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EARLY CAMBRIAN FAUNAS FROM EASTERN SAN BERNARDINO COUNTY, CALIFORNIA

by Jack D. Mount[1]

Introduction

Moderately to highly fossiliferous lower Cambrian clastic and carbonate rocks crop out at localities scattered throughout much of the Mojave Desert in eastern San Bernardino County, California. The original discovery of fossiliferous lower Cambrian rocks was made in the southern end of the Marble Mountains about 3.3 kilometers northeast of the railroad siding of Cadiz. Similar sections have since been located in the Providence, Kelso, New York and Mesquite Mountains and Silurian and Salt Spring Hills, all in eastern San Bernardino County. The present report, which is the fifth in a series of preliminary notes making known the results of my research on the faunas from these rocks, figures 29 Early Cambrian fossils, more than tripling the number of taxa known prior to the initiation of my studies.

Previous Studies

More than 40 formal and informal papers, notes and abstracts have been published dealing with aspects of the paleontology and stratigraphy of the study area; however, only the more useful references are described as follows.

Darton (1907, 1915) first described the lower Cambrian section in the southern Marble Mountains as part of his study of the geology along the route of the Santa Fe Railroad. Clark (1921) described in more detail this same section and listed 4 trilobite taxa. Using Clark's original collection from the classical locality near the old Vaughan Quarry at the end of the Marble Mountains (see figure A), Resser (1928) prepared the first systematic report on the fossils describing 6 taxa, 3 of them new olenellid trilobites.

As the results of studies for graduate degrees at the University of California, J. C. Hazzard published a series of papers (Hazzard and Crickmay, 1933; Hazzard and Mason, 1936; Hazzard, 1937a, 1938, 1954) describing in some detail the Cambrian stratigraphy and formalizing the nomenclature for the previously unnamed rock units in the area. Hazzard and Crickmay described an additional new species of olenellid trilobite.

Riccio (1949, 1952) studied the ontogeny and morphology of the olenellid trilobites from the Marble Mountains but made no new additions to the lower Cambrian faunal list for the area.

Four preliminary notes were published by Mount (1973, 1974a, 1974b, 1974c) outlining the progress of his current study of the systematics and biostratigraphy of the Early Cambrian faunas.

Lithostratigraphy

Hazzard (1954) and Stewart (1970) have described the lower Cambrian sections in detail and have divided the lower Cambrian into 5 formations (see figure B).

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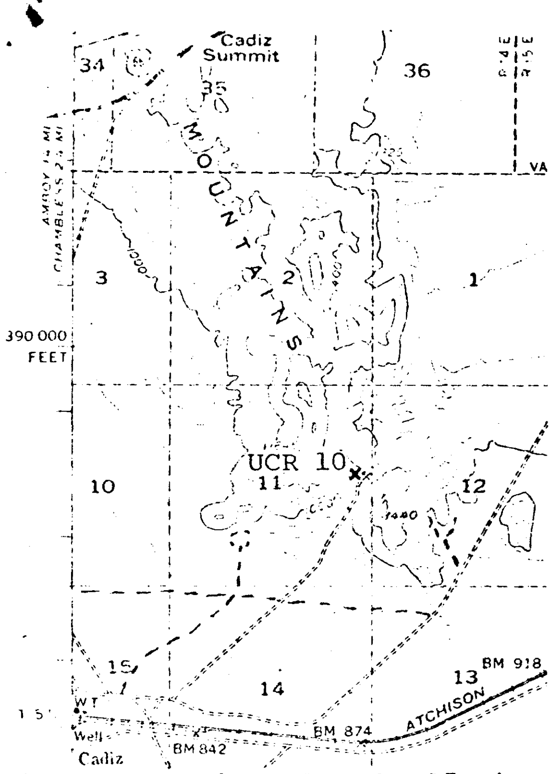


Fig. A. Portion of Danby 15 min. quadrangle (1956 ed.) showing classical lower Cambrian locality in Latham Shale at southern end of Marble Mountains--UCR loc. 10 [=loc. M-5 of Hazzard and Crickmay (1933)].

The lower Cambrian rocks consist of a conformable sequence of shallow marine, clastic and carbonate sediments which overlies cratonic Precambrian plutonic or metamorphic rocks to the south and and Precambrian marine sediments to the north. The youngest Precambrian basement rock, a porphyritic, coarse-grained granite, in the Marble Mountains area has been dated at 1.4 billion years (Lanphere, 1964).

