Palaeontologia Electronica
http://palaeo-electronica.org

NEW OCCURRENCES OF PERMIAN CORALS FROM THE MCCLOUD BELT IN WESTERN NORTH AMERICA

Calvin H. Stevens

ABSTRACT

Previously unreported Permian rugose corals from several terranes considered part of the McCloud Belt are herein described and figured. These include two species from the Eastern Klamath terrane, one of which is described as new; four species from the Central Belt of the Northern Sierra Nevada, with two additional species thought to have been derived from that terrane; four species from the Bilk Creek terrane; and two species from the Harper Ranch subterrane of the Quesnel terrane, one of which is described as new.

Permian species of *Lytvophyllum*? and *Cystolonsdaleia* are now reported from almost all parts of the dispersed McCloud Belt, and *Heterocaninia*? is now known from the Bilk Creek terrane in addition to the Eastern Klamath terrane. These newly reported occurrences strengthen the interpretation that these terranes were closely associated during Early Permian time. None of these genera, however, occur anywhere along the Pangaean margin of North America.

Conversely, *Protowentzelella* and *Tschussovskenia,* which are abundantly represented in Lower Permian rocks all along the western and northern margins of cratonal North America, are rare in rocks of the McCloud Belt. These faunal differences suggest that the terranes of the McCloud Belt lay far out in the Paleopacific Ocean, far west of cratonal North America during the Early Permian so that faunal exchange was minimal.

Calvin H. Stevens. Department of Geology, San Jose State University, San Jose, California 95192-0102, stevens@geosun.sjsu.edu

KEY WORDS: Permian; corals; McCloud Belt, western North America; new species

INTRODUCTION

The name McCloud Belt was coined by Miller (1987) to include terranes in westernmost North America with similar geologic histories and containing similar Early Permian fusulinid faunas differing from those of cratonal North America. Permian rocks considered to belong to the McCloud Belt are in the Eastern Klamath, Bilk Creek, Grindstone, and Chilliwack terranes; the Harper Ranch subterrane of the Quesnel terrane; the Central Belt of the Northern Sierra Nevada (Figure 1); and the Stikine terrane.

PE Article Number: 12.2.6A

Submission: 28 October 2008. Acceptance: 30 April 2009

Stevens, Calvin H., 2009. New Occurrences of Permian Corals from the McCloud Belt in Western North America. *Palaeontologia Electronica* Vol. 12, Issue 2; 6A: 16p;
http://palaeo-electronica.org/2009_2/175/index.html

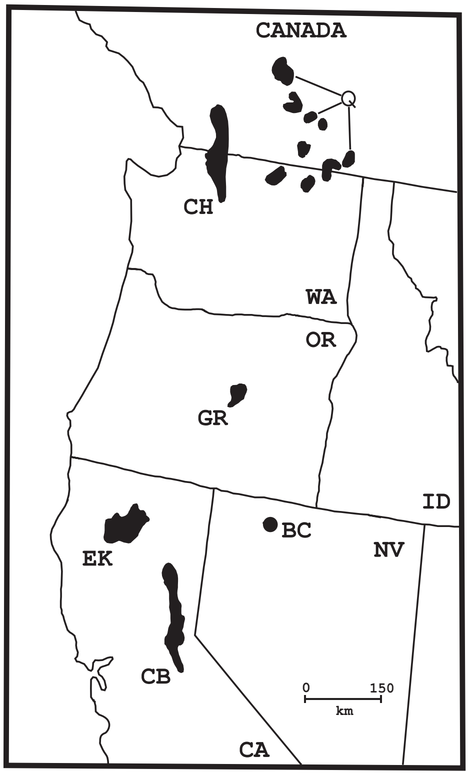

FIGURE 1. Distribution of McCloud Belt rocks in the USA and southernmost Canada. States in USA: WA=Washington, OR=Oregon, ID=Idaho, CA=California, NV=Nevada. Terranes shown in black: BC=Bilk Creek terrane; CB=central belt of Northern Sierra Nevada; CH=Chilliwack terrane; EK=Eastern Klamath terrane; GR=Grindstone terrane; Q=Quesnel terrane.

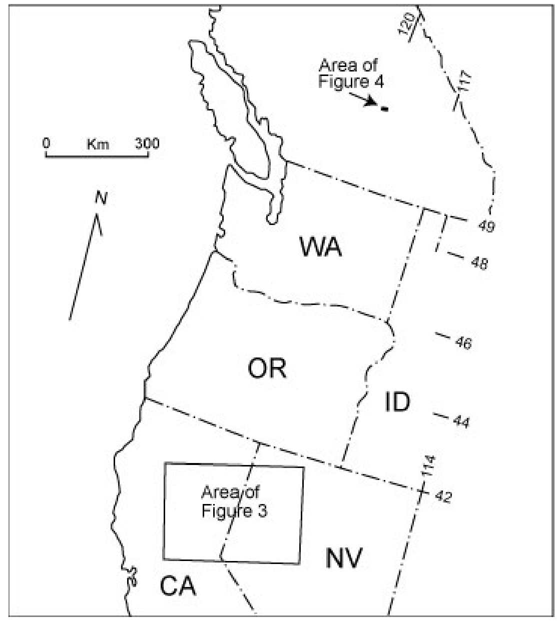

FIGURE 2. General areas of occurrence of corals described herein. See Figure 1 for abbreviations.

The fusulinid faunas from above listed terranes are quite well known from the work of Pitcher (1960) on the Stikine terrane, from reports of Skinner and Wilde (1965, 1966) on the Eastern Klamath, Bilk Creek, Grindstone, and Chilliwack terranes, and from a small study of Stevens (1997) on the Central Belt of the Northern Sierra Nevada. Based on these studies, the various terranes of the McCloud Belt generally have been interpreted to have been closely associated during the Early Permian. The geographic positions of these terranes relative to cratonal North America, postulated on the basis of these and other Permian faunas (e.g., Monger and Ross, 1971; Ross and Ross, 1983; Stevens and Rycerski, 1983; Stevens et al., 1990; Belasky et al., 2002; Belasky and Stevens, 2006), however, are still disputed. Thus, new faunal data are badly needed.

