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GUIDEBOOK FOR FIELD TRIP TO

PRECAMBRIAN-CAMBRIAN SUCCESSION

WHITE-INYO MOUNTAINS, CALIFORNIA

By

C. A. Nelson and J. Wyatt Durham

Thursday-Sunday, November 17-20, 1966

CONTENTS

GENERAL INTRODUCTION

In addition to the Precambrian and Cambrian strata to be seen, the White-Inyo region and its environs affords a wide variety of geologic features. Although we will concentrate on the principal objectives of the trip, we will have the opportunity to observe many features of the structure, geomorphology, and Cenozoic history of the region as well.

Travel will be by bus from San Francisco to Bishop, California on Thursday, November 17. For this segment of the trip, and the return to San Francisco from Bishop, no guidebook has been prepared. We are fortunate, however, to have Mr. Bennie Troxel of the California Division of Mines and Geology with us. Together we will try to provide you with some of the highlights of the trans-Sierran route.

Field gear, including sturdy shoes and warm clothing is essential. Stops at the higher elevations are likely to be cold ones.

As is true of all too many field trips, especially those using bus transportation, many of the best localities for collecting Cambrian fossils and for viewing features of the Precambrian and Cambrian succession are in areas too remote or too inaccessible to be visited.

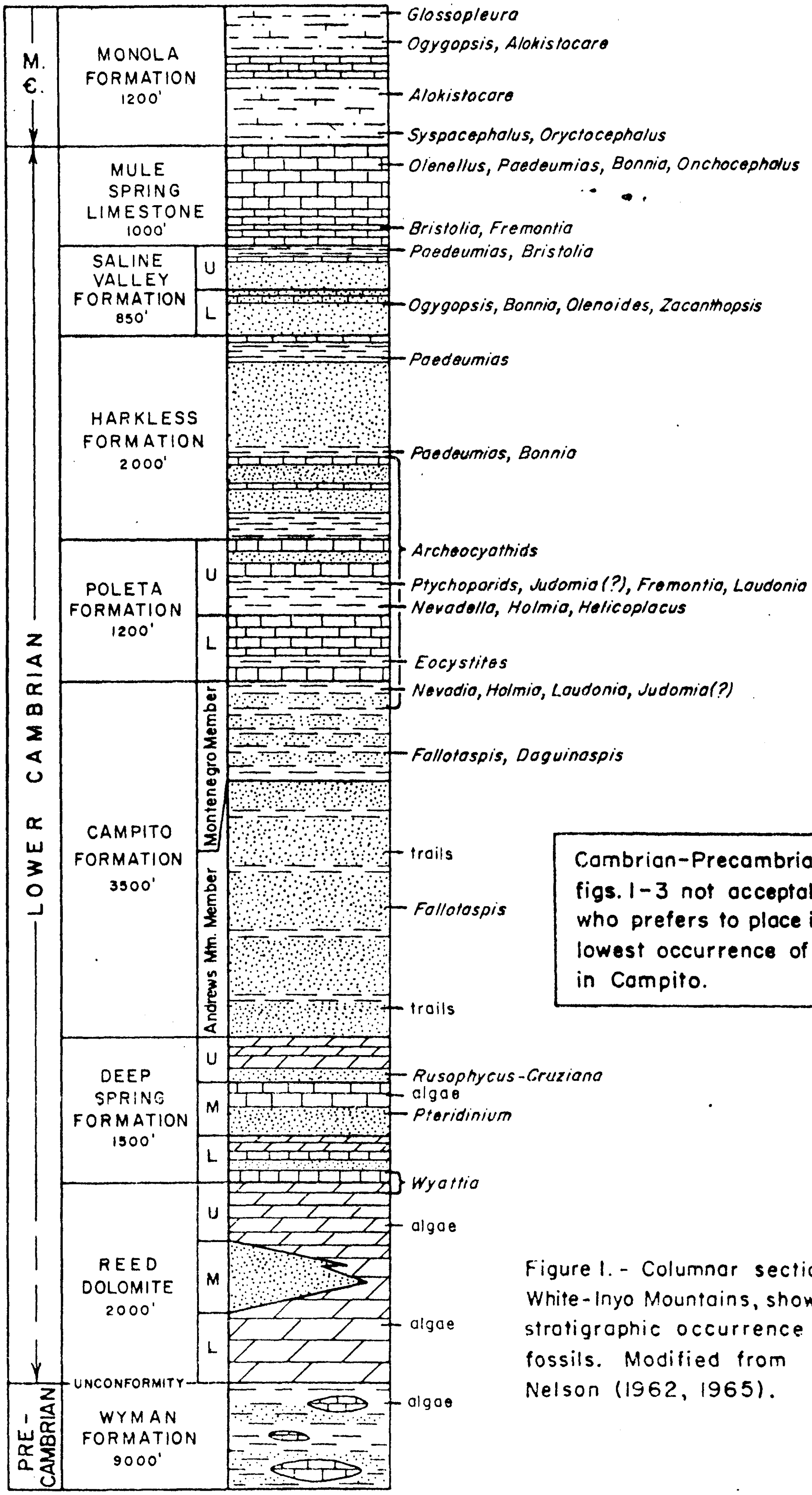
The Precambrian-Lower Cambrian succession is well exposed in the central White-Inyo Range. Since the early work by Walcott (1908) and Kirk (in Knopf, 1918), that part of the succession (Waucoban) containing olenellid trilobites commonly has been regarded as the type for North America, although not by all (Shaw, 1954). In general, structural complexities of the region (Nelson, 1966a,b) preclude the examination of large segments of the succession at any one place.