The lowest sedimentary unit, the Wood Canyon Formation of Nolan (1929), consists of 125 to over 400 meters of a varied assemblage of rocks ranging from shale to sandstone, quartzite and conglomerate. A single specimen of *Olenellus* sp. indet. and a few trace fossils referable to *Skolithos* sp. and *Cruziana* sp. are the only fossils thus far recovered from this formation in the study area and Hazzard (1937b) lists trilobites from the upper one fourth of the Wood Canyon Formation in the Nopah Range which suggests that at least a portion of the formation is Early Cambrian in age.

Massive, unfossiliferous, pink to white ortho- and protoquartzite overlies the Wood Canyon Formation. This is the Zabriskie Quartzite of Hazzard (1937b) and it ranges in thickness from less than 5 meters in the Marble Mountains to over 75 meters in the Salt Spring Hills (Stewart, 1970). In some sections these two formations have been lumped together in earlier reports as the Prospect Mountains Quartzite (Hazzard, 1954; Hewett, 1956); the Tapeats Sandstone (Hewett, 1956; Stewart, 1970) or unnamed quartzite (Fritz, 1975).

The sandstone and quartzite is conformably overlain by the highly fossiliferous Latham Shale of Hazzard (1954), 15 to 45 meters of shale, platy micaceous siltstone, sandstone and a minor amount of limestone. The shale weathers to red, paper-thin fragments and contains abundant olenellid trilobites.

Above the shale is the Chambless Limestone of Hazzard (1954) which ranges from 36 to 66 meters in thickness. It is characterized by the massive beds of gray limestone with countless numbers of algal oncolites of the genus *Girvanella* (Hazzard, 1937a). Platy limestone with trilobite fragments, brachiopods and primitive mollusks and a minor amount of shale occur as interbeds.

The highest unit is the Cadiz Formation of Hazzard and Mason (1936). Hazzard (1954) redefined the formation by lowering the lower contact to include the 33+ meters of lower Cambrian rocks excluded in the original definition. The unit consists of a heterogeneous

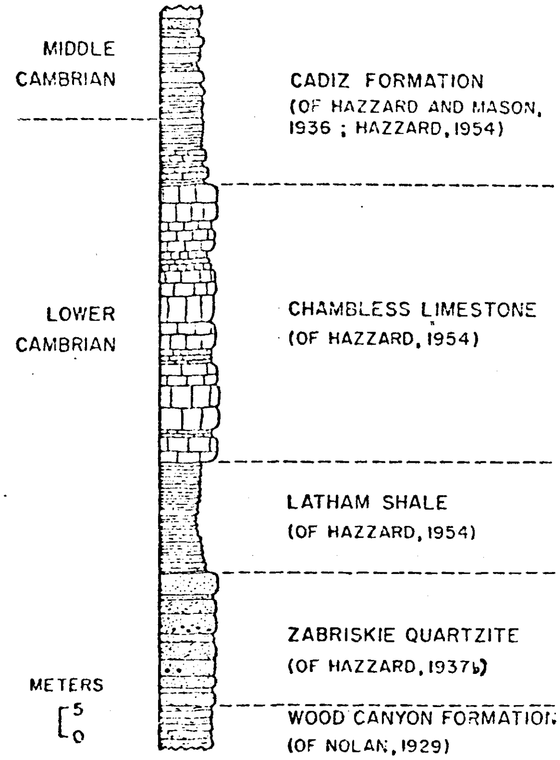


Fig. B. Lower Cambrian section in eastern San Bernardino County.

assemblage of rocks including sandstone, shale, siltstone and limestone. Only about the lower one tenth of the formation is Early Cambrian in age.

Fauna

The faunas thus far recovered from the lower Cambrian rocks total 29 forms which are listed in Table 1. Of the 28 named species, 2 are new genera and 11 are new species.

The Latham Shale is dominated by a large quantity and a great diversity of olenellid trilobites of the genera *Olenellus*, *Bristolia* and *Peachella*. *Olenellus* n. sp. is characterized by the greatly advanced genal spines and the very angular metagenal angle. *Bristolia* n. sp. B has the least advanced genal spines of any species in the genus and the outline of the cephalon is strongly semi-circular. This is the second known occurrence for the inarticulate brachiopod *Mickwitzia occidens* and the articulate brachiopods have been described by Mount (1974c). The presence of the soft-bodied animals *Anomalocaris* n. sp. and the new genus of annelid is particularly interesting and is reminescent of the Burgess Shale fauna.