Early Permian corals are abundant and widespread both in the terranes of the McCloud Belt and along much of the western and northern margins of cratonal North America. These fossils already have been employed in interpretations of relationships between several of the terranes of the McCloud Belt and the geographic positions of these terranes relative to cratonal North America (e.g., Stevens et al., 1990) during the Permian.

Up to the present, however, corals of the McCloud Belt were known primarily from a study by Merriam (1942) on Late Paleozoic corals from the Grindstone terrane, reports by Wilson (1982, 1985) on latest Pennsylvanian and Early Permian corals from the Eastern Klamath terrane, and a study by Stevens and Rycerski (1989) of Early Permian corals from the Stikine terrane. No corals have been described or figured previously from the Central Belt of the Northern Sierra Nevada or from the Bilk Creek and Chilliwack terranes.

The purpose of this paper is to report on previously undocumented occurrences of Permian corals throughout the McCloud Belt to better understand relationships between the faunas of various parts of this belt and between them and those of cratonal North America.

MATERIAL

Collections of Permian corals from several terranes of the McCloud Belt in western USA (Figures 1–3) and southwestern Canada (Figures 1, 2, and 4) made during the past 25 years contain many species from terranes from which they had not

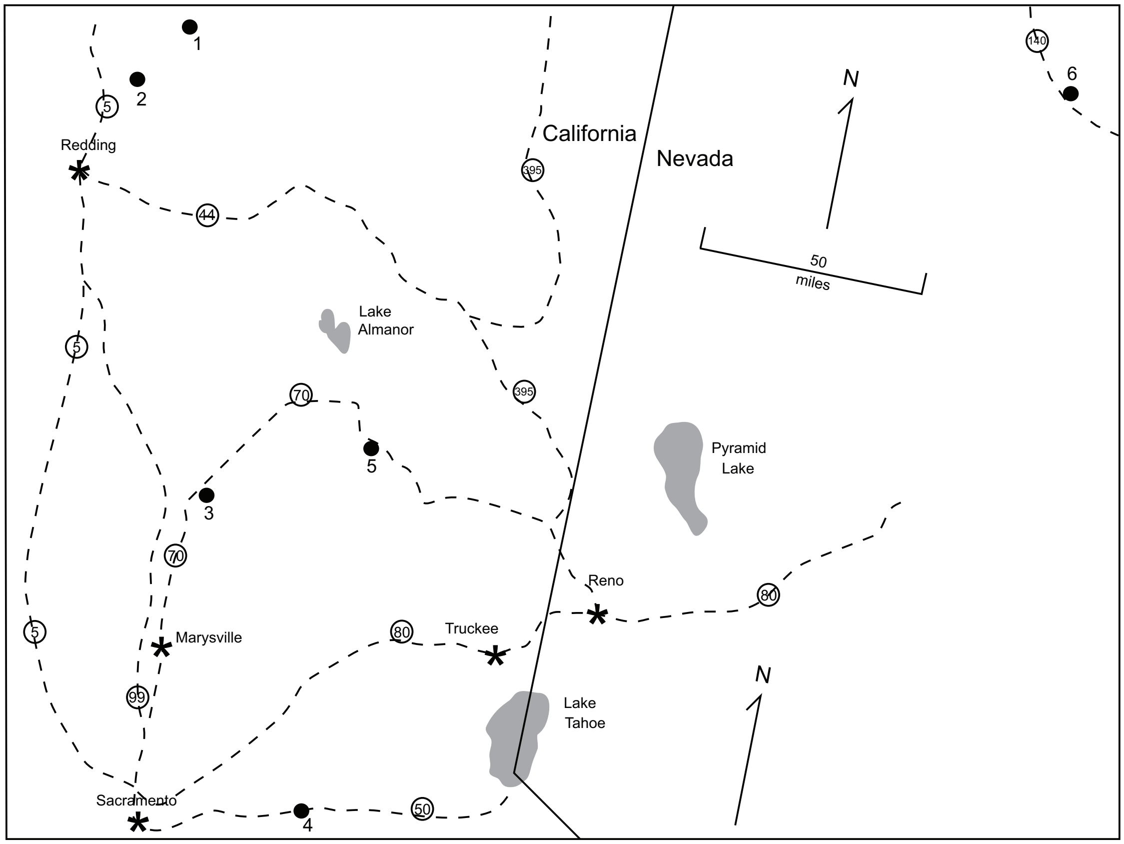

FIGURE 3. Locations of coral samples described herein in western USA. 1=SJS-1034 near McCloud Reservoir; 2=SJS-685 west of McCloud Reservoir; 3=SJS-1032, SJS-1045, SJS-1080, SJS-1294 near Lake Oroville; 4= SJS-833 west of Placerville; 5=SJS-1022 southwest of Quincy; 6=SJS-863, SJS-897, SJS-1066, SJS-1085, SJS-1088 near Quinn River crossing. For details see Appendix. Open circles enclose highway numbers. For regional location see Figure 2.

