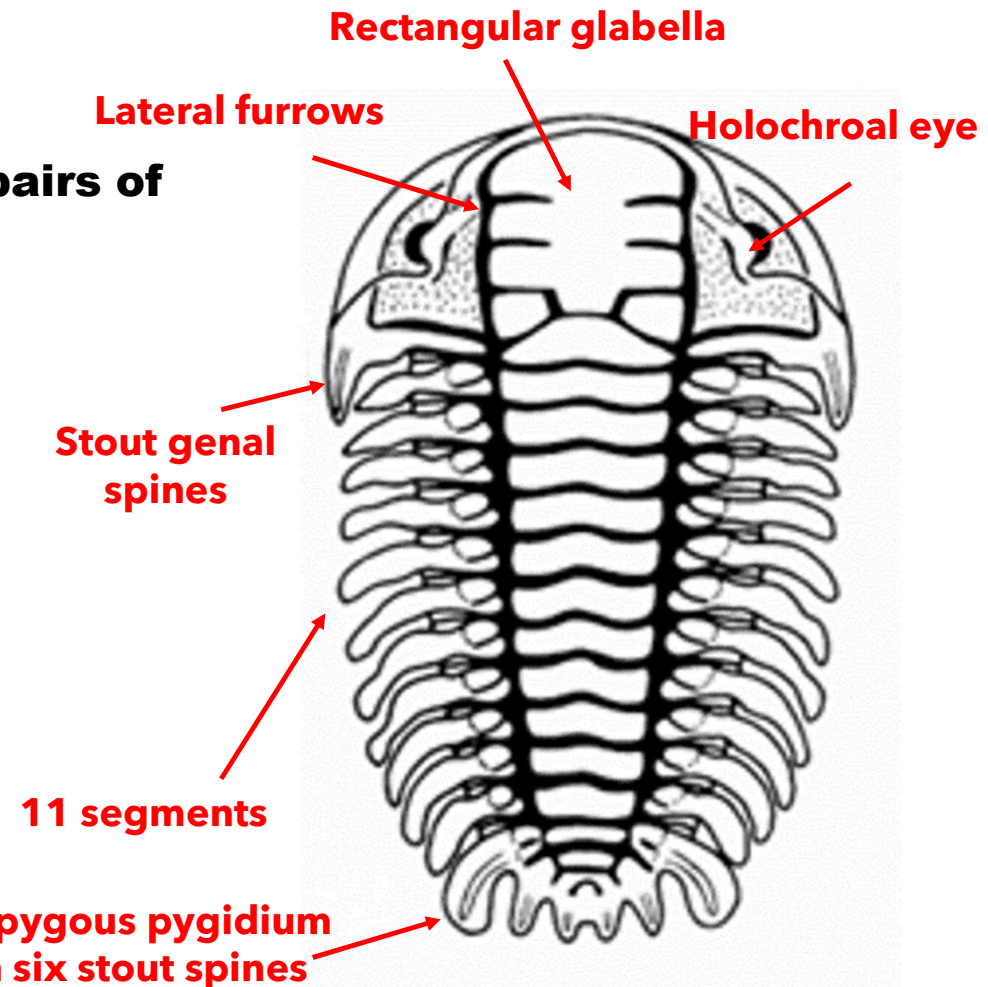
- Micropygous with stout spines

Species

- *C. icarus*

Collecting Sites

- Whitewater Formation. Rt. 127 south of Richmond, IN and Preble County, OH.

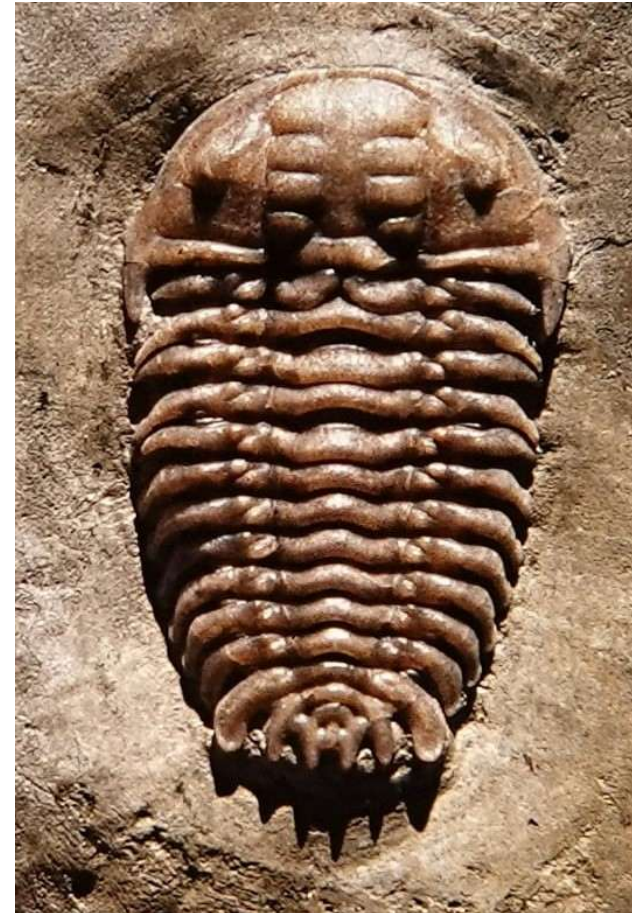


**Inflated rectangular glabella
with deep lateral furrows & holochroal eyes**



Cephalon

**S. Brown collection
Upper Ordovician Verulam Fm.
Anticosti Island, Quebec, CN**



Body

**J. Rush collector
Ex S. Brown collection
AMNH collection
Whitewater Fm.
Preble County, OH**

Tricopelta

Cephalon

- Expanding tripartite glabella with lateral lobes
- Genal angles extend into long curving genal spines
- One of two regional genera with schizochroal eyes
- Conterminant hypostome

Thorax

- 11 pleura

Pygidium

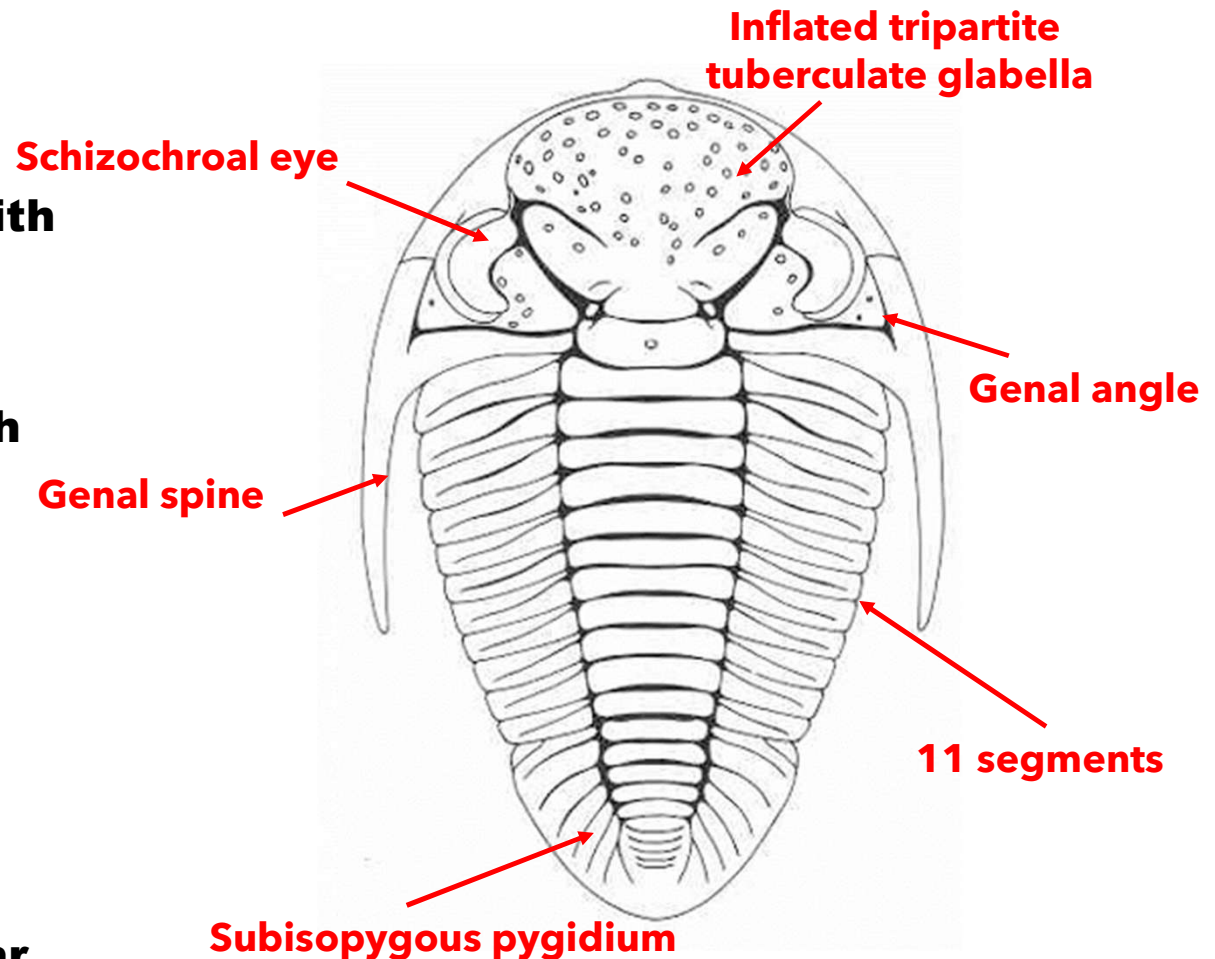
- Subisopygous

Species

- *T. breviceps*

Collecting Sites

- Liberty Fm. St. Leon, IN; Caesar Creek State Park, Harveysburg, OH.