Trilobites in the Chambless Limestone are rare and generally poorly preserved. This is the first record of *Olenellus puertoblancoensis* from the area between its type locality in Sonora, Mexico, and an occurrence in northwestern Canada (Fritz, 1972). The hyolithoid mollusk *Novitatus* has previously been known only from eastern Asia. It is interesting to note that because specimens of some species of trilobites occur in both the Latham Shale and the Chambless Limestone it is possible to compare specimens which may have original relief with those crushed in the shale and Sundberg (1974) has shown that some dimensions of the cephalon may have been increased differentially by as much as 15% through compression.

Fossils are moderately abundant in two shale beds near the base of the Cadiz Formation but are not as diverse as in the Latham Shale. The fauna from these highest beds of the lower Cambrian in western North America is poorly known. The new olenellid genus, which appears to be thus far known only from the Cadiz Formation in the Marble Mountains, has mixed characteristics of the genera *Bristolia*, *Peachella* and *Olenellus*.

Biostratigraphy

The stratigraphic ranges of the trilobite taxa suggest that this assemblage belongs to the upper part of the *Bonnia-Olenellus* Zone of Rasetti (1951), the youngest of the three Early Cambrian zones (Fritz, 1972). The base of this zone is considered to extend to at least 15 meters below the base of the Latham Shale where a single specimen of *Olenellus* sp. indet. was collected. The Early Cambrian fossils from eastern San Bernardino County are sufficiently abundant and evenly stratigraphically distributed and can be grouped into two faunules (see figure 31) demonstrating the need for two subdivisions of the upper part of the *Bonnia-Olenellus* Zone.

The oldest of the two subzones, the *Bristolia* Subzone of Mount (1974a, 1974b), is based on an assemblage of olenellid trilobites dominated by the genera *Olenellus* and *Bristolia* and the base of the subzone is placed at the first appearance of *Bristolia bristolensis*. The ranges of *B. insolens*, *B.* n. sp. A, *B.* n. sp. B, *Olenellus mohavensis*, *O. nevadensis*, *O.* n. sp., *Peachella iddingsi*, *Onchocephalus* n. sp., and *Poulsenia* n. sp. are apparently restricted to the subzone. The longer ranging *Olenellus clarki* and *O. gilberti* appear to have their first occurrences within the subzone. The *Bristolia* Subzone ranges from the base of the Latham Shale to about 15 to 30 meters above the base of the Chambless Limestone.

Table 1. Early Cambrian fossils from eastern San Bernardino Co.

TAXA / FORMATIONS		Latham Shale	Chambless Limestone	Cadiz Formation
Phylum Coelenterata				
Class Anthozoa				
Order Actinaria				
Bergaueria radiata Alpert, 1973	[fig. 1]	X		
Phylum Brachiopoda				
Class Inarticulata				
Order Acrotretida				
Family Acrotretidae				
Acrotreta primaeva Walcott, 1902	[fig. 27]			X
Family Acrothelidae				
Acrothele spurri Walcott, 1908	[fig. 22]		X	
Order Paterinida				
Family Paterinidae				
Paterina prospectensis (Walcott, 1884)	[fig. 2]	X	X	
Dictyonina pannula (White, 1874)	[fig. 28]			X
Mickwitzia occidens Walcott, 1908	[fig. 3]	X		
Class Articulata				
Order Orthida				
Family Nisusiidae				
Nisusia new species	[fig. 4]	X		
Family Eoorthidae				
Wimanella highlandensis (Walcott, 1886)	[fig. 29]			X
Phylum Mollusca				
Class Calyptoptomatida				
Order Hyolithida				
Family Hyolithidae				
Hyolithes whitei Resser, 1938	[fig. 5]	X	X	X
Order Orthothecida				
Novitatus new species	[fig. 23]		X	
Phylum Annelida				
Annelid-new genus and species	[fig. 20]	X		
Phylum Arthropoda				
Class Trilobita				
Order Redlichiida				
Family Olenellidae				
Olenellus clarki (Resser, 1928)	[fig. 6]	X	X	X
Olenellus fremonti Walcott, 1910	[fig. 7]	X	X	
Olenellus gilberti Meek *in* White, 1874	[fig. 8]	X	X	X
Olenellus mohavensis (Crickmay, 1933)	[fig. 9]	X		
Olenellus nevadensis (Walcott, 1910)	[fig. 10]	X		
Olenellus puertoblancoensis (Lochman, 1952)	[fig. 24]		X	X
Olenellus new species	[fig. 11]	X		
Bristolia bristolensis (Resser, 1928)	[figs. 12,13]	X	X	
Bristolia insolens (Resser, 1928)	[fig. 14]	X		
Bristolia new species A	[fig. 15]	X		
Bristolia new species B	[fig. 16]	X		
Peachella iddingsi (Walcott, 1884)	[fig. 17]	X		
Olenellid-new genus and species	[fig. 30]			X
Order Ptychopariida				
Family Ptychopariidae				
Onchocephalus new species	[fig. 18]	X		
Poulsenia new species	[fig. 25]		X	
Class Malacostraca				
Subclass Eumalacostraca				
Order Syncarida				
Anomalocaris new species	[fig. 19]	X		
Phylum Echinodermata				
Class Eocrinoidea				
Family Eocrinidae				
Gogia new species	[fig. 21]	X		
?*Gogia* sp.	[fig. 26]		X	
Ichnofossils				
Skolithos sp.				
unidentified tracks, trails and burrows		X		