Olenellid faunas are known from slightly more than 6700 feet of strata (Fig. 1). Some of the faunal elements listed in Figure 1 come from exposures of these same strata in Esmeralda County, Nevada, east of the White-Inyo Range. Various faunal problems and other items of interest will be discussed at appropriate places in the road log and field guide.

ROAD LOG AND TRIP GUIDE

(Clock references indicate direction of feature from bus)

Distance	Cumulative mileage	First Day
	(0.0)	Board bus at Holiday Inn. Road log begins at intersection of U.S. 395 and Line St. in Bishop. Travel south on 395.



Cambrian-Precambrian boundary on figs. 1-3 not acceptable to Durham who prefers to place it just below lowest occurrence of *Fallotaspis* in Campito.

Figure 1. - Columnar section, White-Inyo Mountains, showing stratigraphic occurrence of fossils. Modified from Nelson (1962, 1965).

1.5	(1.5)	At 3 o'clock - large triangular mountain peak is Mt. Tom. Its upper red part is made up of Late Paleozoic quartzite and Mesozoic metavolcanic rocks, extensions of which can be seen extending behind the mountain to the NW. This is one of several of the pendants in this part of the Sierra, one of which contains fossils of Ordovician age. Looking back at 4 o'clock in the distance is the Wheeler Crest, underlain principally by quartz monzonite, the east face of which is an example of a precipitous fault scarp outlining the front of the Sierra Nevada. In contrast, the area extending from about 2 o'clock to 11 o'clock is made up of gentle valleyward sloping surfaces. This is the Coyote Warp of Bateman (1965, p. 174), interpreted as a folded erosion surface descending from near the crest of the eastern Sierra to the floor of Owens Valley and beneath. This feature occupies the front of the Sierra from this point to just south of Big Pine, 15 miles to the south. This contrasts to the fault scarp nature of the Sierran front both north and south. Along this portion of the Owens Valley, the valley fill is thin along its western margin and markedly increases in thickness along the eastern edge of the Valley adjacent to the scarp of the White-Inyo Range.
12.0	(13.5)	at this point, the main fault scarp of the Sierra front south of the Coyote Warp can be seen.
1.1	(14.6)	at 2:30 o'clock, the long triangular ridges descending on both sides of Big Pine Creek are deposits of the Sherwin glacial advance.
0.5	(15.1)	junction of Westgard Road and 395 - turn left.
1.6	(16.7)	crossing Owens River, a part of the Los Angeles water system. Dead ahead in the middle distance is a series of fault scarps cutting Quaternary gravels and lake beds.
0.8	(17.5)	junction with Waucoba Road (to Death Valley) - continue on Westgard Road.
1.9	(19.4)	peak at 11 o'clock is Black Mtn., underlain by sandstone and shale of the Campito Formation. Contact on left is normal Campito-Poleta contact; on right shoulder of mountain is same contact overturned.

0.6	(20.0)	road passes through Quaternary gravels.
2.4	(22.4)	exposures on right of road are principally shale and quartzite of the Upper member of Poleta Fm.
0.2	(22.6)	at 12 o'clock - buff colored band extending to skyline is the lower member of Poleta Fm., overlain by black shale of upper Poleta.
0.8	(23.4)	Toll House Spring - history of Toll Road is discussed in USFS index map - from this point to the "narrows" ahead, the road passes through exposures of the Campito Formation.
2.4	(25.8)	Campito "narrows".
0.6	(26.4)	small narrows in limestone of basal Poleta Fm., archeocyathids can be collected here - no stop.
0.2	(26.6)	exposures on right are shale and limestone of upper Poleta Fm. - to be visited as STOP 18 on second day.
0.4	(27.0)	Poleta narrows - exposures of basal Poleta, with archeocyathids - no stop.
0.8	(27.8)	STOP 1 - stop at Westgard Pass sign (not Westgard Pass). This is Cedar Flat (apparently so named for the abundant juniper trees), a typical high upland flat. It is fault controlled (Fig. 3) and is a remnant of one of the erosion "surfaces" cutting the White Mtns. The exposures on the right all along Cedar Flat are basal Poleta limestone. At 12 o'clock in distance are rough light-colored rocks of Birch Creek pluton, one of several small satellites of the Sierran complex. On skyline ridge at 10 o'clock, dark rocks are Campito; light rocks (tree covered) are Reed Dolomite.
0.8	(28.6)	junction of White Mtn. Road and Westgard Road-turn left at Bristlecone Forest sign.
1.2	(29.8)	basal Poleta limestone in small narrows.
2.1	(31.9)	Fossil Area on right - to be visited as STOP 10. Basal Poleta limestone exposed on right along road for next 0.5 mile.
1.0	(32.9)	8000' elevation sign on right.