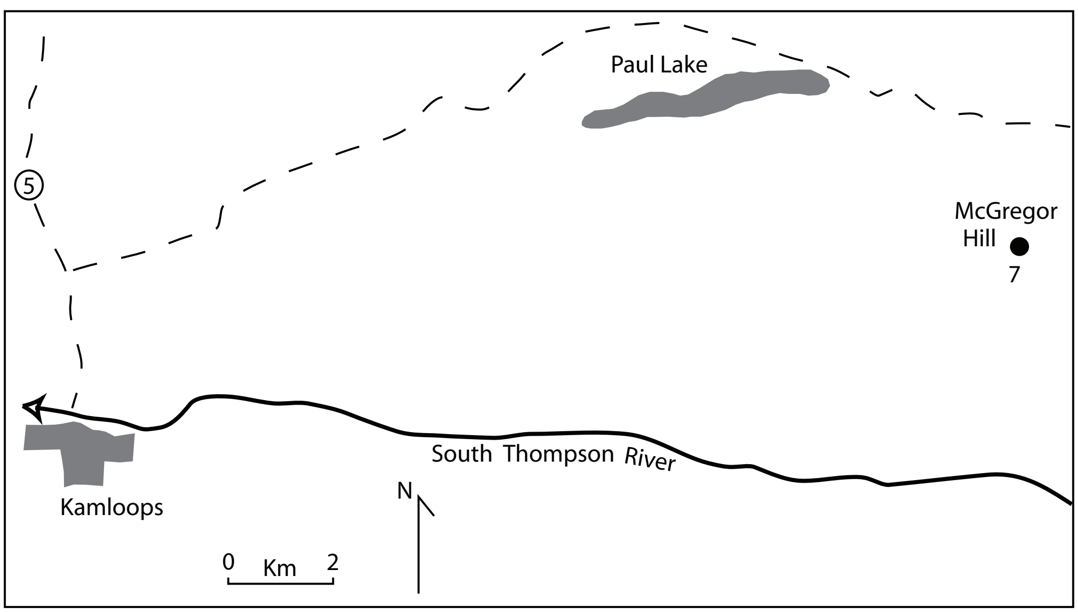

FIGURE 4. Location of coral samples described herein in southern Canada. 7=SJS-1014, SJS-1015 on McGregor Hill. Open circle contains the highway number. The other dashed line indicates a minor road. For general location see Figure 2.

been reported previously. This includes two additional species from the Eastern Klamath terrane, one of which is described as new; four species from the Central Belt of the Northern Sierra Nevada, with two additional species thought to have been derived from that terrane; four species from the Bilk Creek terrane; and two species from the Harper Ranch subterrane of the Quesnel terrane, one of which is described as new.

SYSTEMATIC PALAEONTOLOGY

All holotypes bear USNM numbers and a C number, and are housed at the U.S. National Museum. Other figured specimens bearing a C number preceded by the letters SJS, presently housed in the San Jose State University Museum of Paleontology, are soon to be transferred to the University of California Museum of Paleontology at Berkeley.

Family AULOPHYLLIDAE Dybowski, 1873
Genus HETEROCANINIA Yabe and Hayasaka, 1920
Heterocaninia? langenheimi, Wilson, 1982
Figure 5.4-5.7

DESCRIPTION.- Corallum solitary with corallite diameters up to at least 55 mm. Major septa about 42 at a diameter of 33 mm, thin in dissepimentarium, dilate in tabularium; septa greatly thickened in cardinal quadrant of one specimen; cardinal septum considerably shortened. Minor septa very short, generally form ridges on wall and crests on outermost dissepiments; in one specimen several minor septa extend one-half distance across dissepimentarium. Axial structure one-half to two-thirds corallite radius, composed of a sinuous, obscure median lamella, numerous septal lamellae, and many ranks of elongate, steeply dipping axial tabellae. Dissepimentarium one-fourth to one-third corallite radius, composed of numerous ranks of small, steeply dipping globose dissepiments often in a herringbone pattern. Tabularium composed of incomplete, commonly cystose tabulae, generally slightly inclined upward to the axial column.

MATERIAL. - Three specimens, five transverse, five longitudinal sections.

REMARKS.- The present specimens compare favorably with those figured by Wilson (1982) from the Eastern Klamath terrane. Wilson described the tabulae as “sagging, or sloping inwards and upwards generally to axial tabellae.” This is true of his figure 14d, but in his figure 14a the tabulae are more similar to those figured here. As pointed out by Wilson (1982) the present species probably does not belong in the genus *Heterocaninia*, but at present there are no better options.

OCCURRENCE.- SJS 1085, SJS 1088, Bilk Creek terrane.

Family LITHOSTROTIONIDAE d’Orbigny, 1852
Genus *Tschussovskenia* Dobrolyubova, 1936
Tschussovskenia? sp.
Figure 6.8

DESCRIPTION. - Corallum fasciculate with corallites up to 10 mm in diameter. Major septa about 26, moderately long, thin, subequal in length. Minor septa short, confined to narrow dissepimentarium which is about one-fifth corallite radius, composed of one to three ranks of interseptal dissepiments.

MATERIAL. - One colony, two transverse sections.

REMARKS.- Material was not available for sectioning longitudinally. This specimen resembles *T. captiosa* Dobrolyubova, 1936, but it lacks any indication of an axial structure common in that species, it has more septa than generally is present in *T. captiosa*, and it has better developed minor septa. The present form is very similar to an unnamed species from Lower Permian rocks in Lee Canyon, Spring Mountains, Nevada.

OCCURRENCE.- SJS 1294, Central Belt of Northern Sierra Nevada.

Family DURHAMINIDAE Minato and Kato, 1965
Genus *Durhamina* Wilson and Langenheim, 1962
Durhamina sp. cf. D. *moormanensis* (Stevens, 1967)
Figure 7.7-7.9

DESCRIPTION.- Corallum fasciculate with corallites 8-16 mm in diameter, most 12-16 mm. Major septa 23-27, long, commonly enter axial area, distal ends may be twisted irregularly. Minor septa commonly interrupted, some extend as spines into tabularium. Axial structure very loose, composed of an apparently discontinuous median lamella, axial ends of long major septa, and locally up to six ranks of steeply dipping axial tabellae. Dissepimentarium about 2 mm wide, composed of three to six ranks of steeply dipping, mostly interseptal dissepiments, some lonsdaleoid in largest corallites. Tabularium 1.5-2.0 mm wide, composed of mostly incomplete, moderately upwardly inclined tabulae. Biform morphology developed.

MATERIAL. - One colony, three transverse, three longitudinal sections.