9/15/2025

**Forward expanding glabella,
tuber surface, schizochroal eyes & glabellar furrows**



Cephalon

**Nikki Zehler collector
St. Leon Liberty Fm.
Dearborn County, IN**

**Note intact genal spines, tuber glabella,
furrows, and 11 thoracic segments**



Body

**Nikki Zehler collector
St. Leon Liberty Fm.
Dearborn County, IN**

Achatella

Cephalon

- **Forward expanding tuberculate glabella;**
three pairs of lateral glabellar furrows
- **Genal angles extend into long genal spines**
- **One of two local genera with shizochroal eyes**
- **Conterminant hypostome**

Thorax

- **11 spinose segments**

Pygidium

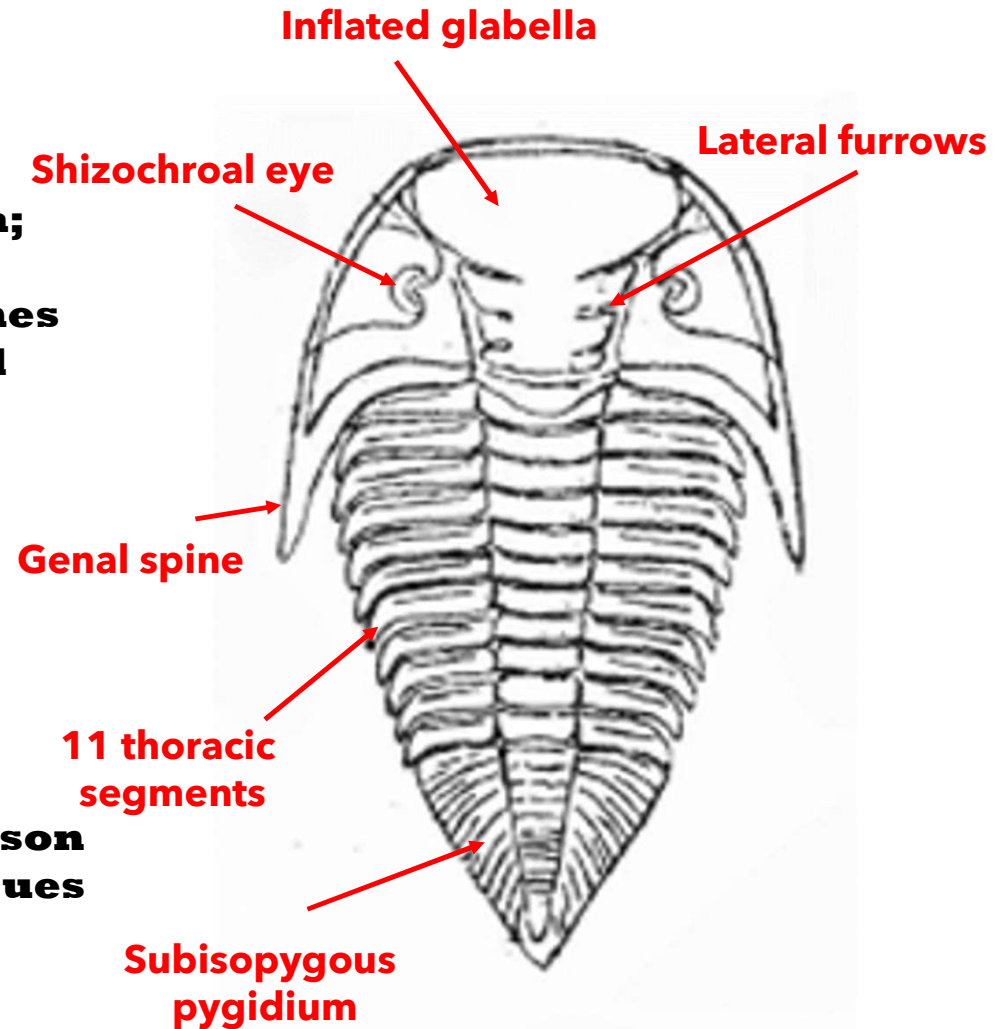
- **Subisopygous**

Species

- ***A. carleyi***

Collecting Sites

- **Fairview Fm. Maysville West Roadcut, Mason County, KY; Hamilton County, Rt. 747 at Dues Rd.**



**Forward expanding glabella,
tuber surface & glabellar furrows**



Cephalon

**S. Brown collection
Verulam Fm., Upper Ordovician
Simcoe County, Ontario, Canada**



Body

**B. Cooper collector, AMNH collection
Upper Ordovician
Kope Formation Fulton Member
Bracken County, KY**

Ceraurus

Cephalon

- **Inflated glabella with lateral furrows.**
- **Beady globose eyes located far out on cheek**
- **Genal angles extend into curving spines**
- **Tuberculate surface**
- **Conterminant hypostome**

Thorax

- **11 spinose segments**

Pygidium

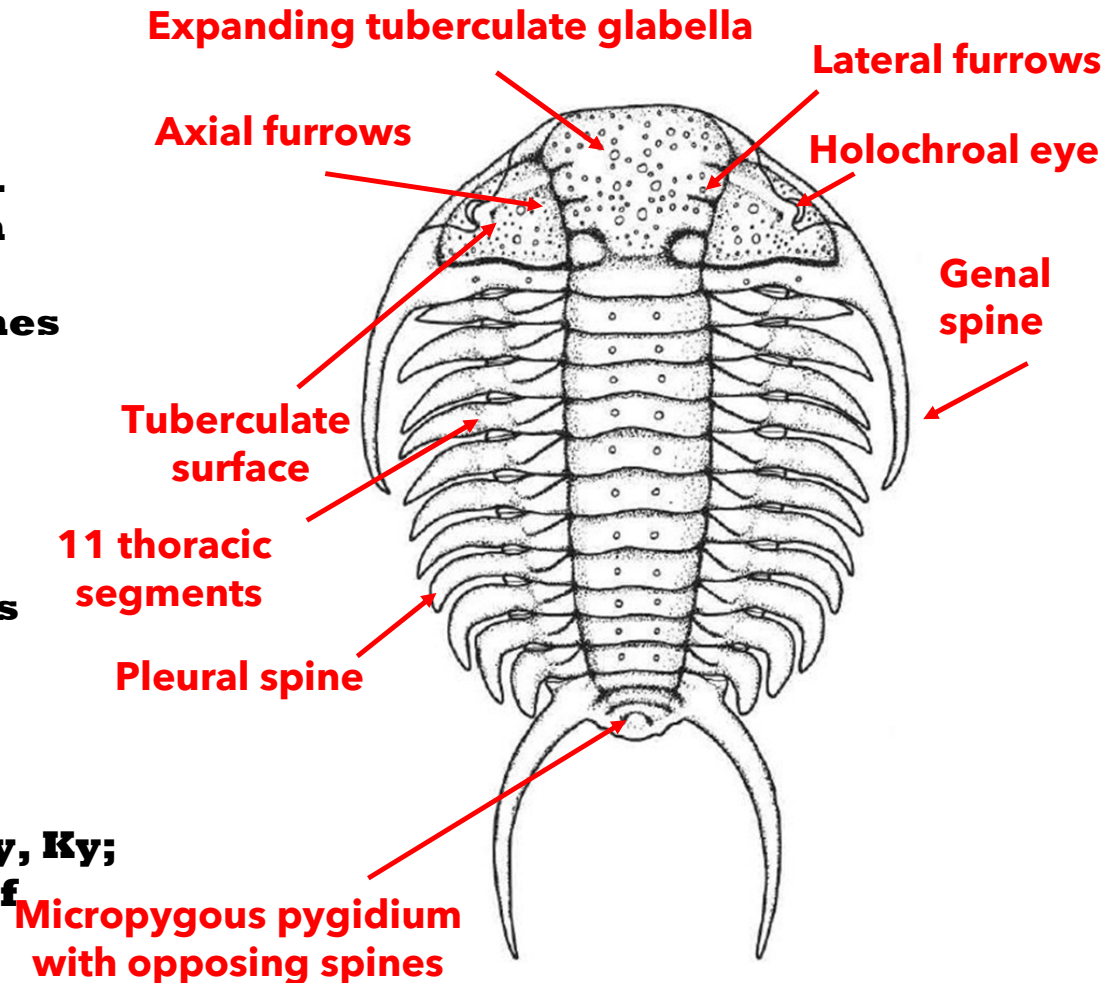
- **Micropygous with two opposing spines**

Species

- ***C. milleranus* (Maysvillian)**
- ***C. miseneri* (Richmondian)**

Collecting Sites

- **Maysville West Roadcut, Mason County, Ky;
Rt. 132, Warren County; Rt. 127 south of
Richmond, IN.**



**Forward expanding inflated glabella
with three pairs of furrows**



Cephalon

J. Rush collector
S. Brown collection
Kope Fm.
Bracken County, KY



Body

Ben Cooper collector
AMNH collection
Upper Ordovician
Kope Formation
Maysville, KY

Isotelus

Cephalon

- **Most common species has rounded anterior profile with genal spines**
- **Holochroal eyes**
- **Conterminant hypostome**

Thorax

- **8 segments**

Pygidium

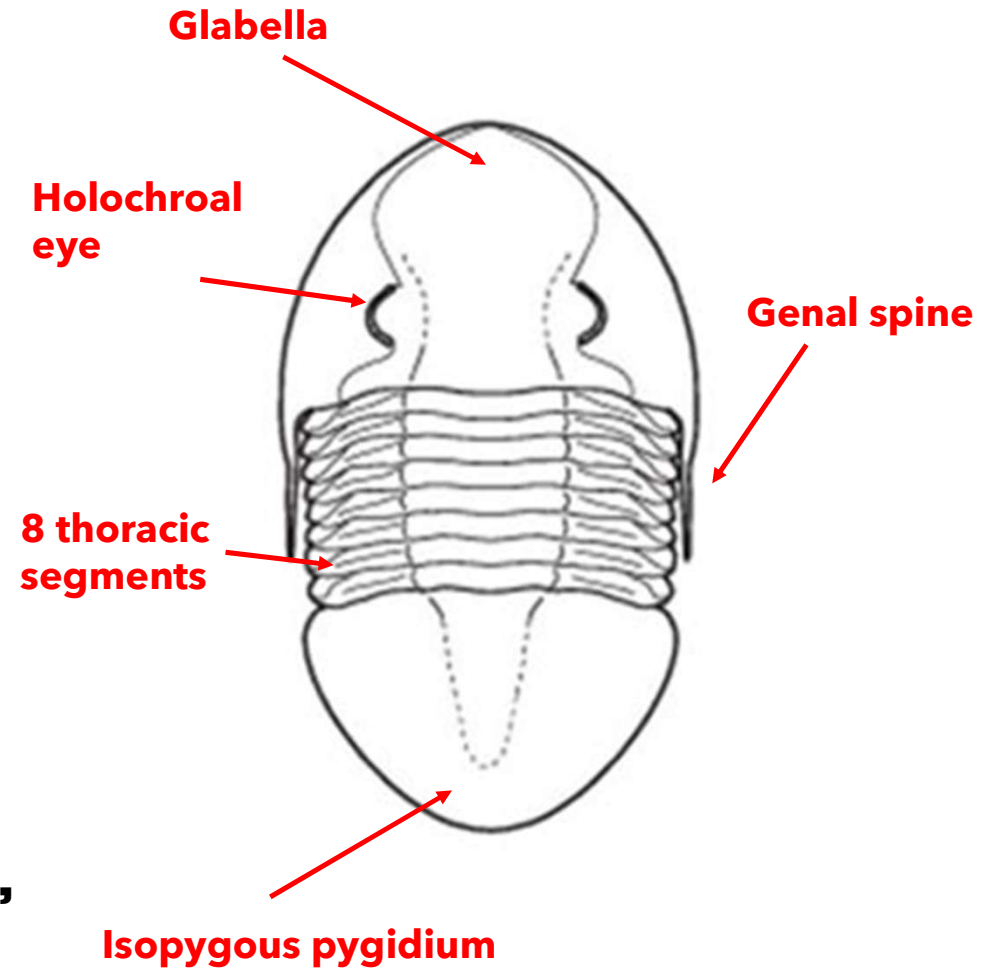
- **Isopygous**

Species

- ***I. maximus***
- ***I. gigas***

Collecting Sites

- **St. Leon, IN; White Oak Creek and Flat-Run, Highland County, OH; Oldenburg, Franklin County, IN.**