0.7	(33.6)	for next 0.6 mile exposures of upper Poleta limestone and shale on left side of road.
0.4	(34.0)	road on left to Grandview Campground; rocks on ridge to right are limestone of basal Poleta.
0.6	(34.6)	for next 3.6 miles exposures along road and on hills to left and right are Campito Fm.
1.5	(36.1)	9000' elevation sign on right.
2.1	(38.2)	Sierra View Point - STOP 2 - from the western "viewing stand" - straight west is the city of Bishop - to the right of Bishop is the eroded southern edge of the Bishop Tuff, a welded tuff and pumice deposit of Quaternary age - directly west of Bishop is Mt. Tom, the triangular red-brown peak - S60W is Coyote Flat and one can see the gentle southerly and northerly warped surfaces extending down to the Owens Valley, in contrast to the steep scarp of Wheeler Crest to the north of Mt. Tom. To the left of Coyote Flat is the Palisade Glacier system and the North Palisade and Middle Palisade above the glaciers. These peaks comprise one of the most rugged portions of the eastern Sierra front. Across the main canyon to the west (middle distance), the largely gray limestone and shale exposures are the Upper Cambrian portion of the Emigrant Fm., here lying in thrust contact with the Harkless Fm. In order to view other Sierra peaks, including Mt. Whitney, one must take the foot path to the south of viewing area. S10W of second viewpoint are Mt. Whitney, 14,495', and Mt. Williamson, 14,375'. From the main viewing area - to the SE lies Deep Spring Valley; it can best be seen in afternoon light on our return down the mountain. If you can tear your eyes away from the Sierra, the rocks underfoot here are Andrews Mtn. member of the Campito Fm.
0.5	(38.7)	at about 8 o'clock - a better view of the Coyote Warp.
0.5	(39.2)	to left in canyon (below road) - exposure of contact between upper Deep Spring Fm. (buff) and Campito Fm. (black).

0.6 (39.8) 10,000' elevation sign on right.

0.3 (40.1) entering Reed Flat (see Fig. 2). The Reed Dolomite was named for exposures east of Reed Flat. In this region, the Reed Dolomite is not divisible into members, comprising rather a monotonous non-bedded light gray dolomite. In contrast, to the south and southeast, the formation contains a detrital median tongue which we will see at STOP 12 tomorrow.

0.6 (40.7) entrance to Schulman Grove - turn right - STOP 3. The Grove has been developed by the USFS to display features of Bristlecone pines, some of which have been dated as more than 4000 years. See USFS index map.

A few years ago fossils of uncertain character were recognized in the Reed Dolomite near the Molly Gibson Mine about 4 miles southeast of Schulman Grove. Recently these have been described by Taylor (1966) as *Wyattia reedensis* n. gen., n. sp. At the type locality *Wyattia* occurs in several beds near the contact with the overlying Deep Spring Formation. (Nelson believes the *Wyattia*-bearing beds to be basal Deep Spring rather than Reed.) The outcrops of the Reed Dolomite north of the parking area at Schulman Grove are at approximately the same stratigraphic position as at the type locality but the rocks have been subjected to a slightly greater degree of alteration. Poorly preserved material suggestive of *Wyattia* has been observed in these strata. *Wyattia reedensis* is a small conical shaped fossil ranging up to about 6 mm in length with a bulbous, slightly coiled protoconch. A peculiar internal shell structure occupies from 1/2 to 2/3 of the apical portion of the shell. Inasmuch as the rocks in which it occurs have suffered some alteration, the microstructure of the wall of the shell is not well preserved in the specimens studied so far, but the wall of the outer shell seems to have had 3 layers. Morphologically *Wyattia* is somewhat suggestive of *Salterella* and *Globorilus* of the Cambrian and Taylor has tentatively referred *Wyattia* to the same order (Globorilida of the Molluscan class *Calyptoptomatida* Fisher, 1962).

Although *Wyattia* is by far the dominant fossil in the limestones at the type locality, structures suggestive of other kinds of animals are occasionally observed, suggesting that *Wyattia* may have been a member of a rather diverse biota.