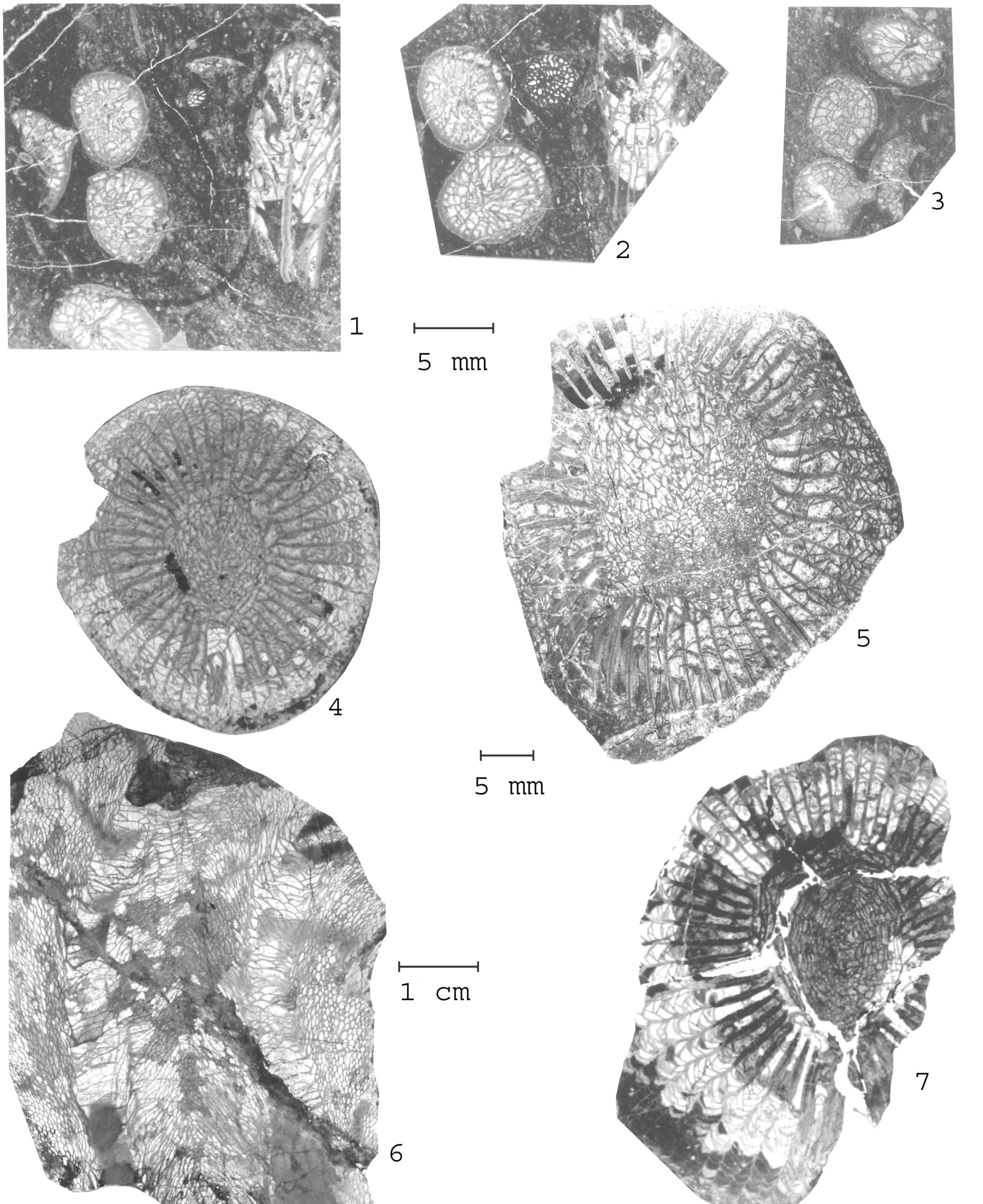

FIGURE 5. Corals from Bilk Creek terrane. 1-3, *Lytvophyllum*? sp. 2, SJS 1066, slides C10-C12; 4-7, *Heterocaninia*? *langenheimi*, 4,6,7, SJS 1085, slides C13, C15, C16; 5, SJS 1088, slide C14. Upper 5-mm scale is relevant to Figures 5.1-5.3; lower 5-mm scale is relevant to Figures 5.4, 5.5, 5.7; 1-cm scale applies to Figure 5.6.