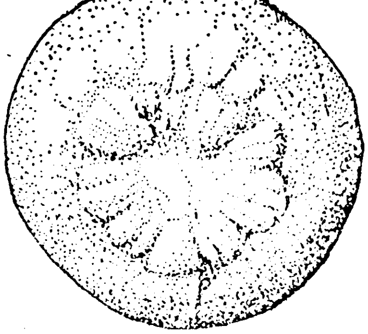


Fig. 1 (x1.7)
Bergaueria radiata Alpert
Holotype, LACMIP 1233, basal view
[specimen from near Goldfield, Nevada; after Alpert (1973)]

Fig. 2 (x3.0)
Paterina prospectensis (Walcott)
Hypotype, UCR 10/2006
pedicle valve exterior

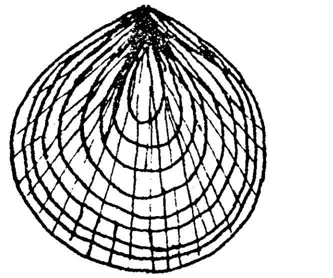


Fig. 3 (x1.4)
Mickwitzia occidens Walcott
Hypotype, UCR 10-8/1
brachial valve exterior

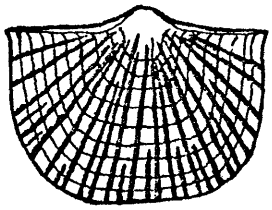


Fig. 4 (x2.0)
Nisusia new species
Hypotype, UCR 10/2019
pedicle valve exterior

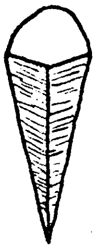


Fig. 5 (x2.4)
Hyolithes whitei Resser
Hypotype, UCR 10/2018
side view

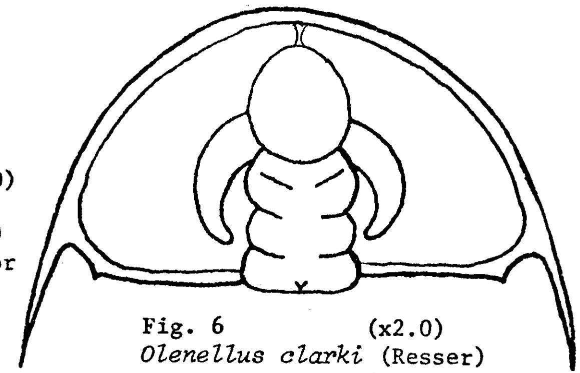


Fig. 6 (x2.0)
Olenellus clarki (Resser)
Topotype, UCR 10/1144
complete cephalon