Cephalon

**T. Johnson collector
Waynesville Fm.
Adams County, OH**

Glabella defined by arrow-shaped break in cephalon. See previous slide



Body **Knox Cooper collector
Arnheim Fm. Flat Run
Highland County, OH**

Cryptolithus

Cephalon

- **Raised central glabella with lateral lobes, short occipital spine**
- **Lacks eyes; considered blind**
- **Dorsal and ventral perforations arranged in concentric rings**
- **One of two local genera with a natant hypostome**

Thorax

- **6 segments**

Pygidium

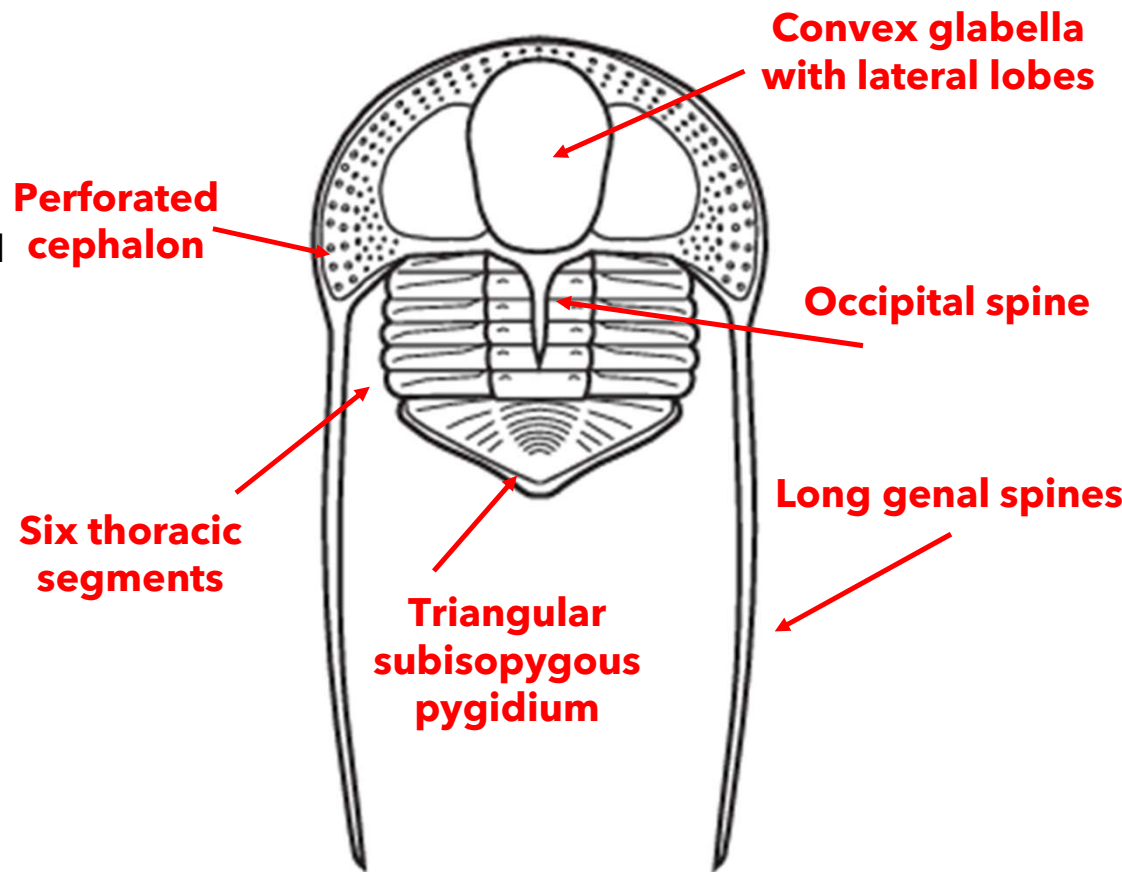
- **Subisopygous**

Species

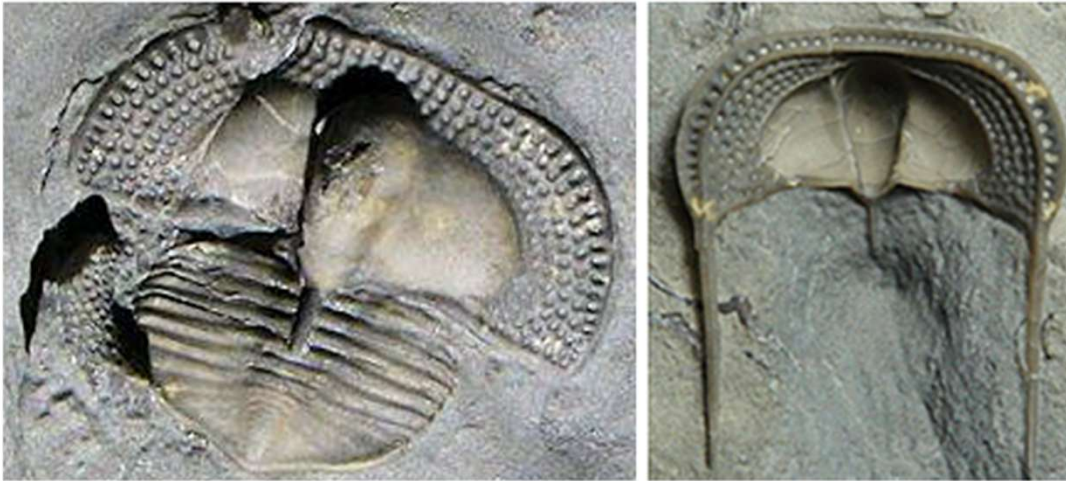
- ***C. tessellatus***

Collecting Sites

- **Kope formation. Sycamore Creek, Hamilton, County, OH; Rt. 52 at Twelve-Mile, Clermont County, OH; Kenton County, KY.**



Raised central glabella with adjacent lobes, dorsal and ventral concentric penetrations & medial occipital spine



Cephalon

**Dorsal and Ventral Views
J. Rush collector
Kope Formation
Northern KY**

Cephalon, thorax & pygidium



Body

**Upper Ordovician
Kope Formation
Kenton County, KY**

Decoroproetus

Cephalon

- Vaulted glabella, narrowing forward
- Spined genal angle
- Holochroal eyes
- One of two local genera with natant hypostome