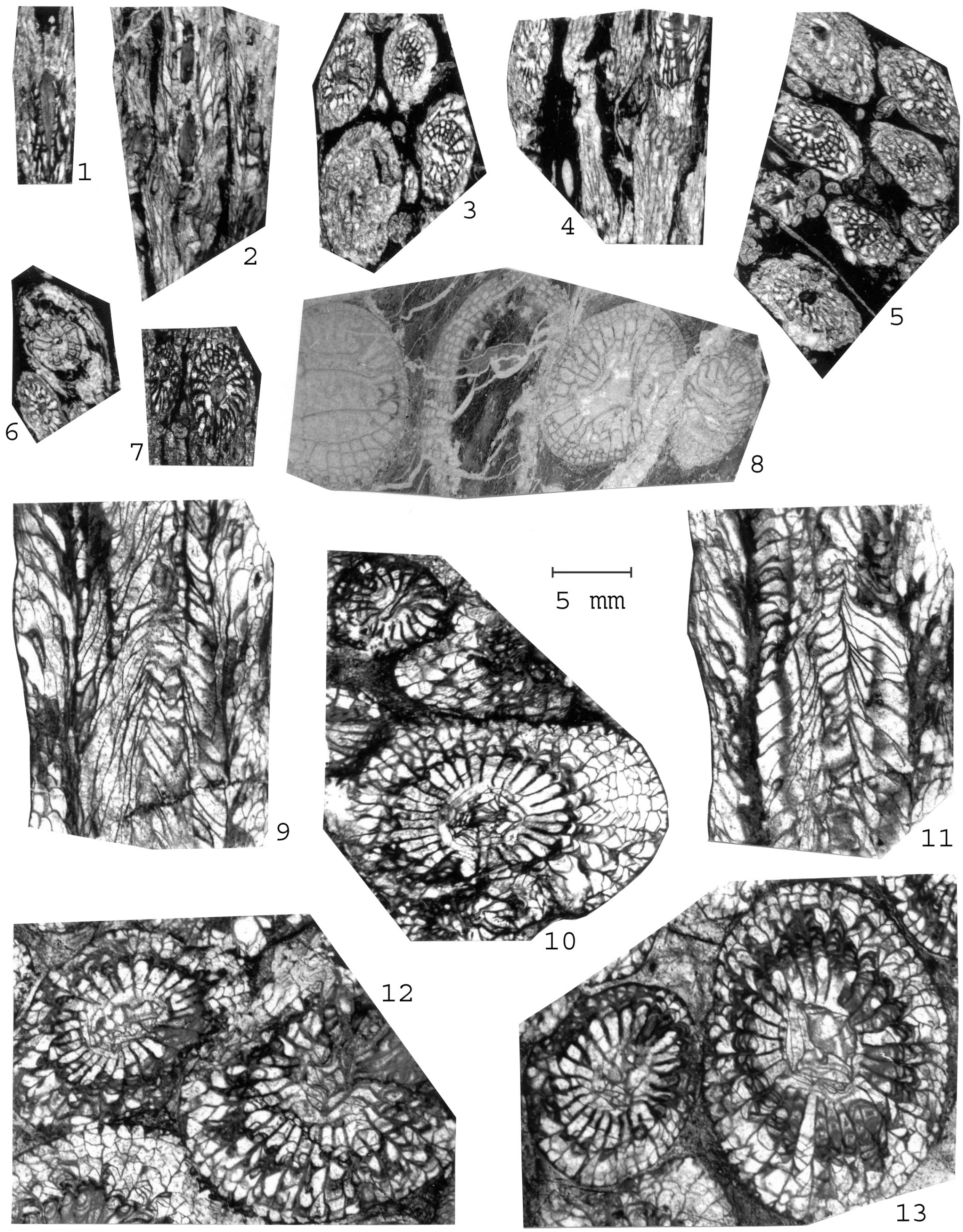

FIGURE 6. Corals from Central Belt of Northern Sierra Nevada and Jurassic conglomerate in western Sierra Nevada. 1-7, *Lytvophyllum*? sp. 1, SJS 1032, slides C26-C31, C56; 8, *Tschussovskenia*? sp., SJS 1294, slide C32; 9-13, *Paraheritschioides* sp. cf., *P. californiense*, SJS 1022, slides C33-C37. Five-mm scale applies to all figures.