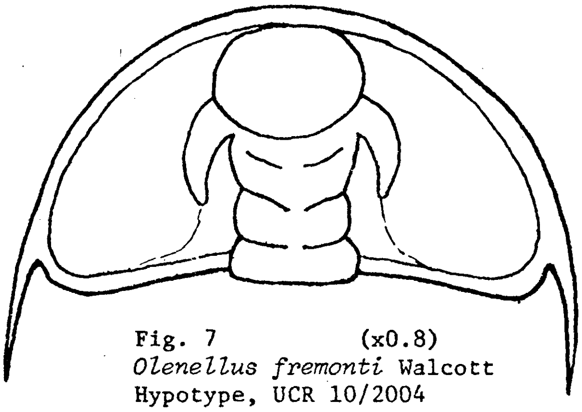


Fig. 7 (x0.8)
Olenellus fremonti Walcott
Hypotype, UCR 10/2004
complete cephalon

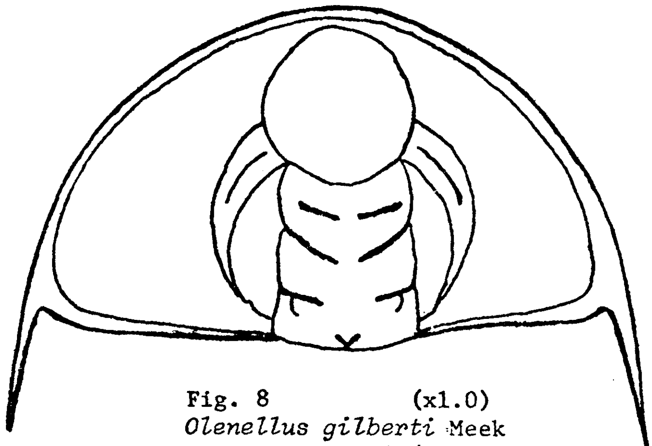


Fig. 8 (x1.0)
Olenellus gilberti Meek
Hypotype, UCR 10/2008
complete cephalon

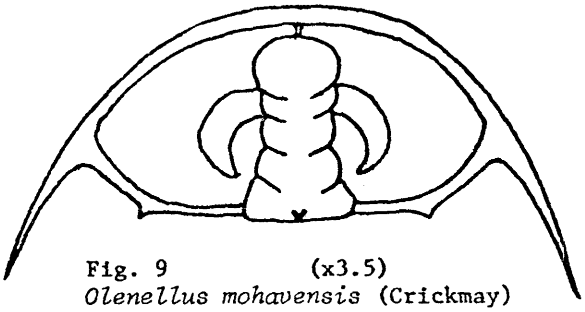


Fig. 9 (x3.5)
Olenellus mohavensis (Crickmay)
Topotype, UCR 10/316
complete cephalon

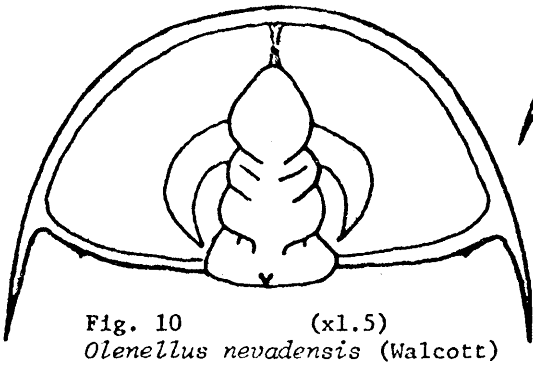


Fig. 10 (x1.5)
Olenellus nevadensis (Walcott)
Hypotype, UCR 10/2005
complete cephalon

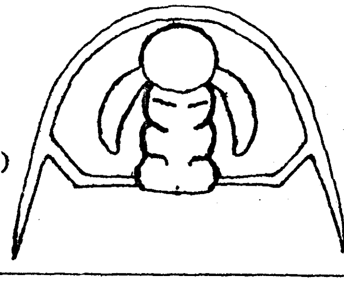


Fig. 11 (x1.5)
Olenellus new species
Hypotype, UCR 7897/1
complete cephalon

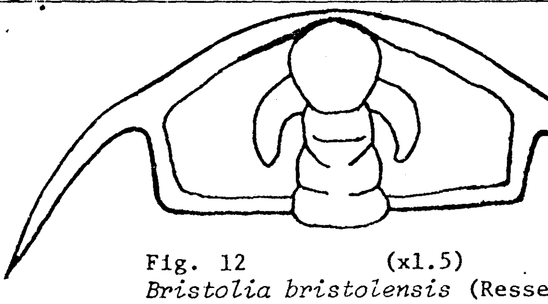


Fig. 12 (x1.5)
Bristolia bristolensis (Resser)
Topotype, UCR 10/10
complete cephalon