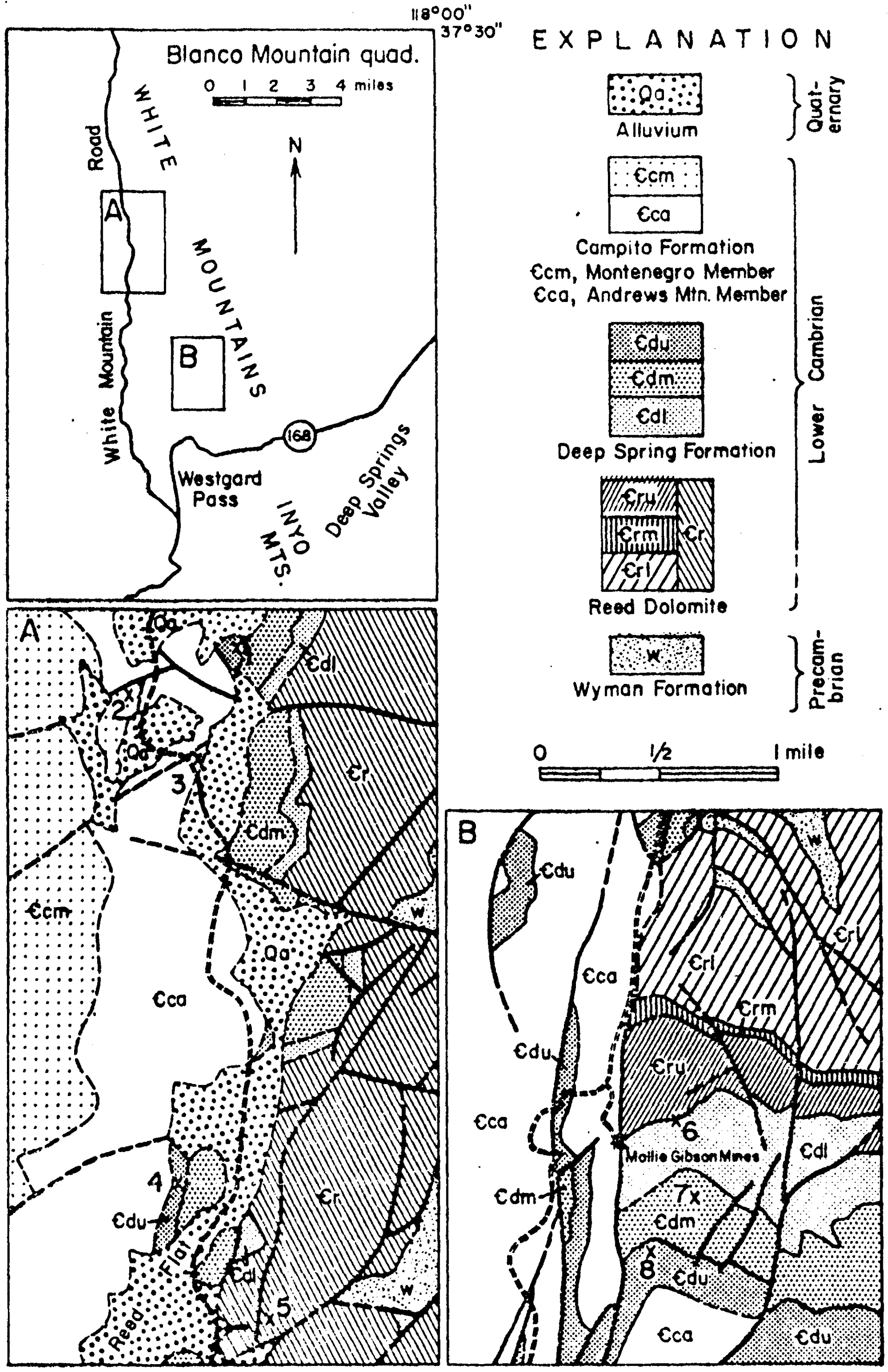


Figure 2. - Index map and geologic maps showing geologic occurrence of localities. Loc. 1, 4, 8, (*Rusophycus - Cruziana*); Loc. 2 = STOP 5 (*Fallotaspis*); Loc. 3 = STOP 4 (tracks in €ca); Loc. 5 = STOP 3 (*Wyattia*); Loc. 6 (*Wyattia* type locality); Loc. 7 (*Pteridinium?*). Geologic maps from Nelson (1966b).

Cambrian - Precambrian boundary on figs. 1-3 not acceptable to Durham who prefers to place it just below lowest occurrence of *Fallotaspis* in Campito.

Lunch (?)

0.3 (41.0) return to Grove entrance - turn right and proceed north on White Mtn. Road.

0.4 (41.4) on right - brown quartzite of middle member of Deep Spring Fm. It is from beds of this unit that the ? Pteridinium (Plate 1, Fig. B) was collected (see Fig. 2B, loc. 7).

1.0 (42.4) ahead - section of Deep Spring Fm. - buff brown limestone of basal member lying above white Reed, red-brown quartzite and gray dolomite are middle member, alluvial cover in saddle is on upper member. Left of saddle is Campito Fm.
To right of Reed, the fault control of many of the upland basins is well illustrated. Fault runs through Coldwater Spring at foot of brown talus and NE through saddle in distance.

1.3 (43.7) STOP 4 - tracks and trails in basal Campito Fm. on right side of road. See Fig. 3, Plate 4.

0.6 (44.3) STOP 5 - looking north through power poles, the Deep Spring Fm. can be seen between white Reed Dolomite and Black Campito Fm. - the high peak on right is Blanco Mtn., made up of Reed Dolomite.
On far skyline, first black peak is Campito Mtn., high white and brown peak is Sheep Mtn., underlain by Deep Spring Fm.
The upper Deep Spring in this vicinity (loc. 1, Fig. 2A) has produced numerous Rusophycus-Cruziana. As all good specimens have been collected, we will have to be satisfied with Figs. E, G. F. of Plate 1.
Short walk SW to Fallotaspis locality (loc. 2, Fig. 2A). Rocks are shale and siltstone of the Montenegro member of Campito Fm. See Figs. 2, 3, 4, 5 of Plate 2.
The occurrence of Fallotaspis and Daguinaspis here and at STOP 16 and elsewhere provides one of the few ties to the North African Cambrian succession (Nelson and Hupe, 1964). The poorly preserved Fallotaspis (Plate 2, Fig. 1) from the Andrews Mtn. member of Campito Fm. is similar to forms from the lowest trilobite bearing beds in Morocco (Hupe, 1952) and the forms here referred to Fallotaspis cf. longa and Daguinaspis from the Montenegro member