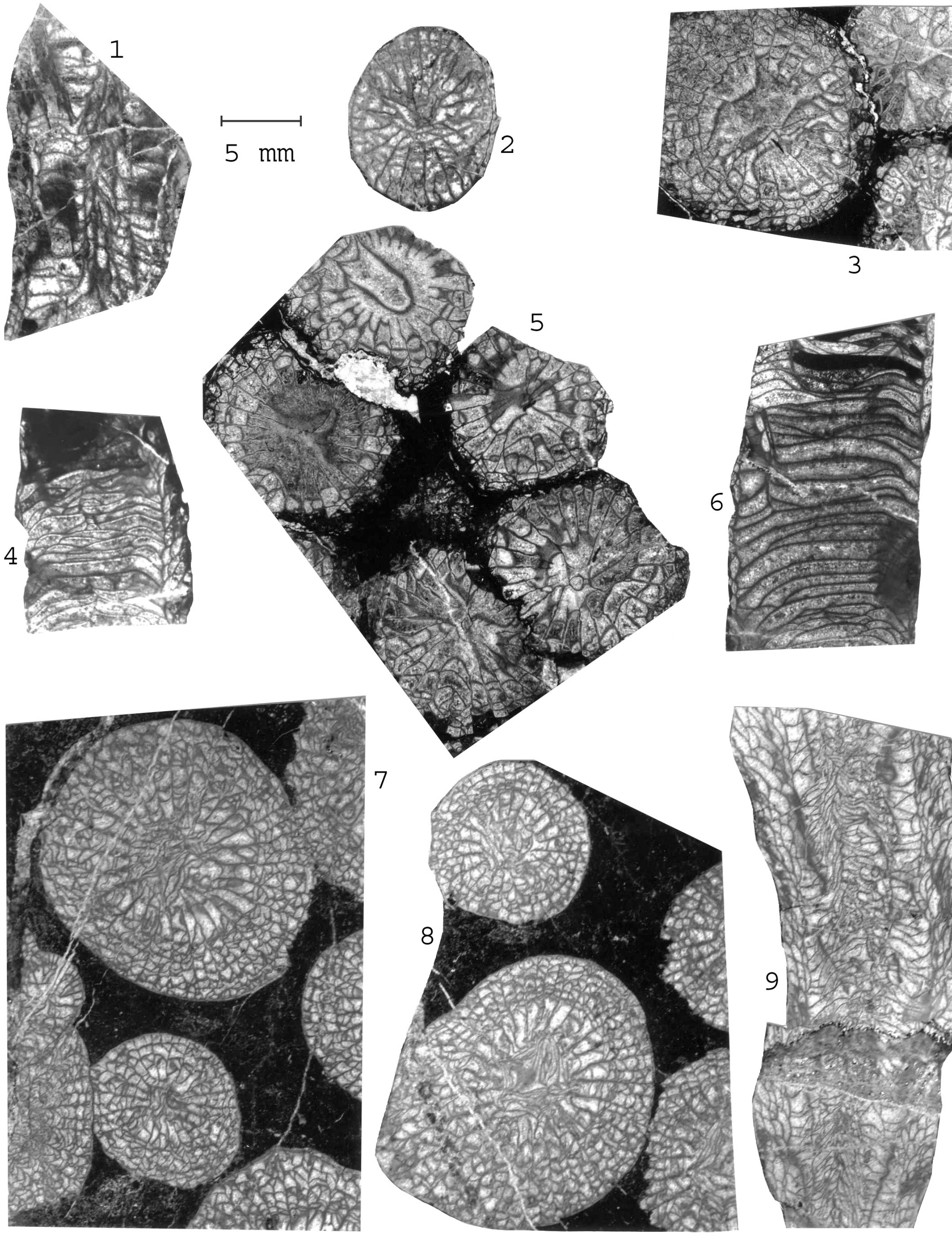

FIGURE 7. Corals from Bilk Creek terrane and Jurassic conglomerate in western Sierra Nevada. 1,2, *Paraheritschioides*? sp., SJS 833, slides C17, C18; 3-6, *Heintzella* sp. cf. *H. radiata*, SJS 863, slides C19, C20, C22; 7-9, Durhamina? sp. cf. *D.*? *moormanensis*, SJS 897, slides C23-C25. Five-mm scale applies to all figures.

REMARKS.- This species resembles *D. moormanensis* in size and number of septa. The present specimen differs in having lonsdaleoid dissepiments locally developed, minor septa that commonly are interrupted, and an axial structure locally with numerous ranks of steeply dipping axial tabellae. Immature corallites 5 mm in diameter show the tangle of major septa at the axis typical of the Durhaminidae. These new specimens, therefore, tend to confirm the assignment of this species to the genus *Durhamina.*

OCCURRENCE.- SJS 897, Bilk Creek terrane.

Genus *Pseudocystophora* Kossovaya, 1997
Pseudocystophora wilsoni n. sp.
Figure 8.1-8.4, 8.6, 8.7

DIAGNOSIS. - A species of *Pseudocystophora* with unusually large corallites and with complex dissepimentarium consisting of an outer, elongate, lonsdaleoid series, and an inner globose series of dissepiments.

DESCRIPTION. - Corallum mostly aphroid, composed of polygonal corallites 14-18 mm in diameter. Wall reduced to few short segments. Major septa 19-20, few to more than one-half extend into axial structure, slightly dilate in tabularium, thin and discontinuous in dissepimentarium; one septum may be slightly shortened. Minor septa extend about 1 mm into tabularium where they are dilated. Axial structure very loose, composed of obscure median lamella, two-three ranks of steeply inclined axial tabellae, and distal parts of up to 13 major septa. Dissepimentarium complex, about one-half corallite radius; outermost dissepiments lonsdaleoid, elongate, narrow, mostly gently dipping, commonly in three or four ranks on both sides of very short wall segments; inner dissepiments of about four ranks, globose, gently to steeply inclined, form a complex of V-shaped, concentric, and lateral dissepiments in transverse section. Tabularium composed of moderately adaxially inclined, complete and incomplete tabulae.

ETYMOLOGY. - Named for Edward Wilson who has described most of the corals in the Eastern Klamath terrane.

MATERIAL.- One colony, holotype – USNM 531319, 5 transverse, 4 longitudinal sections, Eastern Klamath terrane.

REMARKS. - This species resembles *P. fryi* (Wilson, 1982) in its general characteristics. The present species, however, has considerably larger corallites, more septa, a much more complex dissepimentarium, and much more widely spaced tabulae.

OCCURRENCE.- SJS 685, Eastern Klamath terrane.

Family KLEOPATRINIDAE Fedorowski, Bamber, and Stevens, 2007
Genus *Fomichevella* Fedorowski, 1975
Fomichevella sp. cf. F. *major* (Heritsch, 1939)
Figure 9.9-9.11

DESCRIPTION.- Fasciculate corallum with corallite diameters at least 26 mm. Major septa about 34, thin in dissepimentarium, dilated in tabularium; cardinal septum moderately shortened. Minor septa very short, generally appear as small prongs on the wall. No indication of an axial structure. Dissepimentarium about one-half corallite radius, composed of herringbone and concentric dissepiments. Nature of tabularium uncertain because of lack of a longitudinal section.

MATERIAL.- One colony, seven transverse sections.

REMARKS.- This specimen is similar to *F. major* in corallite diameter, number of septa, the relatively long cardinal septum, and the general shortness of minor septa. Material was not adequate for preparation of a longitudinal section.

OCCURRENCE. - SJS 1080, Central Belt of Northern Sierra Nevada.

Genus *Heintzella* Fedorowski, 1967
Heintzella sp. cf. H. *radiata* (Fedorowski, 1965)
Figure 7.3-7.6

DESCRIPTION.- Corallum fasciculate, corallites 12-15 mm in diameter. Major septa 24-26, generally thin throughout, several septa commonly much longer than others and extend into axial area; in one corallite cardinal septum very short and counter septum extends to center where it is connected to median lamella. Minor septa very short. Axial structure when present consists of a median lamella commonly connected with counter septum, rarely with one or two septal lamellae. Dissepimentarium one-fourth to one-third corallite radius, composed of about three ranks of steeply dipping globose to elongate dissepiments. Tabularium composed of complete and incomplete tabulae generally slightly arched upward.

MATERIAL. - One colony, two transverse, five longitudinal sections.

REMARKS.- This specimen resembles the holotype of *H. radiata* in most respects. It differs in hav-