Thorax

- Ten spinose segments

Pygidium

- Subisopygous

Species

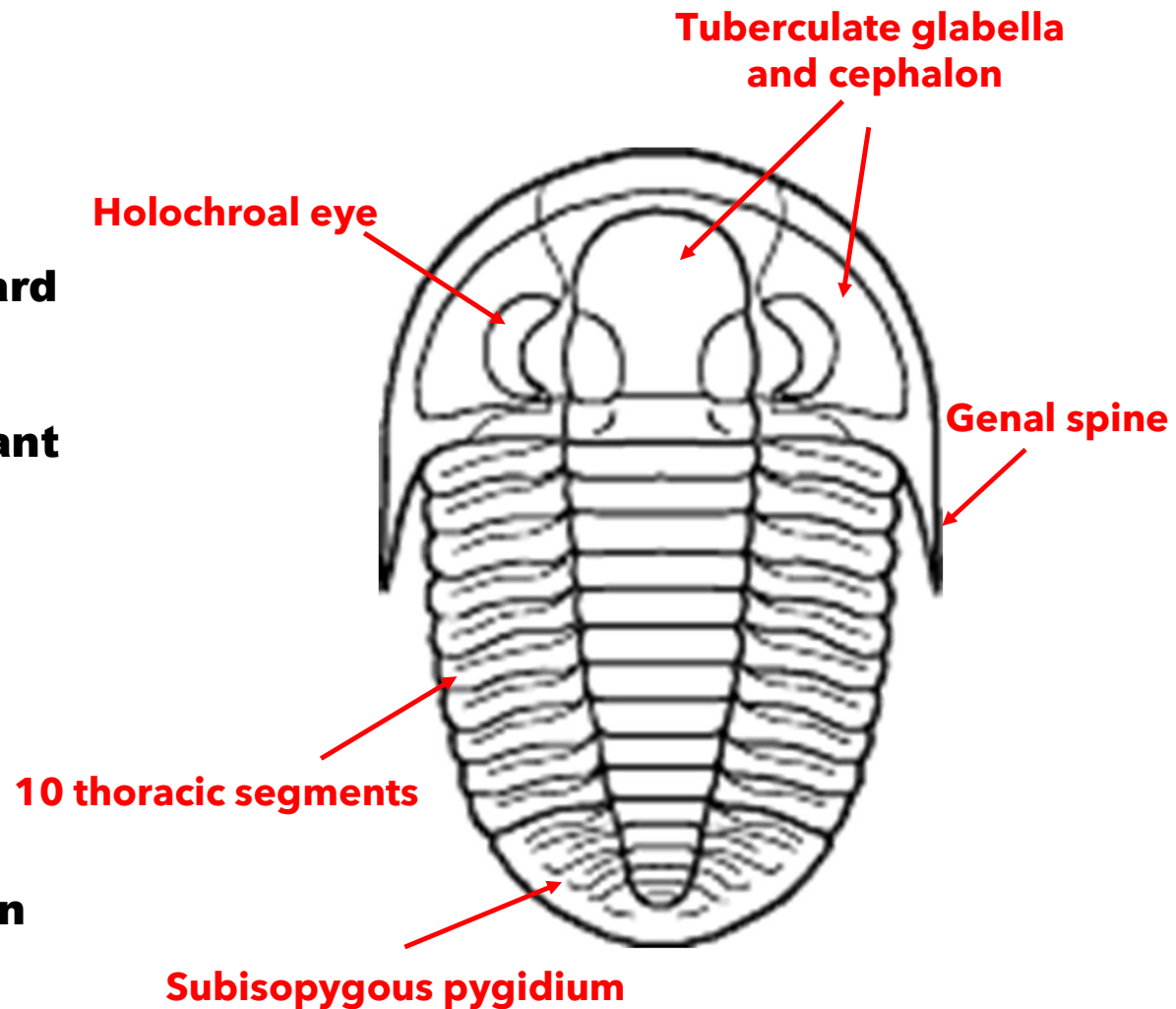
- *D. parviusculus*

Collecting Sites

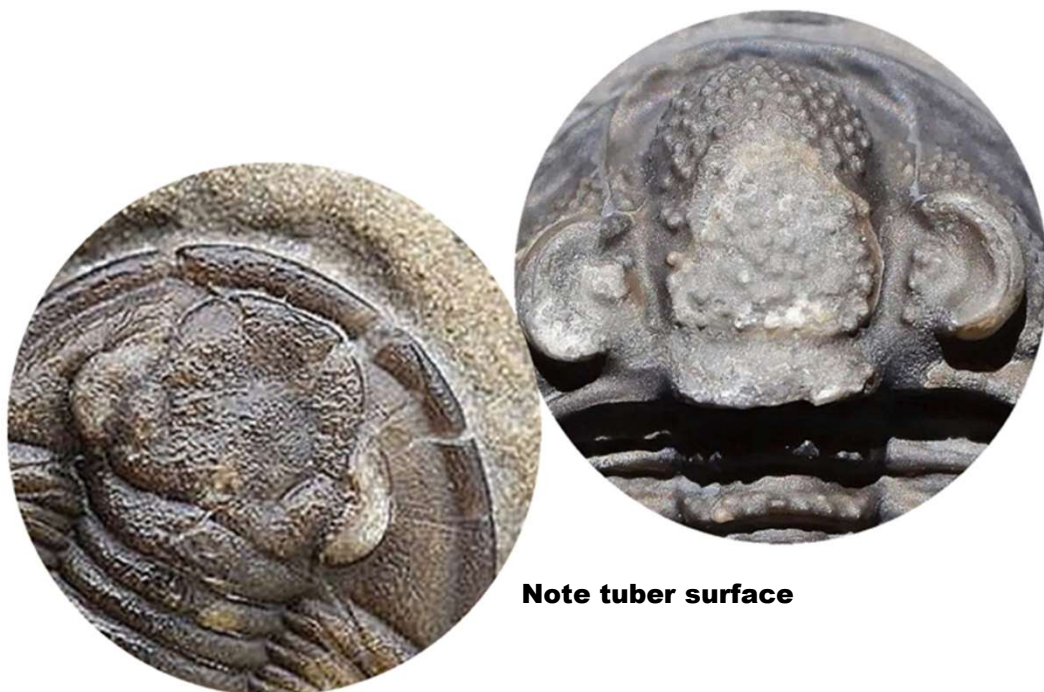
- Kope Formation. AA Hwy, Bracken County, KY



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**Vaulted tuberculate glabella
with holochroal eyes**



Note tuber surface

Cephalon

**Upper Ordovician
Neuville Fm.
Quebec, CN**



Body

**J. Rush collector
Ex S. Brown collection
Kope Fm.
Bracken County, KY**

Allolichas

Cephalon

- Glabella structure complex with fused lateral, occipital, and cranial lobes. Pair of longitudinal furrows divides glabella into three lobes
- Bladelike genal spines
- Holochroal eyes
- Conterminant hypostome

Thorax

- 11 spinose segments

Pygidium

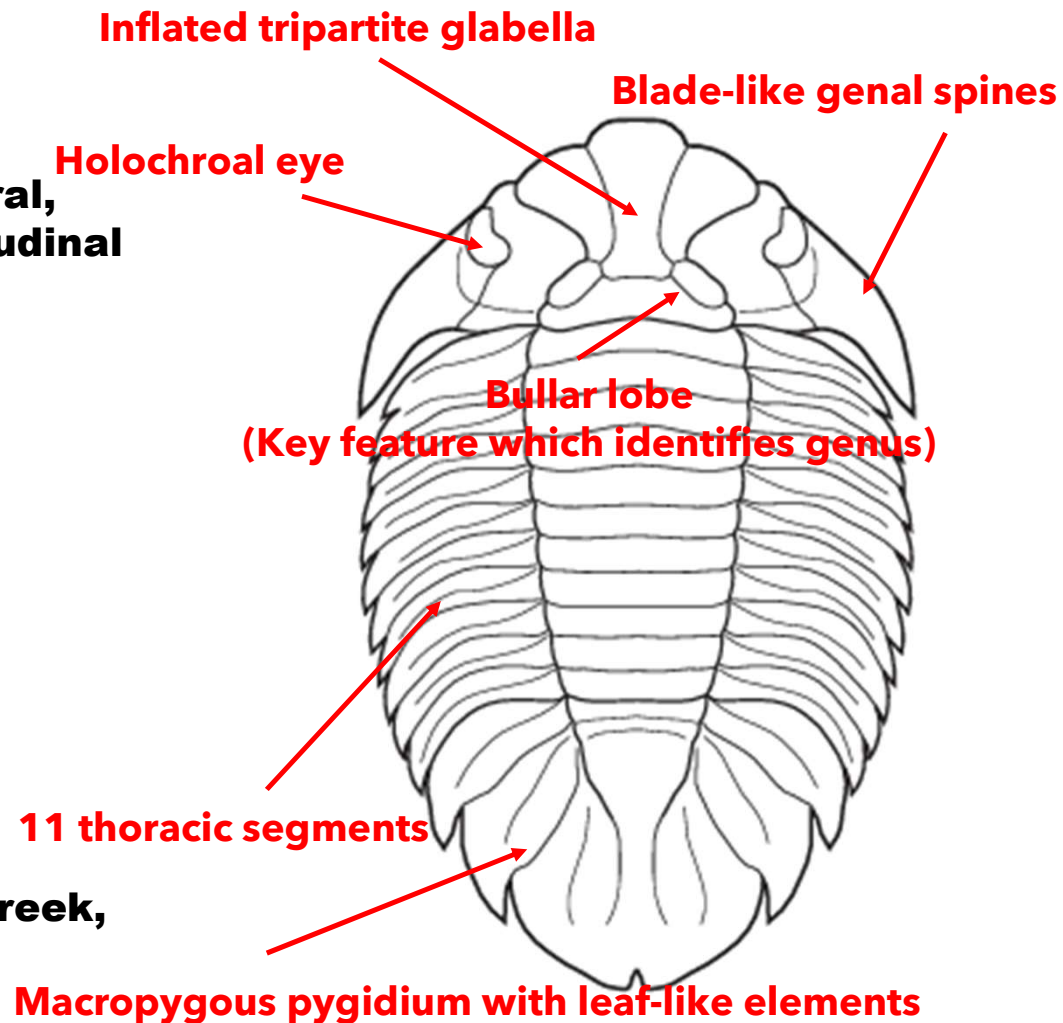
- Macropygous, with 3 pairs of leaflike pleura

Species

- *A. halli*
- *A. harrisi*
- *A. shideleri*

Collecting Sites

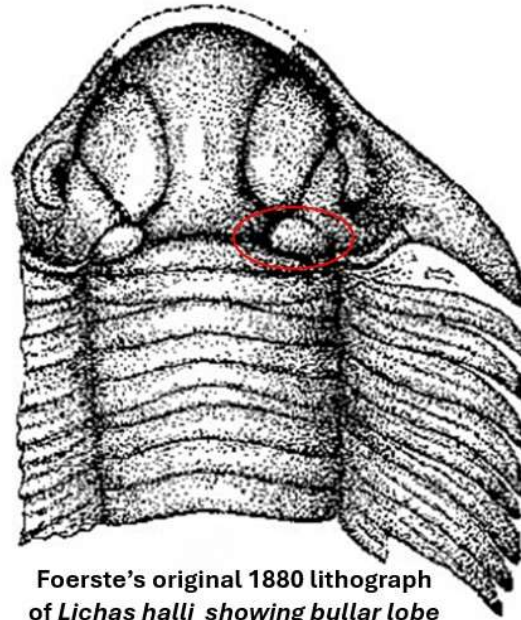
- Oldenburg, Franklin County, IN; White Oak Creek, Flat-Run, Highland County OH.