		agree rather closely with forms from Hupe's higher zones. Bus heads south on White Mtn. Road.
3.3	(47.6)	entrance to Schulman Grove on left.
0.6	(48.2)	STOP 6 (?) - at south end of Reed Flat on small hill to west of road - tracks and trails in lower Campito Fm.
1.8	(50.0)	STOP 7 - do not leave bus - Sierra View Point - looking to SE across Deep Spring Valley at east dipping section of Wyman Fm. (dark), Reed and Deep Spring Fms. (banded and light colored), Campito Fm. (dark), Poleta Fm. (two thin light colored bands separated by dark band), Harkless Fm. (dark) in contact with granitic rocks.
3.2	(53.2)	STOP 8 - do not leave bus - view east across Deep Spring Valley - on ridge to east of dry lake can be seen the contact between two granitic bodies - dark rock of higher part of ridge behind lake is 186 my monzonite. It is intruded by the light colored quartz monzonite, 140 my, underlying the lower part of the ridge. These two dates, together with a cluster of dates around 90 my, are the most common granite episodes in the White-Inyo Range.
1.1	(54.3)	STOP 9 - down small canyon to left, turn right after 100 yards and proceed down canyon through narrows of basal Poleta limestone to reef-like structures in limestone of upper Montenegro member of Campito Fm. See Fig. 3. The archaeocyathids of the Montenegro, Poleta, and Harkless formations of this region have been the subject of a study by Roland A. Gangloff (unpublished Masters thesis, University of California, Berkeley). Gangloff is continuing his studies but the information on archaeocyathids presented herein is largely derived from his Master's thesis. He recognizes three distinct assemblages, characteristic of the Upper Montenegro, the lower Poleta limestone, and the uppermost Poleta limestone and lower Harkless bioherms, respectively. Some of the distinctiveness may be due to variations in ecology, but in large part (except for those of the upper Poleta) the changes appear to be due to factors other than ecology.

The archaeocyathid bioherm exposed in the north wall of the canyon can be traced continuously northward along the strike for about 100 feet. Discontinuous smaller bioherms can be observed for about 200 yards farther along the strike through a stratigraphic interval of about 30 feet. A possible thickness of 18 feet is present. The archaeocyathid limestones grade rapidly downdip into the silty shales of the Montenegro formation. The archaeocyathids making up the bioherm seem to be all solitary types. The elongate, more or less columnar appearing "Ethmophyllum" ceratodictyoides Raymond is by far the most abundant species. Gangloff has reported 16 species from this bioherm. Other abundantly represented species are Metethomophyllum meeki (Walcott) and a new genus assigned to the Syringocnematidae of Taylor. The other genera from this horizon include Ajacicyathus (2 sp.), Erbocyathus, Ethmophyllum, Pycnoidocyathus (3 sp.), and Syringocyathus. Four of the species occur in the overlying formations, with one (Metethomophyllum meeki) being found only in bioherms of the younger Harkless formation. One of the longer ranging species, Ajacicyathus ichnusae was first described from Sardinia but none of the other species are known outside of North America. Erbocyathus and Annulofungia were previously known only from Russia. Ajacicyathus, Coscinocyathus and Pycnoidocyathus are genera of worldwide distribution, but in general at the specific level the archaeocyathid fauna of the Montenegro is quite different from that of other parts of the world. Return to bus.

0.4 (54.7) STOP 10 - Fossil Area - archeocyathids in basal Poleta limestone.

Gangloff has recognized over 20 species of archaeocyathids, including both solitary and colonial types within the limestones of the Lower Poleta formation, but the generic diversity is much less than that in the Montenegro Formation. The fauna is dominated by the genus Archaeocythus, represented by 6 species, and a new genus likewise with 6 species (assigned to family Syringocnematidae Taylor). Other genera represented are Ajacicyathus, Annulofungia, Ethmophyllum, Pycnoidocyathus, and Syringocyathus. Only three of the species (Ajacicyathus ichnusae, Ethmophyllum whitneyi, and Annulofungia n. sp.) range down into the Montenegro formation. Colonial types are abundant in contrast to their absence in the Montenegro. In general the lower Poleta assemblage is quite different from any known in other parts of the world.

Another distinct assemblage of archaeocyathids occurs in the limestones at the top of the Poleta formation and in the small bioherms within the basal beds of the Harkless Formation. Fifteen species have been recognized in this assemblage, with large solitary individuals of species of Coscinocyathus, Archaeocyathus, and Pycnoidocyathus as conspicuous constituents. A distinctive new genus related to Somphocyathus Taylor is also present. Annulofungia and Metethmophyllum are the other genera represented. This upper fauna resembles one described from the Yukon by Kawase and Okulitch (Journ. Paleont., vol. 31, pp. 913-930, pls. 109-113, 1957) and by the abundance of Coscinocyathus resembles many of the Siberian faunas described by Vologdin and Zhuravleva.

3.4	(58.1)	junction of White Mtn. Road and Westgard Road - turn right.
5.9	(64.0)	on left - folds in upper Poleta limestone - these are among the structures that Walcott (1895) reported as the "Appalachian folds" of the White Mountains.
3.9	(67.9)	at 12 o'clock - the two sharp ridges at foot of Sierra on both sides of creek are Sherwin moraine. at about 11 o'clock is Crater Mtn., a Quaternary volcanic cone located along one of the N-S faults in Owens Valley. On the east flank of the crater can be seen the scar of the 1872 Owens Valley earthquake. A larger, and presumably older scarp can be seen cutting the granitic rocks west of Crater Mtn.
1.0	(68.9)	junction of Westgard Road and Saline Valley Road. At 9 o'clock on the NW slope of the Inyo Range - orange brown stripe with blue limestone band near top is Middle Cambrian Monola Fm. (See Fig. 1) Buff-brown overlying rocks are Middle and Upper Cambrian Bonanza King dolomite; white rocks below Monola Fm.

are Lower Cambrian Mule Spring Fm.
Further south along front of range are volcanic cones and flows of Quaternary age located along the frontal fault system of the Inyo Range.