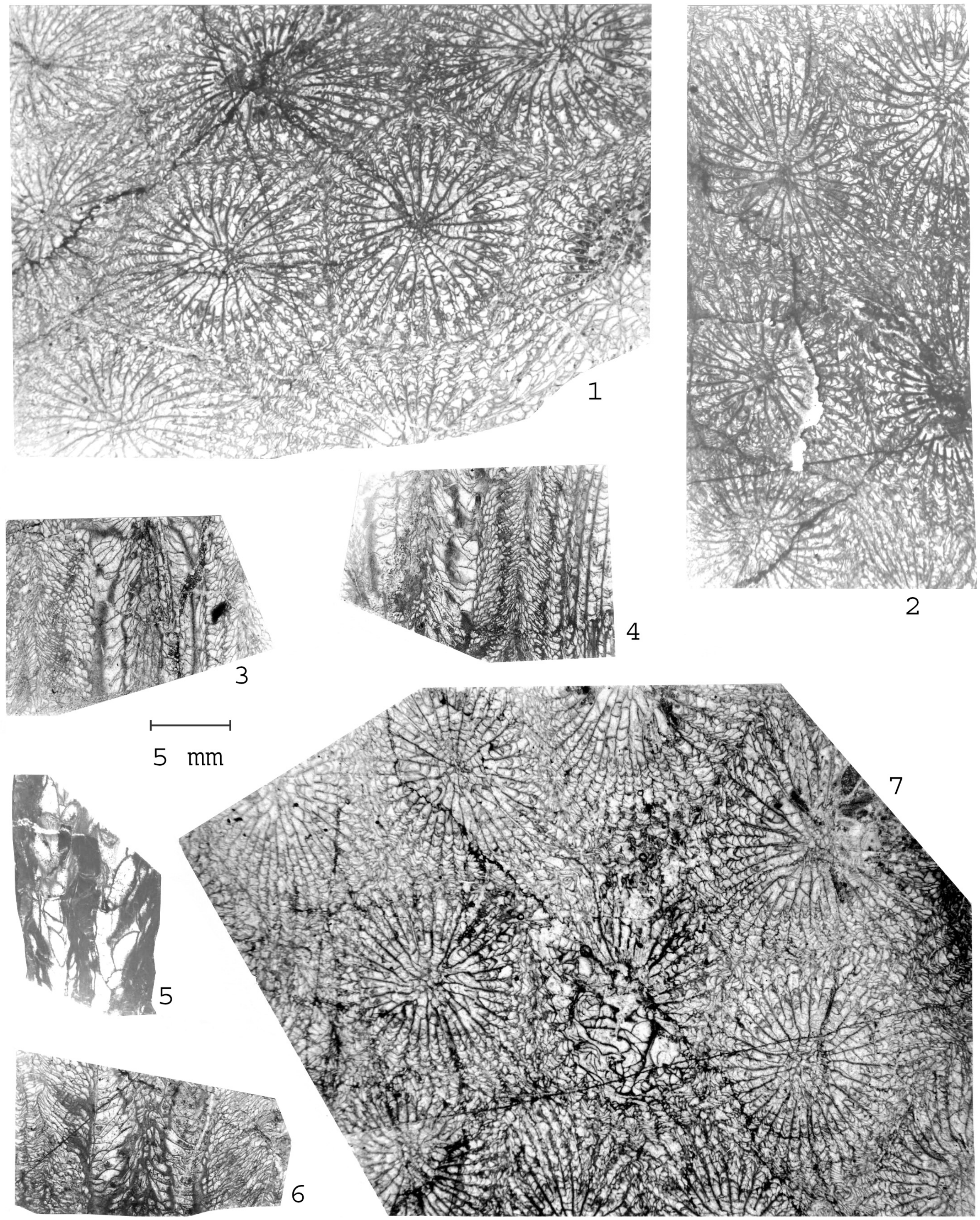

FIGURE 8. Corals from Eastern Klamath terrane and Central Belt of Northern Sierra Nevada. 1-4, 6, 7, *Pseudocystophora wilsoni* n. sp., holotype, USNM 531319, SJS 685, slides C49 (Figures 1 and 2), C51, C52, C54, C55, respectively; 5, *Darwasophyllum*? sp., SJS 1034, slide C53. Five-mm scale is relevant to all figures.