Inflated tripartite glabella, longitudinal furrows, and outboard eyes



This is a specimen of *Allolichas* from the Cincinnati area showing bullar lobes (in red)



Foerste's original 1880 lithograph of *Lichas halli* showing bullar lobe

***A. halli* showing bullar lobes**
(Courtesy Al Scheer)

Cephalon



Body

J. Rush collector
Allolichas harrisi
Waynesville Fm
Preble County, OH

Meadowtownella

Cephalon

- Raised glabella, lateral lobes, anterior fringe, and genal spines
- ***No occipital spine!***
- Holochroal eyes
- Conterminant hypostome

Thorax

- 10 major spinose segments with numerous secondary spines

Pygidium

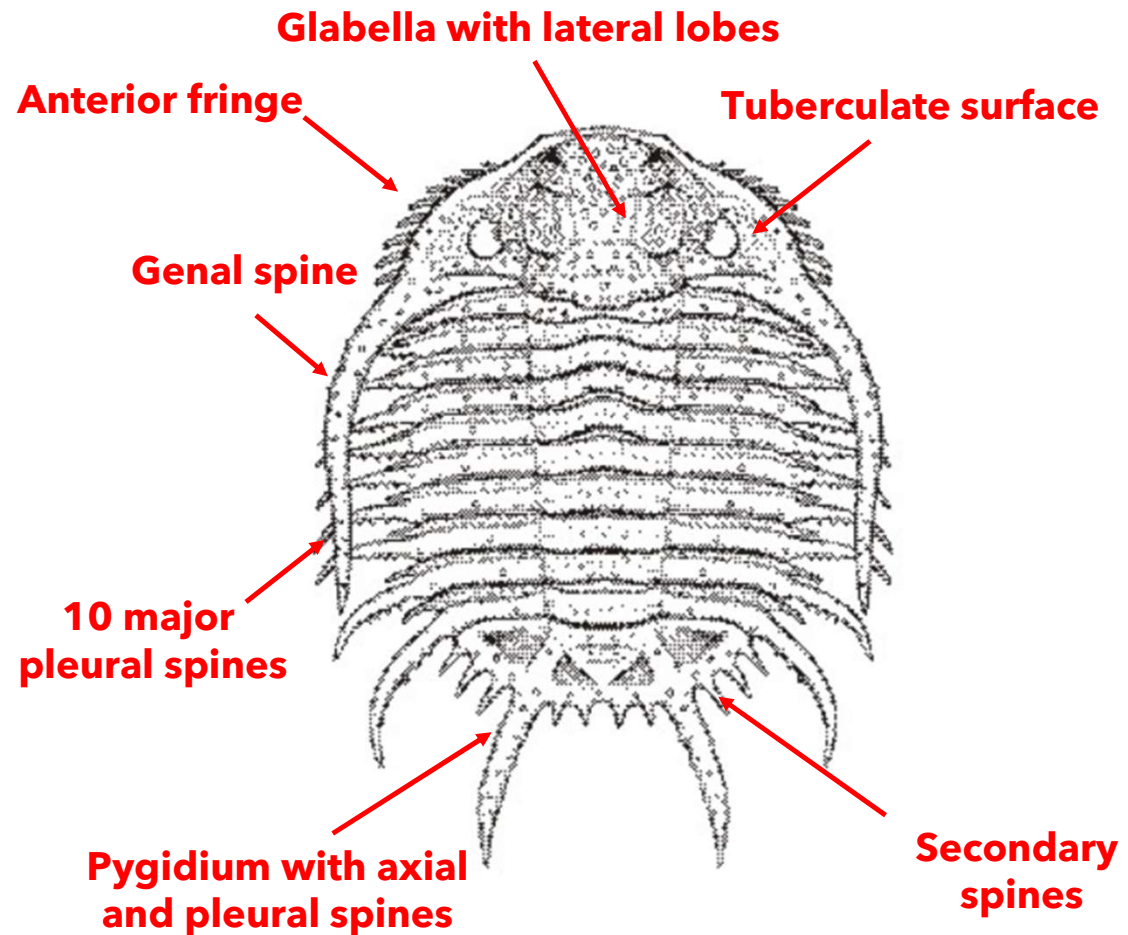
- Micropygous with medial and pleural spines

Species

- *M. crosotus*

Collecting Sites

- Kope Formation. Hamilton, County OH; Bracken County, KY; Covington, KY.



**Raised glabella, lateral lobes,
anterior fringe, genal spines & tuber surface
throughout**

After Prep



Cephalon

**J. Rush collector
Upper Ordovician Kope Fm.
Northern KY**

Before Prep



**Slightly disarticulated specimen
showing exoskeleton features**



Body

**J. Rush collector
S. Brown collection
Upper Ordovician Kope Fm.
Hamilton County, OH**

Acidaspis

Cephalon

- Glabella tapers forward extending to anterior margin bordered by lateral lobes and eyes
- Anterior fringe and genal spines
- **Note pronounced occipital spine!**
- Holochroal eyes
- Conterminant hypostome

Thorax

- 10 major thoracic segments

Pygidium

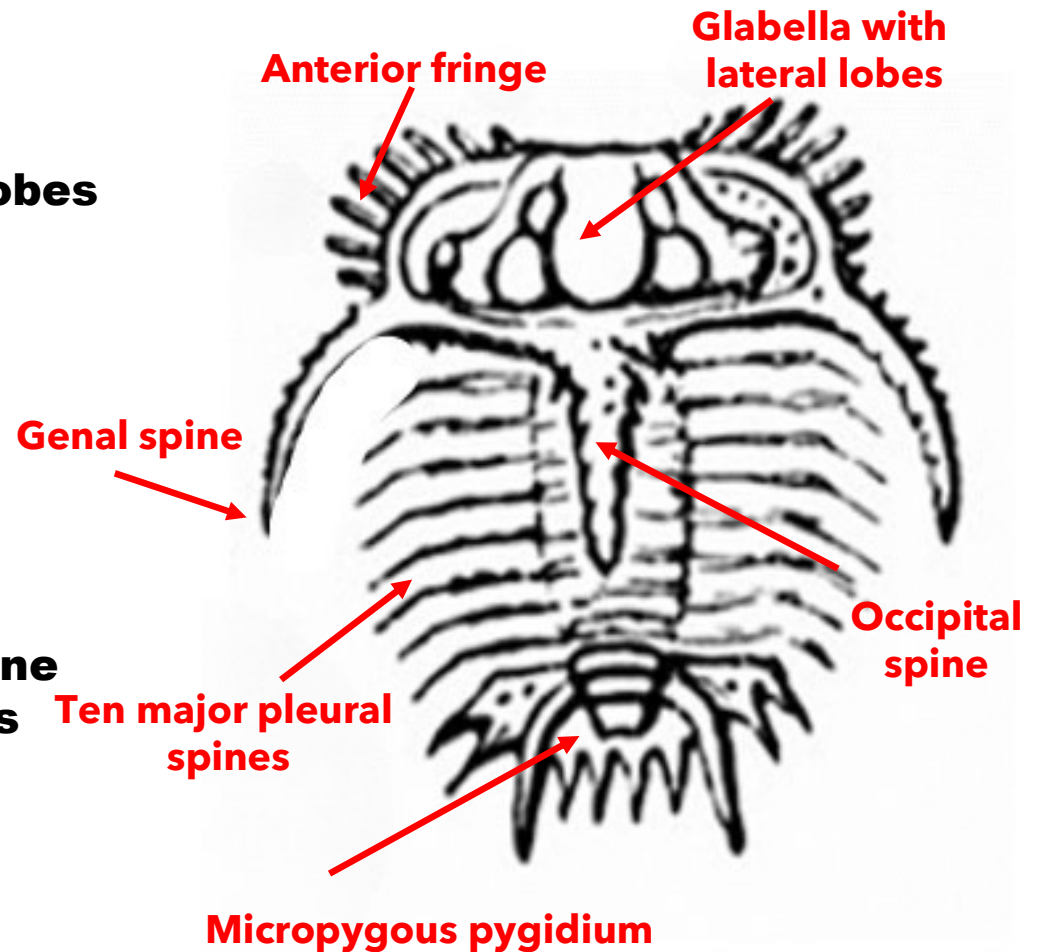
- Micropygous, with 2 – 3 axial rings, one or more pairs of tubular border spines

Species

- *A. cincinnatiensis*
- *A. n. sp.*

Collecting Sites

- Found throughout the Cincinnatian



Glabella with tuberculate surface, vertical satellite lobes & large occipital spine



Adult, J. Rush collector



**Small juvenile, C. Puritz collector
S. Brown collection**

Cephalon

**Upper Ordovician Kope Fm.
Northern Kentucky**

Note large occipital spine!



Body

**Ben Cooper collector
AMNH collection
Upper Ordovician Kope Fm.
Pendleton County KY**

Odontopleura

Cephalon

- Raised glabella with lateral lobes.
- Long genal spines
- Outboard globose holochroal eyes
- ***No occipital spine!***
- Anterior fringe and genal spines
- Conterminant hypostome

Thorax

- 10 major segments with secondary spines

Pygidium

- Micropygous, axial & pleural spines

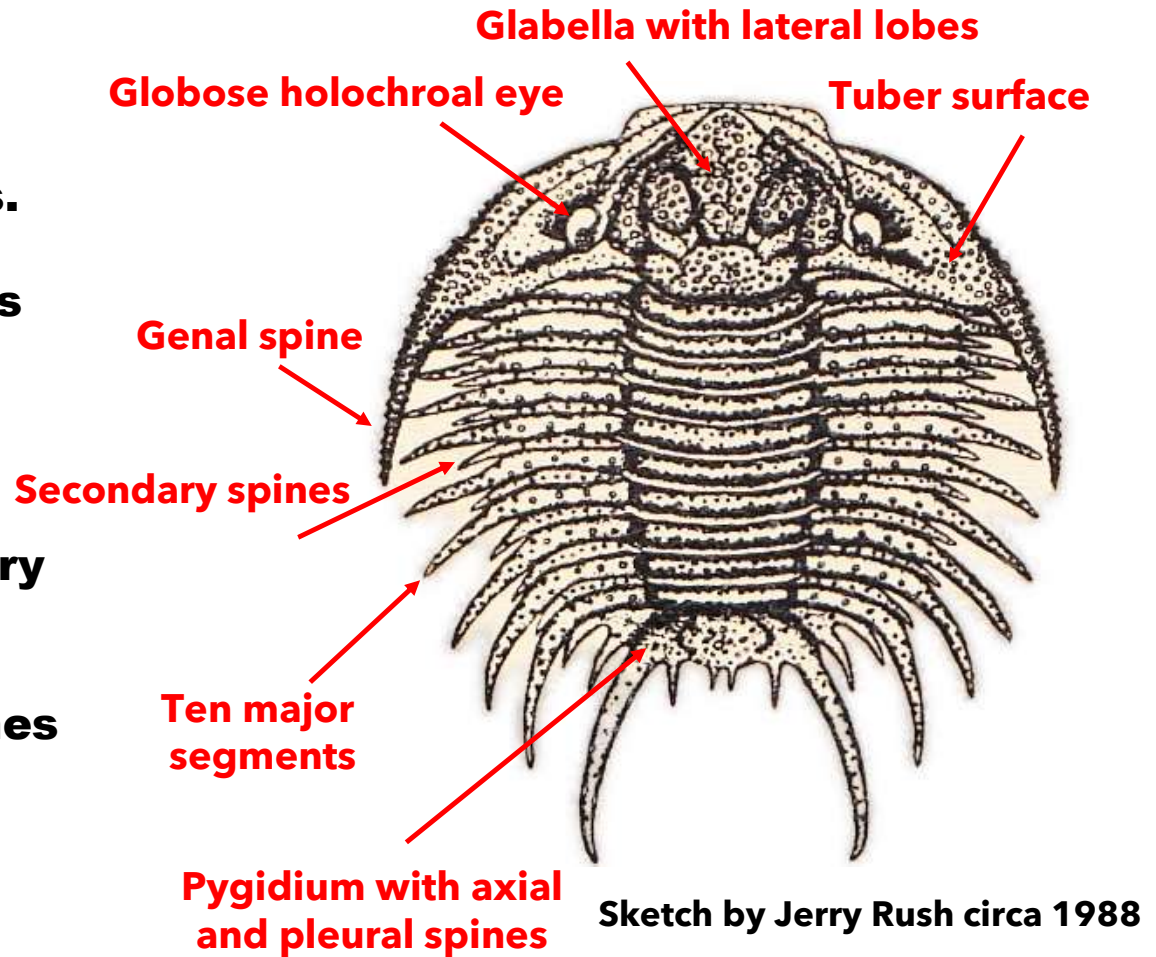
Species

- *O. n.sp.*

Collecting Sites

- Waynesville Fm. Franklin County, IN; Montgomery County, OH.