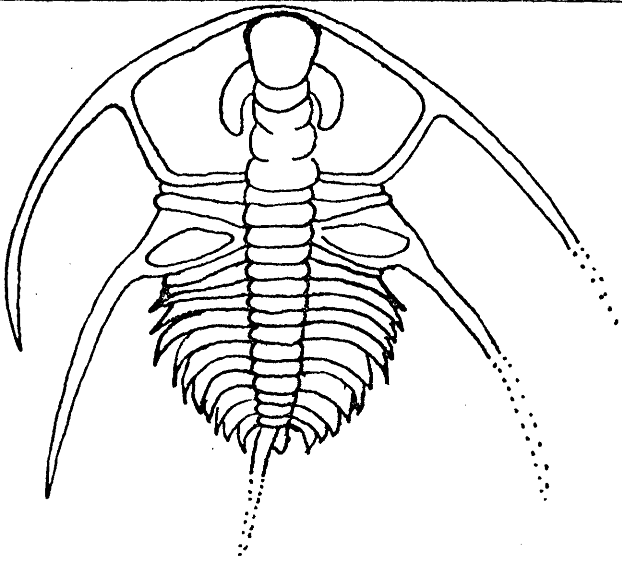


Fig. 13 (x1.5)
Bristolia bristolensis (Resser)
Topotype, UCR 10/7
complete exoskeleton

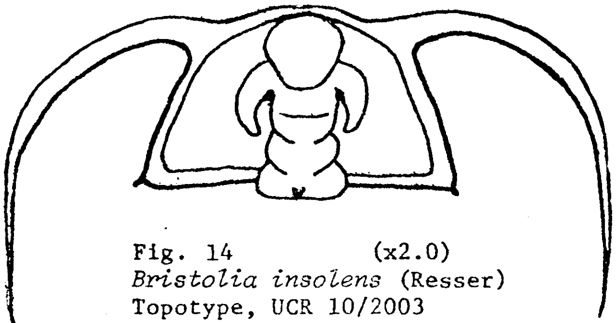


Fig. 14 (x2.0)
Bristolia insolens (Resser)
Topotype, UCR 10/2003
complete cephalon

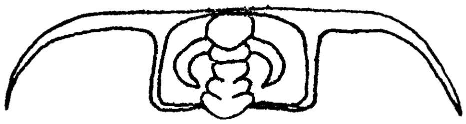


Fig. 15 (x3.0)
Bristolia new species A
Hypotype, UCR 10-3/1
complete cephalon
Bristolia anteros Palmer & Halley, 1979

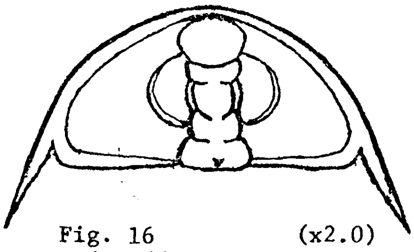


Fig. 16 (x2.0)
Bristolia new species B
Hypotype, UCR 7271/7
complete cephalon

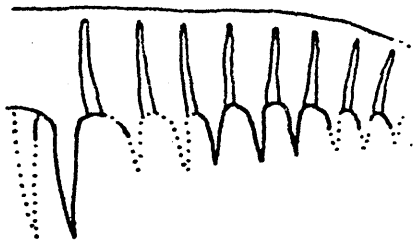


Fig. 19 (x0.5)
Anomalocaris new species
Hypotype, UCR 7002/1
part of body

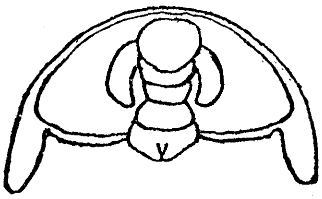


Fig. 17 (x4.0)
Peachella iddingsi (Walcott)
Hypotype, UCR 10-1/14
complete cephalon

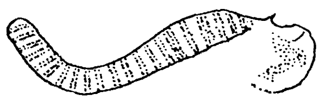


Fig. 20 (x1.0)
Annelid-new genus and species
Hypotype, UCR 7003/1
part of body

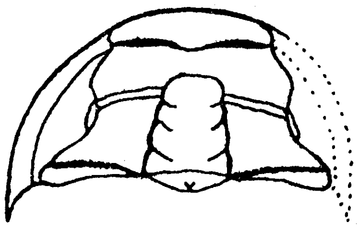


Fig. 18 (x3.0)
Onchocephalus new species
Hypotype, UCR 10/2012
nearly complete cephalon

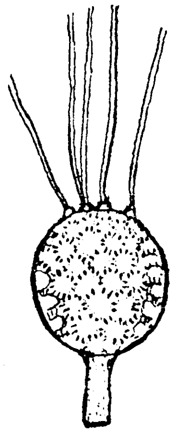


Fig. 21 (x1.5)
Gogia new species
UCMP specimen
nearly complete skeleton

EARLY CAMBRIAN FOSSILS FROM THE CHAMBLESS LIMESTONE

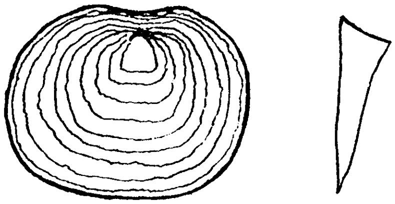


Fig. 22 (x5.5)
Acrothele spurri Walcott
Hypotype, UCR 7311/3
pedicle valve exterior