2.4 (71.3) junction of Westgard Road and 395 - turn right.

5.6 (76.9) at approximately 3 o'clock, both north and south of major canyon, section exposed above the alluvial cones is Reed Dolomite (massive non-bedded buff), Deep Spring Fm. (banded buff and brown), and Campito Fm. (black). At south side of canyon is Black Mtn., with Deep Spring and Campito repeated at top of mountain.

9.5 (86.4) intersection of 395 and Line St. in Bishop.

Second Day

(0.0) same starting point as first day - road log same as first day for first 17.5 miles.

17.5 (17.5) junction of Westgard Road and Waucoba Road (to Death Valley and Saline Valley) - turn right - at 1 o'clock, a small young fault scarp cutting fan gravels at point where road enters small canyon.
To the left, the two tree patches mark springs along the frontal fault system.

1.7 (19.2) immediately on left - granodiorite, dated at 76 my -

0.7 (19.9) on left - exposures of the Waucobi Lake Beds. These partially tuffaceous shales and siltstones are Quaternary, probably related to the maximum glaciation of the Sierra. As will be seen as we proceed up Waucoba Canyon, they interfinger with coarse alluvial gravels apparently marking the edge of the lake basin.

1.3 (21.2) exposures on right are Middle Cambrian Monola Fm. (Nelson, 1965). No fossils have been found in these exposures, as the rocks are mildly hornfelsed. The strata, elsewhere, however, have yielded typical Middle Cambrian trilobites as *Syspacephalus*, *Oryctocephalus*,

		Alokistocare, Ogygopsis, and Glossopleura (see Fig. 1).
2.6	(23.8)	directly on left - anticlinal fold in Waucobi Lake Beds. This fold lies along the trend of one of the large fault scarps seen earlier.
0.1	(23.9)	on right - exposures of Reed Dolomite.
0.3	(24.2)	STOP 11 - in small gulley on right, exposures of upper portion of Wyman Fm. Rough weathering gray-brown rocks on hills above are Reed Dolomite. The Wyman in the White-Inyo region is unconformable beneath the Reed. Although impossible to prove the unconformity at any one outcrop, regional differences in the Wyman beneath the Reed suggest slight pre-Reed erosion. For this and other reasons, the Wyman is regarded as undoubted (if any unit can be so regarded) Precambrian. The Wyman here, as elsewhere, contains limestone beds containing algal structures, always so recrystallized as to prevent identification. - continue east on Waucoba Road
1.1	(25.3)	on right - buttress unconformity of Quaternary alluvial gravels on Wyman Fm. Wyman Fm. exposed on right for next 0.5 mile - on left, interfingering of Waucobi Lake Beds and Quaternary alluvial gravels for next 0.7 mile.
0.7	(26.0)	entrance to Devils Gate - STOP 12 (brief) while bus turns around - the rocks exposed in Devils Gate are the Hines Tongue of the middle Reed Dolomite. The Hines Tongue comprises a tapering wedge of quartzite, sandy dolomite, and siltstone ranging from 800 feet in the Waucoba Spring quadrangle (SE of here) to 50 feet in the center of the Blanco Mtn. quadrangle and to zero to the north and west of that position. Together with other detrital units in the Cambrian-Ordovician succession, it illustrates a probable eastern cratonic origin for the major portion of the detrital fraction in the succession.
0.4	(26.4)	turn around for bus - return to bus and head west on Waucoba Road.
2.8	(29.2)	looking at the Sierra front ahead, one can see the sloping (to the right) - from 12 o'clock to 1 o'clock surface of the Coyote Warp.

3.8	(33.0)	rounding curve, coming out of Waucoba Canyon-brief STOP 13 - do not leave bus - good view of Sierra scarp and Crater Mtn. - directly behind Crater Mtn. is dark rock of the Tinemaha granodiorite (Mesozoic) - to the left on the Sierra summit is a red colored pendant made up of meta-sediments and meta-volcanics in contact with dark igneous rocks - half way down the Sierran front to left of pendant are two tree-covered "flats" that are probably the southern extensions of the Coyote Warp.
2.1	(35.1)	junction of Waucoba Road and Westgard Road - turn right - from this point to Bristlecone Forest turn-off the road log is same as for first day (without stops).
11.1	(46.2)	junction of Westgard Road and White Mtn. Road - continue north on Westgard.
1.3	(47.5)	Westgard Pass (north end of Cedar Flat).
2.3	(49.8)	STOP 14 - on left side of road - tracks and trails in Andrews Mountain member of Campito Fm. (Fig. 3).
1.8	(51.6)	Deep Spring Valley viewpoint - STOP 15 - turn bus and return to Cedar Flat.
3.6	(55.2)	Westgard Pass - STOP 16 (Fig. 3) - short walk to Fallotaspis-Daguinaspis locality. This is the first locality in the White-Inyo Range from which these forms were collected. Unfortunately for our trip, many touring groups have collected here and good material is now difficult to find.
1.7	(56.9)	turn-off to right to "camp" localities.
0.4	(57.3)	STOP 17 (see Fig. 3) - Camp locality. This site has served for several years as the Berkeley-UCLA summer geology field camp. Consequently, several of the localities have been severly collected.