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Sketch by Jerry Rush circa 1988

Glabella with lateral lobes, anterior margin fringe & tuberculate surface



Cephalon

Dorsal & ventral views of adjacent specimen showing partial enrollment



Body

**J. Rush, collector
Upper Ordovician
Waynesville Fm.
Montgomery County, OH**

Hemiarges

Cephalon

- Tripartite glabella with inflated lateral lobes.
- Blade-like genal spines.
- Entire body covered by tubercles.
- Conterminant hypostome

Thorax

- Eleven spinose segments

Pygidium

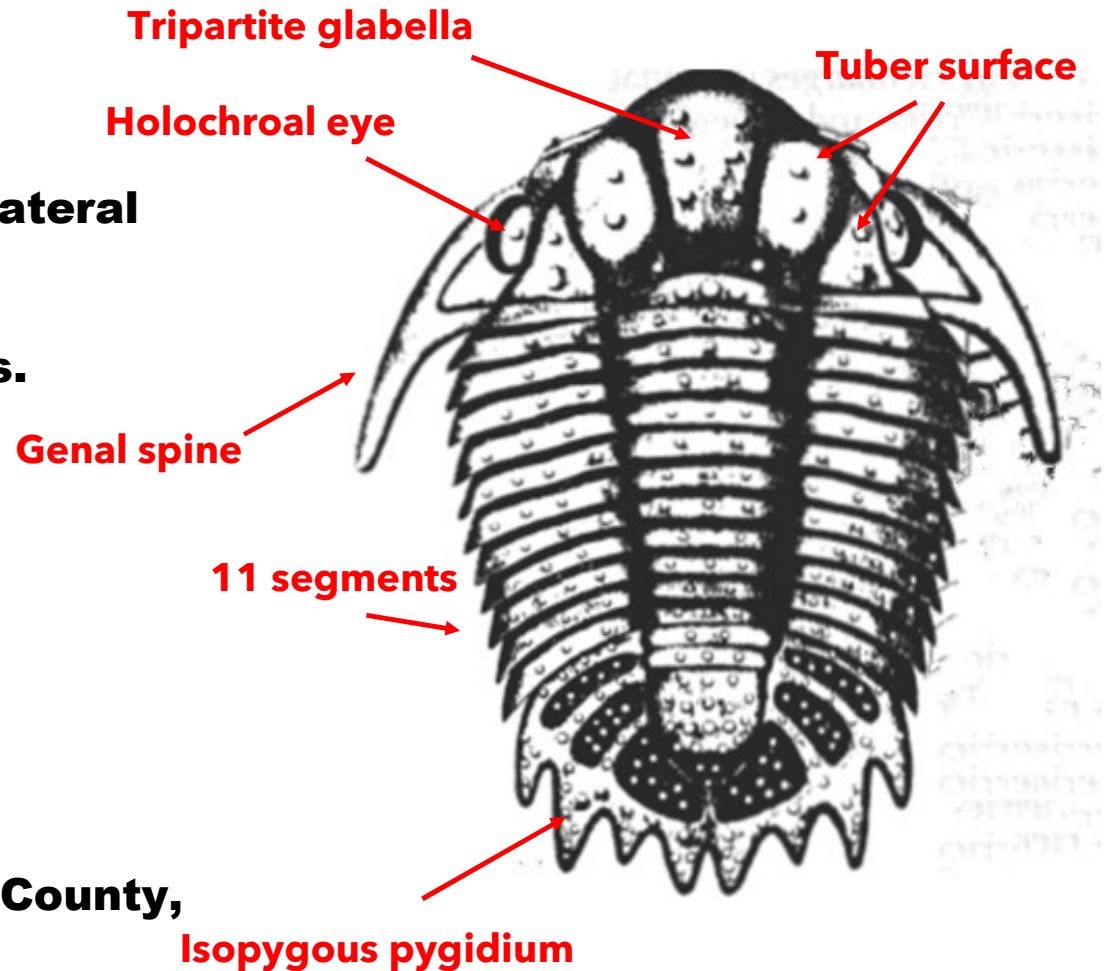
- Isopygous with four pairs of unequal spines

Species

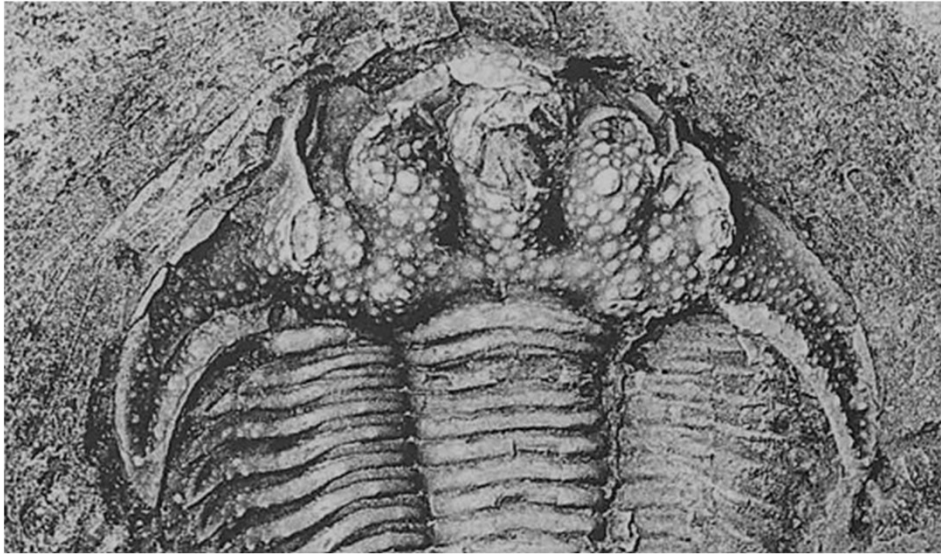
- *H. cf. paulianus*

Collecting

- Liberty Fm. Beasley Run, Preble County, OH.



Tripartite glabella, various size tubers, inflated lateral lobes, and bladed genal spines



Cephalon

**Upper Ordovician
Verulam Fm.
Simcoe County, Ontario CN**



Body

**Upper Ordovician
Verulam Fm.
Simcoe County, Ontario, CN**

B. F. minuens
Collecting Experience

Collecting

- Nowadays, *Flexicalymene retrorsa minuens* frequently collected from the Liberty Formation at two sites; Rt. 1 @ St. Leon, IN, and Harveysburg, OH (Caesar Creek State Park)
- (Foerste, 1910, 1919) says ...“Rare in the upper part of the Richmondian, **from the Liberty to the Elkhorn**, but occasional specimens may be found. These usually are rather small”...
- Specimen on right from Whitewater Formation collected in the 1930s



~13 mm actual size

Enrolled specimen, Whitewater Formation,
Richmond, IN. Collected by John Misener

St. Leon, Indiana

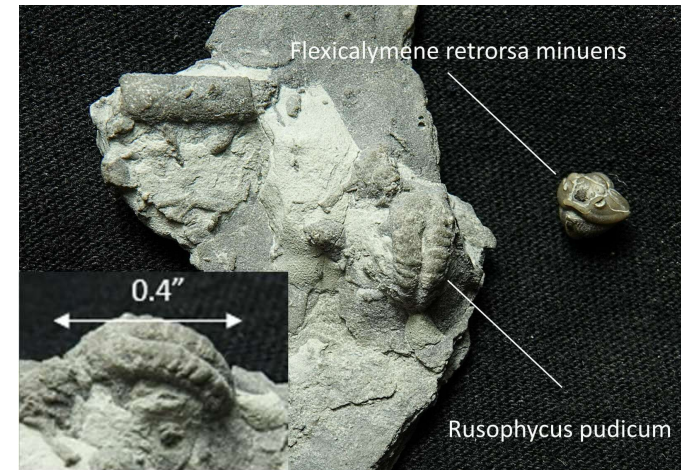
Upper row - Jerry Rush collector



Growth Series



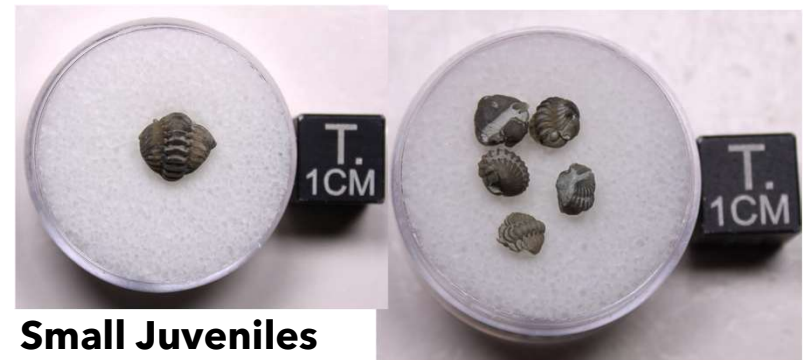
**Juvenile with corneas on the left.
Adult with right-eye cornea on right.**



**Juvenile body fossil with *Rusophycus*
S. Brown collection**



Nikki Zehler & Cole Simpson collectors



Small Juveniles

**C. Puritz collector
S. Brown collection**

Caesar Creek State Park, Ohio

Mature Individuals



**Ron Fine collector
Liberty Formation
Caesar Creek State Park Spillway
Waynesville Ohio**

Juvenile Individuals

**Brooke Storer collected ~300
Individuals from the spillway floor**



**Brooke Storer collector
S. Brown collection
Liberty Formation
Caesar Creek State Park Spillway
Waynesville Ohio**

**Gutter cast with several *F. minuens*
Rusophycus preserved in positive hypo relief**



**Liberty Formation
Caesar Creek State Park Spillway
Waynesville Ohio**

Flexicalymene Species Timeline

Species	C1	C2	C3	C4	C5			C6
	Edenian	Maysvillian		Richmondian				
	Kope	Fairview	Grant Lake	Arnheim	Waynesville	Liberty	Whitewater	Elkhorn
<i>F. abbreviata</i>	X							
<i>F. granulosa</i>	X	X						
<i>F. meeki</i>		X	X					
<i>F. retrorsa</i>				X	X	X		
<i>F. retrorsa minuens</i>						X	X	X

• *F. abbreviata*, *F. granulosa*, *F. meeki*, & *F. retrorsa* extent based on (Hanke, 2004), (Davis,1998) and collecting experience

• *F. retrorsa minuens* based on (Foerste, 1910, 1919), (Davis,1998), and collecting experience

HANKE, B. R. 2004. Flexicalymene (Trilobita) from the Cincinnati Series (Upper Ordovician) of Ohio, Indiana, and Kentucky: a case study of microevolutionary pattern within a single species lineage in a sequence stratigraphic framework. Unpublished Ph.D. diss., University of California Riverside, Riverside, CA.