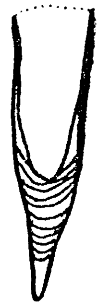


Fig. 23 (x2.3)
Novitatus new species
Hypotype, UCR 2332/1
longitudinal section

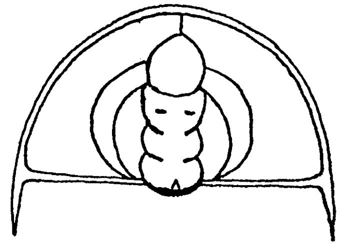


Fig. 24 (x3.2)
Olenellus puertoblancoensis (Lochman)
Hypotype, UCR 7311/2
complete cephalon

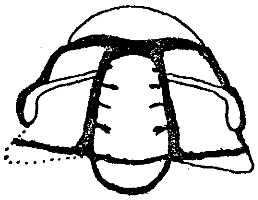


Fig. 25 (x2.2)
Poulsenia new species
Hypotype, UCR 7306/1
nearly complete cranidium

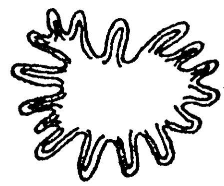


Fig. 26 (x7.4)
?*Gogia* sp.
Hypotype, UCR 7311/1
single thecal plate

EARLY CAMBRIAN FOSSILS FROM THE CADIZ FORMATION

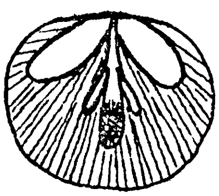


Fig. 27 (x4.5)
Acrotreta primaeva Walcott
Hypotype, UCR 7312/1
brachial valve interior

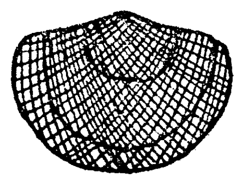


Fig. 28 (x3.7)
Dictyonina pannula (White)
Hypotype, UCR 7307/1
brachial valve exterior

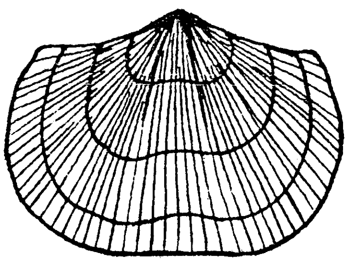


Fig. 29 (x2.2)
Wimanella highlandensis (Walcott)
Hypotype, UCR 7307/12
brachial valve exterior