Among the more interesting biologic aspects of the Lower Cambrian of this region is the recognition that three very distinct classes of echinoderms are present. A single specimen of an edrioasteroid was found by R. J. Moiola in shale of the middle part of the Poleta formation near Silver Peak, Nevada

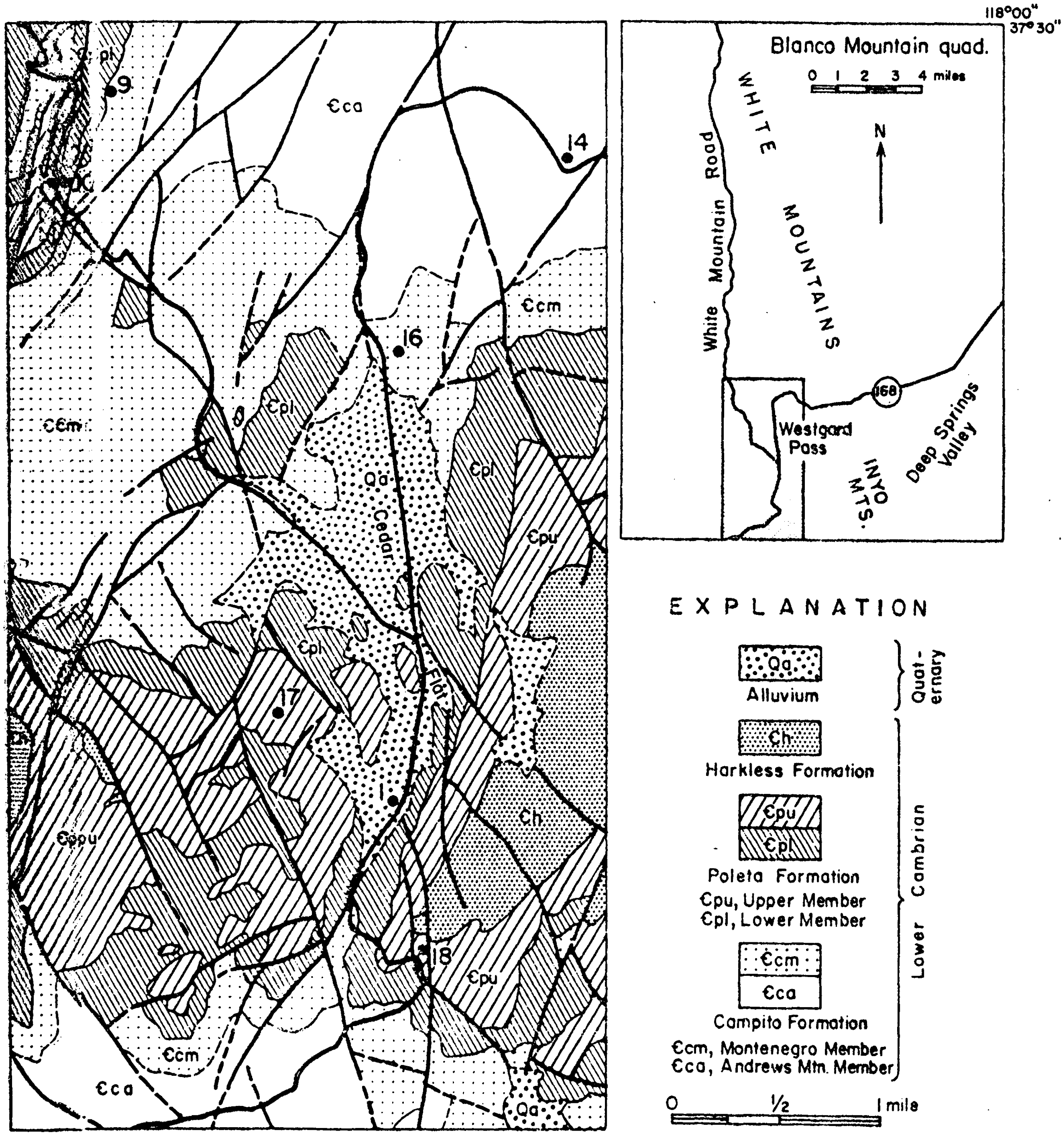


Figure 3. - Index map and geologic map showing geologic occurrence of STOPS 1 (general view), 9 (archeocyathid reef in Ꞓcm), 10 (Ꞓpl archeocyathids), 14 (trails in Ꞓca), 16 (*Fallotaspis* in Ꞓcm), 17 (*Eocystites, Helicoplacus, Nevadella*), 18 (section of Ꞓpu - Ꞓh). Geologic map from Nelson (1966b).

Cambrian–Precambrian boundary on figs. 1–3 not acceptable to Durham who prefers to place it just below lowest occurrence of *Fallotaspis* in Campito.

(about 40 miles NE of Westgard Pass). Disassociated plates of an eocrinoid perhaps somewhat comparable to the Middle Cambrian Gogia [= Eocystites in part] are common in the top of the lower Poleta limestone and the immediately overlying shale of the Westgard Pass area and were abundant in some of the lower shale at this stop.

The unusual pyriform (retracted) to fusiform (expanded) helicoplacoids (Plate 4, Fig. 1, 2), first described in 1963 (Durham, J. W. and K. E. Caster), were discovered in this area and are abundant in the shale in the middle part of the Poleta formation. So far they have been found through about 150 feet of section and are common in this area and adjacent Nevada. A single occurrence has been reported in northwest Alberta. The test of the helicoplacoids was built of spirally arranged plates that were not firmly sutured and had a unique expansion-contraction mechanism. The test broke up easily on death and consequently most occurrences are of disassociated plates, but over 400 specimens with plates associated have been found. The helicoplacoids were so abundant that bedding plane surfaces locally are covered with their plates and small lenses of limestone in which they are a dominant element are reasonably common. Detailed studies of the helicoplacoids are still in progress, but the analyses to date suggest the presence of 6 to 10 species, including one unique type that is being made the basis of a new subclass.