FOERSTE, A.F. 1910, Preliminary Notes on Cincinnati and Lexington Fossils of Ohio, Indiana, Kentucky, and Tennessee: Denison University, Bulletin of the Scientific Laboratories, v.16, p.17-87.

FOERSTE, A.F. 1919. Note of Isotelus, Acrolichas, Calymene, and Encrinus. Bulletin of the Scientific Laboratories, v.19, p.65-81.

Davis, R.A., and R.J. Cuffey, (eds.), 1998. Sampling the layer cake that isn't: the stratigraphy and paleontology of the type-Cincinnati. Ohio Division of Geological Survey Guidebook No. 13

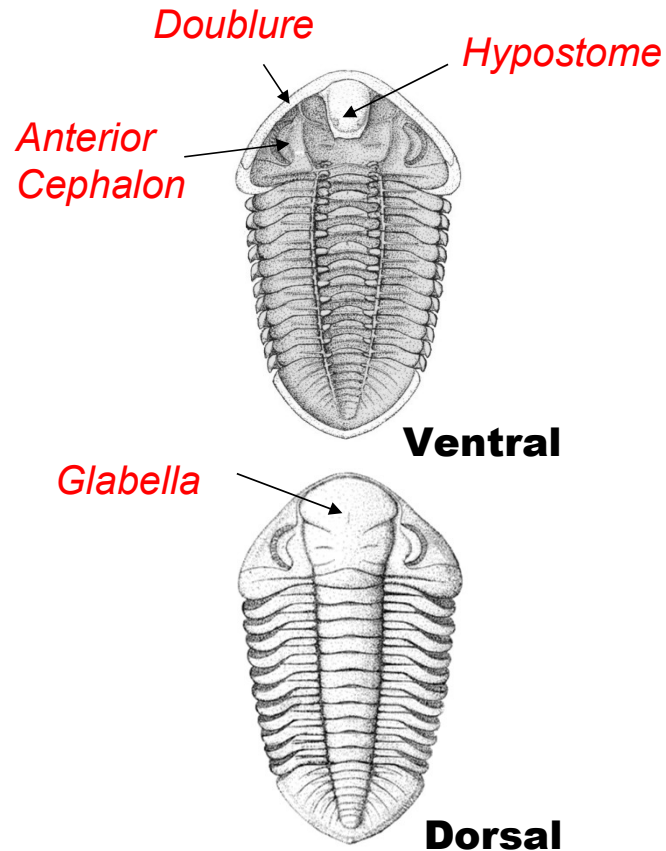
C. Hypostomes



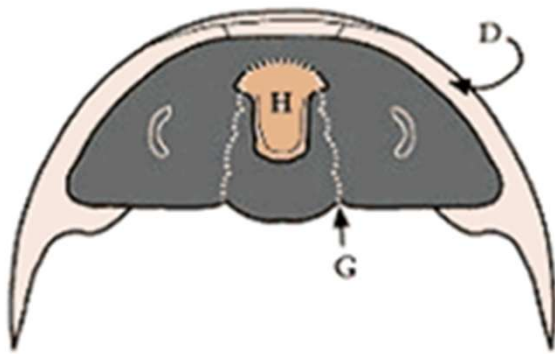
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What's a Hypostome?

- **Hypostome literally means “under mouth”.**
- **In trilobites, it's a shield-shaped calcified structure thought to be a mouthpart**
- **Located ventrally under the medial anterior cephalon**
- **Anterior edge usually aligned with edge of the overlying glabella**
- **Can be free or attached to anterior doublure**

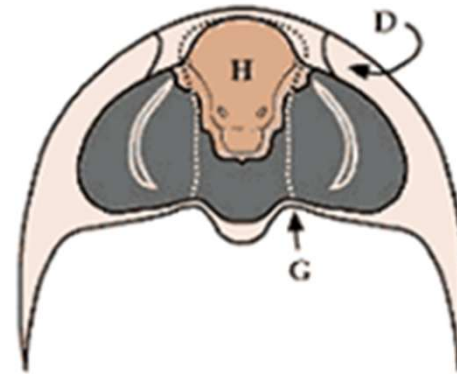


Hypostome Classification – Two Types Occur in Regional Cincinnatian



Natant

Hypostome not attached to doublure, aligned with front edge of glabella. Attributed to deposit feeders

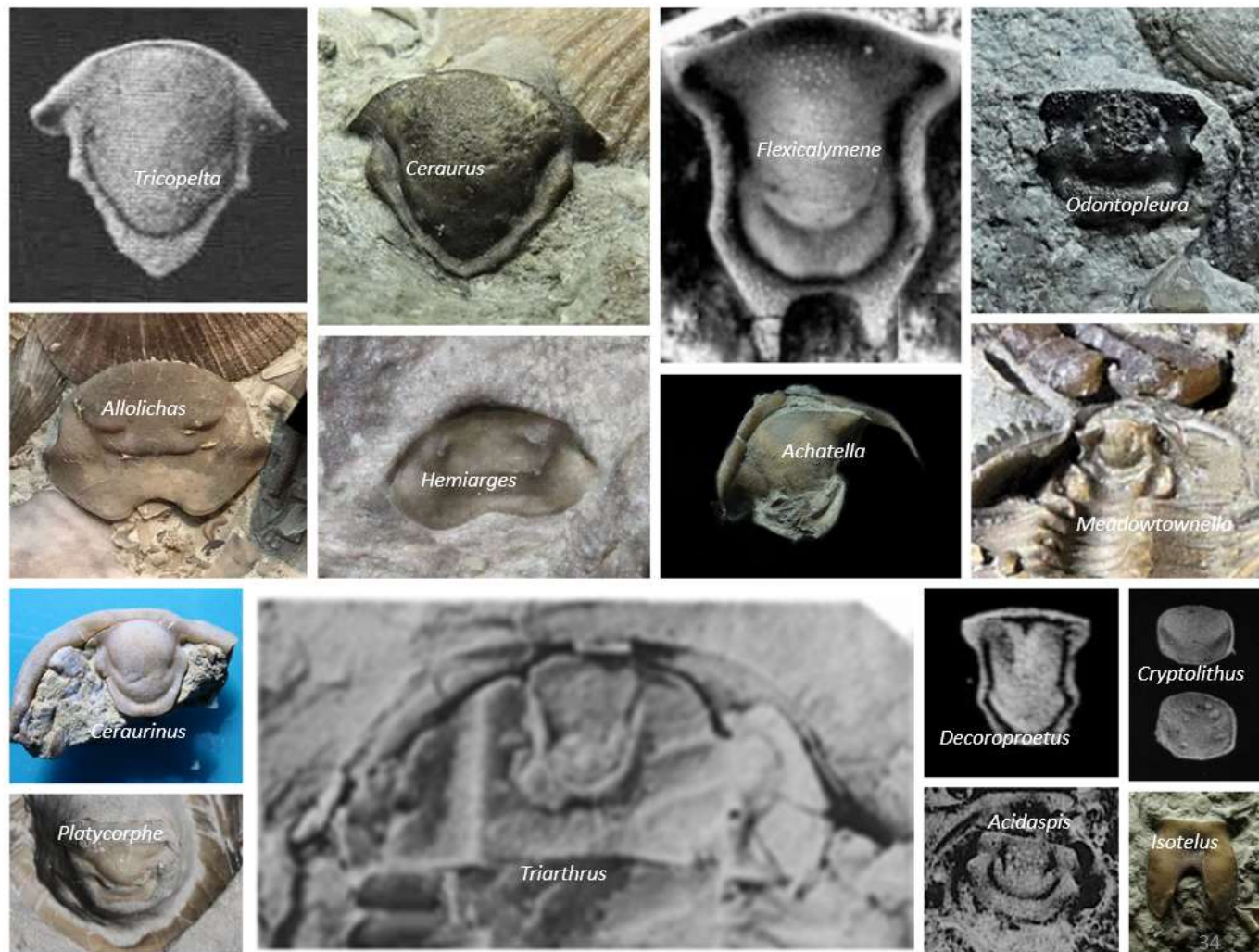


Conterminant

Hypostome attached to anterior doublure aligned with front edge of glabella. Attributed to predators.

Classification based on geometrical relationship between doublure and glabella.