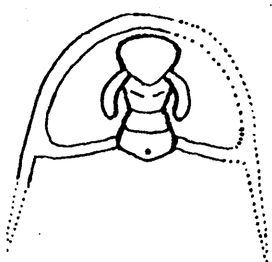
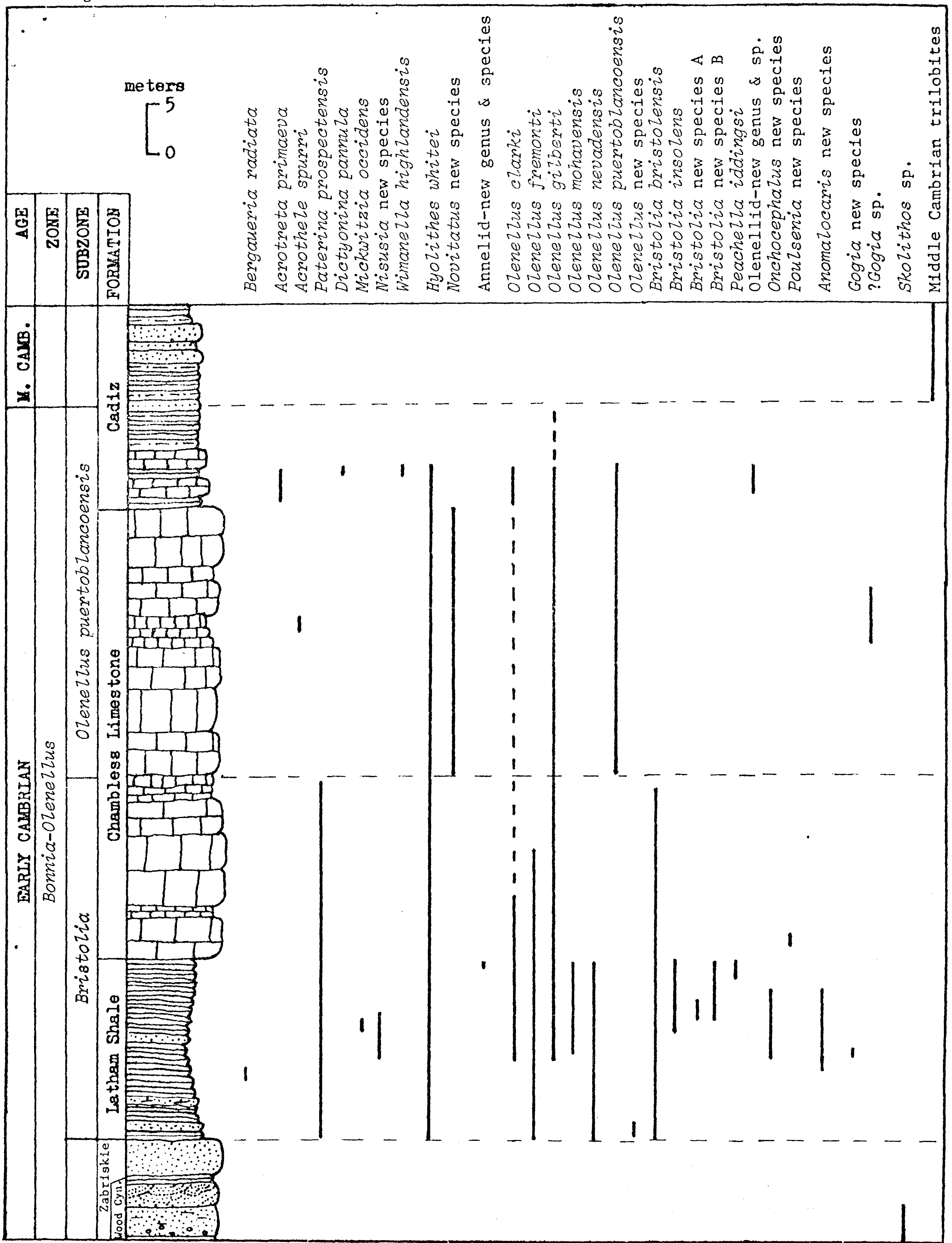


Fig. 30 (x1.5)
Olenellid-new genus and species
Hypotype, UCR 7896/1
partially complete cephalon

Fig. 31. Stratigraphic distribution of Early Cambrian fossils from eastern San Bernardino Co.



The youngest subzone of the Early Cambrian is the *Olenellus puertoblancoensis* Subzone; the base is defined by the first occurrence of *O. puertoblancoensis*. The upper boundary of the subzone, which approximates the Early-Middle Cambrian boundary, is placed at the first appearance of Middle Cambrian trilobites. In eastern San Bernardino County this is 16 to 23 meters above the base of the Cadiz Formation. The new olenellid trilobite and the primitve mollusk *Novitatus* n. sp. are characteristic elements of the subzone. In the east-central California and eastern Nevada areas the assemblages from this subzone are characterized by new olenellid taxa and the ptychoparioid trilobites *Antagmus, Crassifimbra* and *Zacanthopsis* (Palmer, 1971).

The two subzones are particularly well developed at the southern end of the Marble Mountains and on the west slope of the Providence Mountains just south of Summit Springs and these localities should serve as valuable reference sections for the subzones. Assemblages characteristic of these subzones have wide distribution in the southern Great Basin.

The middle Cambrian portion of the Cadiz Formation contains faunas from the Middle Cambrian *Plagiura-Poliella* (Hazzard, 1954), *Albertella* (Takeo Susuki, personal communication), and *Glossopleura* (Mason, 1935; Hazzard and Mason, 1936; Hazzard, 1954; Stoyanow and Susuki, 1955; Stoyanow, 1956) Zones; however, they have not received critical biostratigraphical study.

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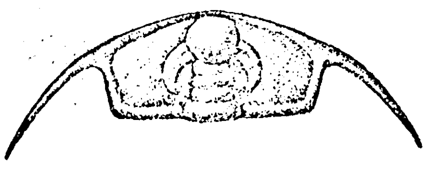

Arthropoda: Trilobita
Bristolia bristolensis (Resser) (x1)
California and Nevada - Lower Cambrian
Type species for the genus