The occurrence of three well defined classes, the Edrioasteroidea, Eocrinoidea and Helicoplacoidea this low in the Cambrian indicates that the origin of the Echinodermata must extend well back into the Precambrian, for much evolution has occurred between any possible common ancestor and these three types.

In addition to the Helicoplacoidea discussed above, the basal beds of the Upper Poleta Fm., have yielded abundant Nevadella addyensis (Plate 3, Fig. 1-3). This is the most abundant of trilobites from the White-Inyo region, although it is confined to a limited horizon in the dark shale at the base of the Upper Poleta.

- return to bus

0.4 (57.7) junction of camp road with Westgard Road - turn right.

1.4 (59.1) STOP 18 (see Fig. 3) - short walk up small wash to left of road - section of shale, limestone, and quartzite of Upper Poleta Fm. overlain by Harkless Fm.
The rocks seen in this section overlie the N. addyensis shale of the basal Upper Poleta. The blue and gray mottled limestone beds and the Scolithus quartzite and the uppermost blue limestone bed of the Poleta are remarkably widespread. These units can be recognized with some considerable confidence eastward to Esmeralda County, Nevada. Away from this locality, these beds have yielded Olenellus, Laudonia, Fremontia, Ptychoparids, and a species of Judomia (?) (see Plate 3, Fig. 5-15). The species of Judomia (?) affords a possible correlation with the Lower Cambrian of Siberia.
The overlying Harkless Fm. is marked by an abrupt change from the blue limestone of the uppermost Poleta to gray-green shale containing thin beds of pisolitic limestone. The basal Harkless beds (though not here) have yielded Paedeumias clarki (see Plate 5, Fig. 1, 2).

11.5 (70.6) junction of Westgard Road and 395 - turn right and return to Bishop.

15.1 (85.7) intersection of 395 and Line St. in Bishop.

Comments on Faunas and Localities Not Visited

Nevadia Fauna (Plate 2)

The middle part of the Montenegro member of Campito Fm. has yielded rather abundant specimens of Holmia rowei and Nevadia weeksi (Plate 2, Fig. 6, 7, 8). Walcott regarded N. weeksi as a primitive, in part because he judged it to come from the lowest trilobite beds in the succession. There is no question, however, about its stratigraphic position well above the Fallotaspis-Daguinaspis forms (see Fig. 1).

This part of the Montenegro member has also yielded specimens of Judomia (?) gracile (Plate 2, Fig. 10-15). This species, the type of which comes from beds equivalent to the Montenegro in the Nopah Range, Death Valley region, has been referred to Wanneria and to Callavia. It seems closest to the Siberian genus Judomia, however, and provides a possible tie to the Lower Cambrian of northeast Asia.

Bonnia-Paedeumias, Ogygopsis Faunas (Plate 5)

From strata above the Poleta Fm., several forms occur which have little apparent stratigraphic distinctiveness, while others occur which are severly restricted in stratigraphic position. Paedeumias occurs throughout the succession from low in the Harkless to the upper beds of the Mule Spring Limestone. Bonnia occurs from beds at the top of the Harkless to the upper part of the Mule Spring, but only in limestone beds. The upper shale of the Saline Valley and the overlying Mule Spring have yielded Fremontella, Bristolia, and Olenellus gilberti, affording a correlation with the Latham shale and Chambless limestone of the Marble Mountains of eastern California.

The most striking fauna of this interval is the Ogygopsis batis fauna which occurs restricted to the middle part of the Saline Valley Fm. The occurrence of Ogygopsis in Lower Cambrian rocks was first recognized in the Inyo Mountains (Nelson, 1963). It was subsequently seen to occur widely in the White-Inyo Range and in Esmeralda County, Nevada. An especially prolific fauna has been recently described by Palmer (1964).

Ogygopsis-Paedeumias-"Protolenid" Fauna (Plate 6)

In addition to their occurrence in the strata described above, Paedeumias and Ogygopsis occur in a unique situation at Miller Mtn., near Basalt, Nevada. Here, they occur in beds regarded as equivalent to uppermost Mule Spring and lowest Monola Fms. Elsewhere, the basal Monola contains only Middle Cambrian forms and the Mule Spring Lower Cambrian forms. In addition to Paedeumias and Ogygopsis these beds contain a peculiar genus with a Protolenid type cranidium and an Ogygopsis type thorax (though with one less thoracic segment) and pygidium (Plate 6, Fig. 6-9, 12, 13).

These beds have been called Lower Cambrian (Nelson, 1963) on the basis of presence of Paedeumias and Olenellus. The fauna contains in addition, forms which resemble the Russian early Middle Cambrian genus Edelsteinaspis (Plate 6, Fig. 10, 11). In describing a somewhat similar situation in the Moroccan Cambrian, Hupe (1960), concludes that beds containing mixed Lower Cambrian forms (the olenellid Kjerulfia and protolenids) and Middle Cambrian forms (Acadoparadoxides) are Middle Cambrian in age.