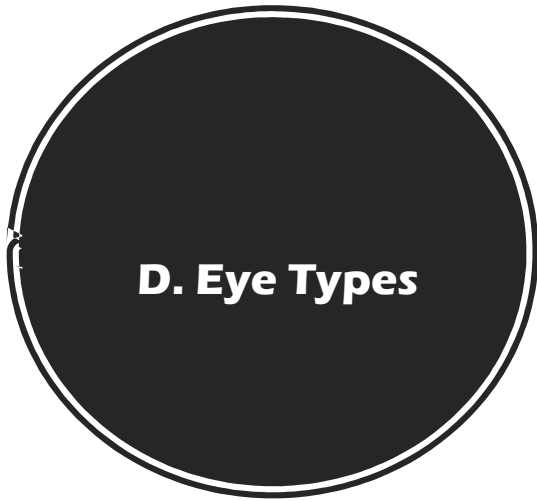
**H – hypostome
G – glabella
D - doublure**



Cincinnatian Trilobitea & Their Hypostomes

- **Natant**
Cryptolithus
Decoroproetus
- **Conterminant**

Tricopelta
Ceraurus
Ceraurinus
Flexicalymene
Allolichas
Hemiarges
Achatella
Acidaspis
Odontopleura
Isotelus
Platycoryphe
Triarthrus
Meadowtownella



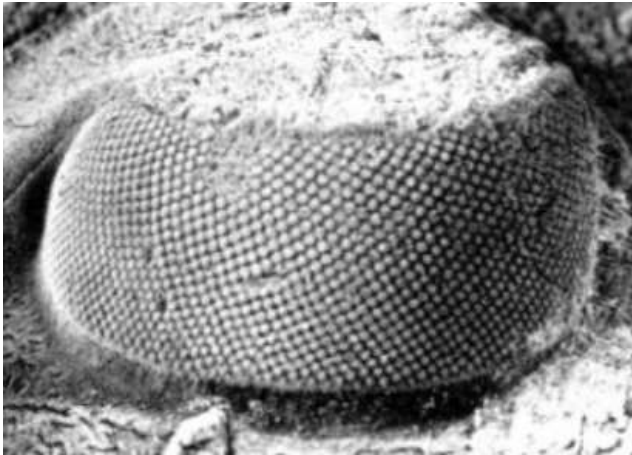
Eye Types

- **Two major eye types**
 - **Holochroal**
 - **Schizochroal**
- **Most trilobites have holochroal eyes**
- **Of the fourteen regional genera**
 - **Eleven are holochroal**
 - **Two are schizochroal**
 - **One is blind**

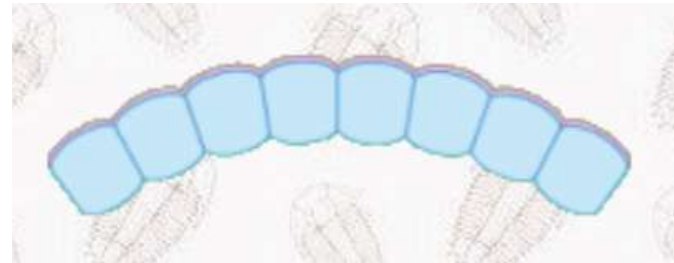
Order	Family	Genus	Eye Structure
Asaphida	ASPHIDAE	<i>Isotelus</i>	Holochroal
Lichida	LICHIDAE	<i>Allolichas</i>	Holochroal
		<i>Hemiargus</i>	Holochroal
Odontopleurida	ODONTOPLEURIDAE	<i>Acidaspis</i>	Holochroal
		<i>Meadowtownella</i>	Holochroal
Phacopida	CALYMENIDAE	<i>Flexicalymene</i>	Holochroal
	HOMALONOTIDAE	<i>Platycorphe</i>	Holochroal
	PTERYGOMETOPIDAE	<i>Tricopelta</i>	Schizochroal
		<i>Achatella</i>	Schizochroal
	CHEIRURIDAE	<i>Ceraurinus</i>	Holochroal
		<i>Ceraurus</i>	Holochroal
Proetida	PROETIDAE	<i>Decoroproetus</i>	Holochroal
Ptychoparida	OLENIDAE	<i>Triarthrus</i>	Holochroal
Trinucleida	TRINUCLEIDAE	<i>Cryptolithus</i>	Blind

Holochroal Eye

Eye Structure



- Many eye lenses covered by a single corneal layer



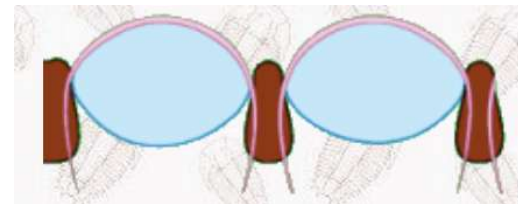
- Characterized by **close packing of biconvex lenses** beneath a **single corneal layer** that covers all of the lenses.
- Lenses are generally hexagonal in outline and range in number from one to more than 15,000 per eye!
- Cross section reveals no sclera between lenses (blue)
- Single cornea (pink) covers all lenses
- Corneal membrane on surface only

Schizochroal Eye

Eye Structure



- Many eye lenses each of which is covered by an individual layer



- Schizochroal eyes are made up of a few to more than 700 relatively **large, thick lenses**, each covered by a **separate cornea**.
- Each lens positioned in a conical or cylindrical mounting separated from its neighbors by **sclera** (brown) between lenses which is very deep
- One cornea (pink) per lens (blue)
- Corneal membrane extends into sclera



Cincinnatian Eye Types

- **Blind**
Cryptolithus
- **Schizochroal**
Tricopelta

Achatella

- **Holochroal**
Decoroproetus

Acidaspis

Triarthrus

Meadowtownella

Odontopleura

Flexicalymene

Hemiarges

Ceraurus

Allolichas

Platycoryphe

Ceraurinus

Isotelus

E. Enrolled Examples



Enrolled Examples

- *Ceraurinus icarus* (Jerry Rush)
- *Platycoryphe christyi* (Jerry Rush)
- *Achatella carleyi* (Cole Simpson)
- *Acidaspis cincinnatiensis* (Dan Cooper)
- *Isotelus maximus* (eBay Photo)
- *Flexicalymene meeki* (Dan Cooper)
- *Triarthrus beckii* (Anonymous)
- *Meadowtownella crosota* (Jerry Rush)
- *Ceraurus milleranus* (Jerry Rush)
- *Odontopleura* sp. (Jerry Rush)
- *Cryptolithus tessalatus* (Anonymous)
- *Tricopelta breviceps* (Cole Simpson)
- *Decoroproetus parviusculus* (Jerry Rush)

Note: The lichids *Hemiargus* & *Amphilichas* probably didn't enroll

F. Dorsal/Ventral Views

Left-to-Right Paired Dorsal/Ventral Views

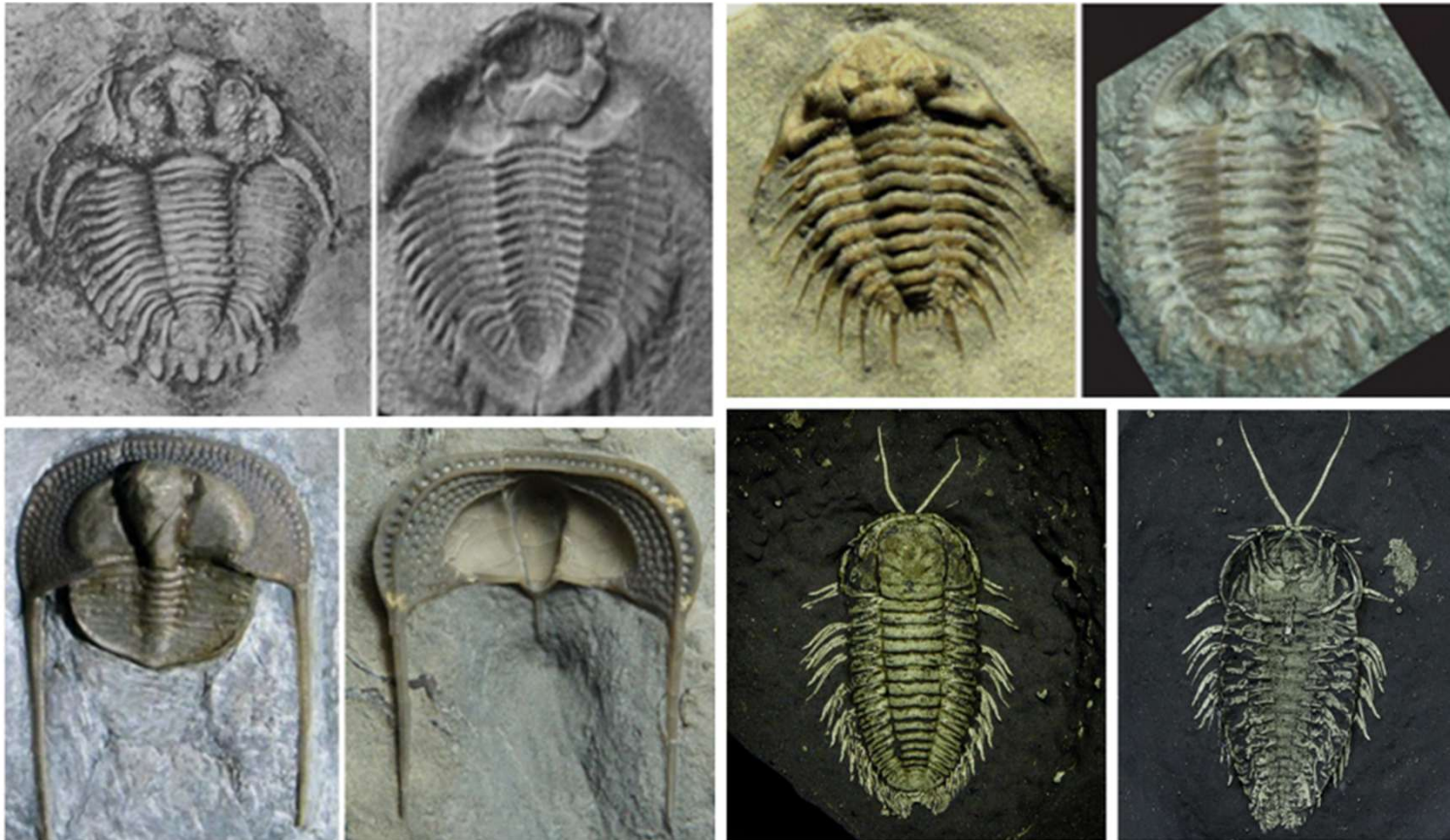
- *Isotelus* (D. Cooper)
- *Ceraurus* (B. Cooper)
- *Flexicalymene* (D. Cooper)
- *Ceraurinus* (M. Hansel/J. Kallmeyer)





**Left-to-Right Paired
Dorsal/Ventral Views**

- ***Alalichas* (D. Cooper)**
- ***Decoroproetus* (E Rush Jr.)**
- ***Acidaspis* (E. Rush Sr)**
- ***Tricopelta* (N. Zehler)**



**Left-to-Right Paired
Dorsal/Ventral Views**

- ***Hemiarges***
- ***Meadowtownella* (J, Rush)**
- ***Cryptolithus* (J. Rush)**
- ***Triarthrus* (M. Martin)**