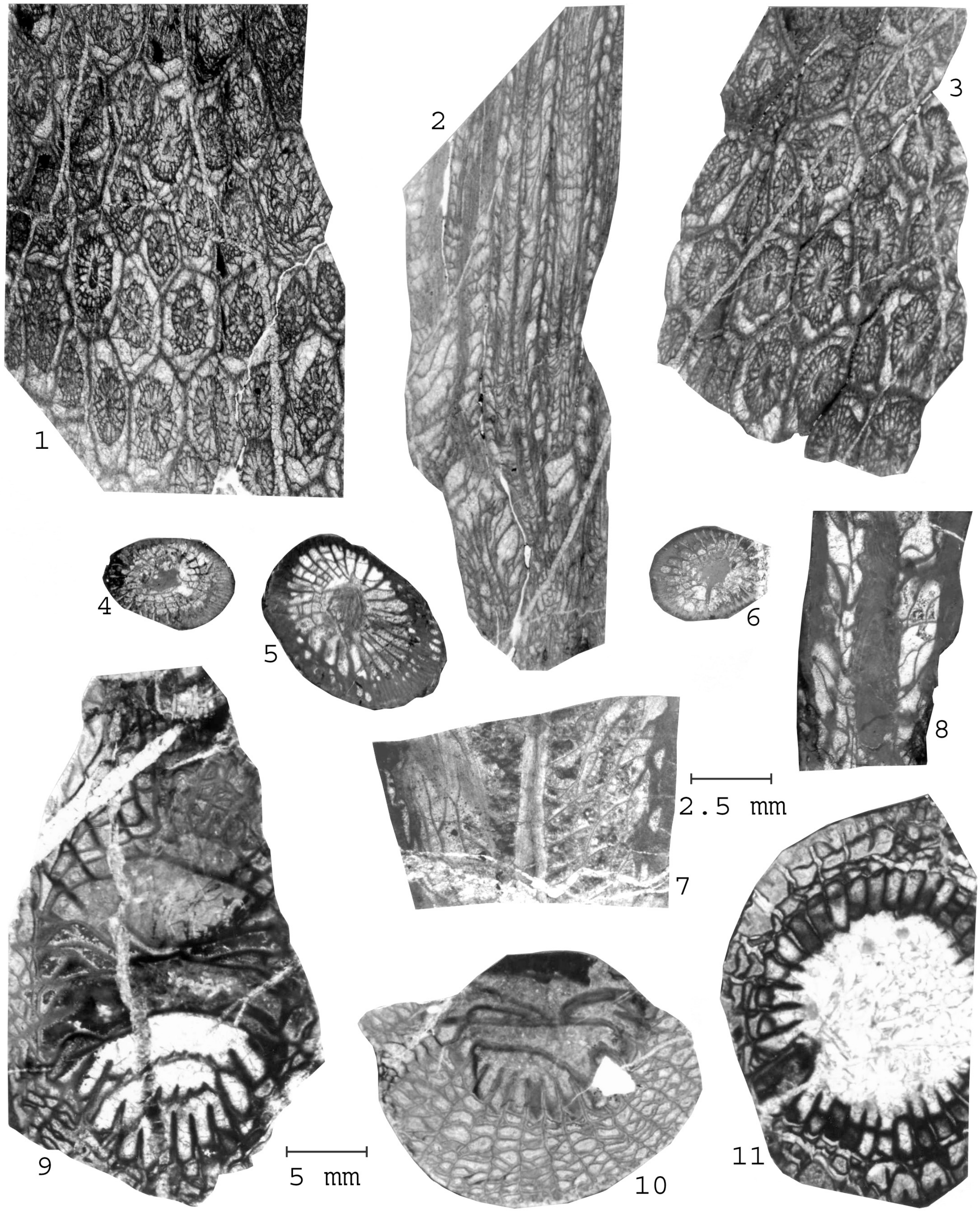

FIGURE 9. Corals from Central Belt of Northern Sierra Nevada and Eastern Klamath terrane. 1-3, *Petalaxis occidentalis*, SJS 1045, slides C38-C40; 4-6, 8, *Darwasophyllum*? sp., SJS 1034, slides C41-C44; 7, solitary coral of uncertain affinity in sample with *Darwasophyllum?* sp., SJS 1034, slide C45; 9-11, *Fomichevella major*, SJS 1080, slides C45-C48. Five-mm scale applies to all figures except 9.7 for which the 2.5-mm scale is relevant.

ing a narrower dissepimentarium and generally shorter major septa.

OCCURRENCE.- SJS 863, Bilk Creek terrane.

Genus *Paraheritschioides* Sando, 1985
Paraheritschioides sp. aff. P. *californiense* (Meek,1864)
Figure 6.9-6.13

DESCRIPTION.- Corallum fasciculate with corallites 10-17 mm in diameter. Major septa 24-28, thin in dissepimentarium, dilated in tabularium, septa long, several commonly connect with axial lamella; cardinal septum shortened by about 1.5 mm. Minor septa very short, may appear as spines on wall. Axial structure consists of an obscure median lamella, up to 10 septal lamellae, and rarely, few axial tabellae. Dissepimentarium about two-fifths corallite radius, consists of four to six ranks of steeply dipping, globose and elongate dissepiments. Tabularium consists of long, commonly complete, tabulae steeply inclined upward to axial lamella.

MATERIAL.- One colony, six transverse, six longitudinal sections.

REMARKS.- This specimen is very similar to *P. californiense*, differing primarily in the extreme shortness of the minor septa and in having much more steeply inclined tabulae.

OCCURRENCE.- SJS 1022, block in mélange, most likely derived from the Central Belt of the Northern Sierra Nevada.

Paraheritschioides? sp.
Figure 7.1, 7.2

DESCRIPTION.- Corallum presumed fasciculate, composed of corallites 9-12 mm in diameter. Major septa 18, extend about two-thirds coral radius, cardinal septum shortened about 1 mm, counter septum continuous with median lamella; another septum appears confluent with one septal lamina. Minor septa about one-third length of major septa, slightly penetrate tabularium. Axial structure weak, consists of thin median lamella, one discontinuous rank of axial tabellae, and possibly several septal lamellae. Dissepimentarium about one-fourth corallite radius, consists of two or three ranks of small globose dissepiments. Tabularium consists of slightly warped tabulae, almost horizontal at dissepimentarium, some then slightly depressed before rising moderately steeply to axial structure.

MATERIAL.- One colony, two transverse, two longitudinal sections.

REMARKS.- The present specimen is placed in the genus *Paraheritschioides* even though the early growth stages are unknown because of its general characteristics. In addition, it closely resembles an undescribed species of that genus from northeastern Nevada. Presence of septal lamellae cannot be confirmed because of poor preservation.

OCCURRENCE. - SJS 833, clast in a Jurassic conglomerate, most likely derived from Central Belt of Northern Sierra Nevada.

Family PETALAXIDAE Fomichev, 1953
Genus *Cystolonsdaleia* Fomichev, 1953
Cystolonsdaleia danneri n. sp.
Figure 10.5-10.9

DIAGNOSIS.- A species of *Cystolonsdaleia* with a large number of septa and multiple ranks of dissepiments.

DESCRIPTION.- Corallum cerioid, composed of polygonal corallites up to 11 mm in diameter. Major septa 20-24, extend 2-4 mm into tabularium, some reach median lamella, one septum continuous with median lamella. Minor septa commonly long, extend into tabularium. Axial structure composed of thickened median lamella, rarely two, with few septal lamellae. Dissepimentarium one-third to one-half corallite radius, composed of two to five ranks of steeply dipping lonsdaleoid dissepiments. Tabularium composed of moderately concave upward tabulae that descend moderately steeply from dissepimentarium, then rise steeply upward to median lamella to form periaxial cones. In one corallite axial structure composed of two laminae between which there are gently convex upward partitions, about 7 per mm (see Figure 10.6).

ETYMOLOGY.- Named for Ted Danner, an expert on Late Paleozoic rocks in British Columbia, who collected the holotype.

MATERIAL.- One colony, holotype - USNM 531318, five transverse, two longitudinal sections, Harper Ranch subterrane of the Quesnel terrane.

REMARKS. - This species differs from all other Permian species of the genus in the large size of the corallites, the large number of septa, and the multiple ranks of dissepiments.

OCCURRENCE. - SJS 1015, Quesnel terrane.

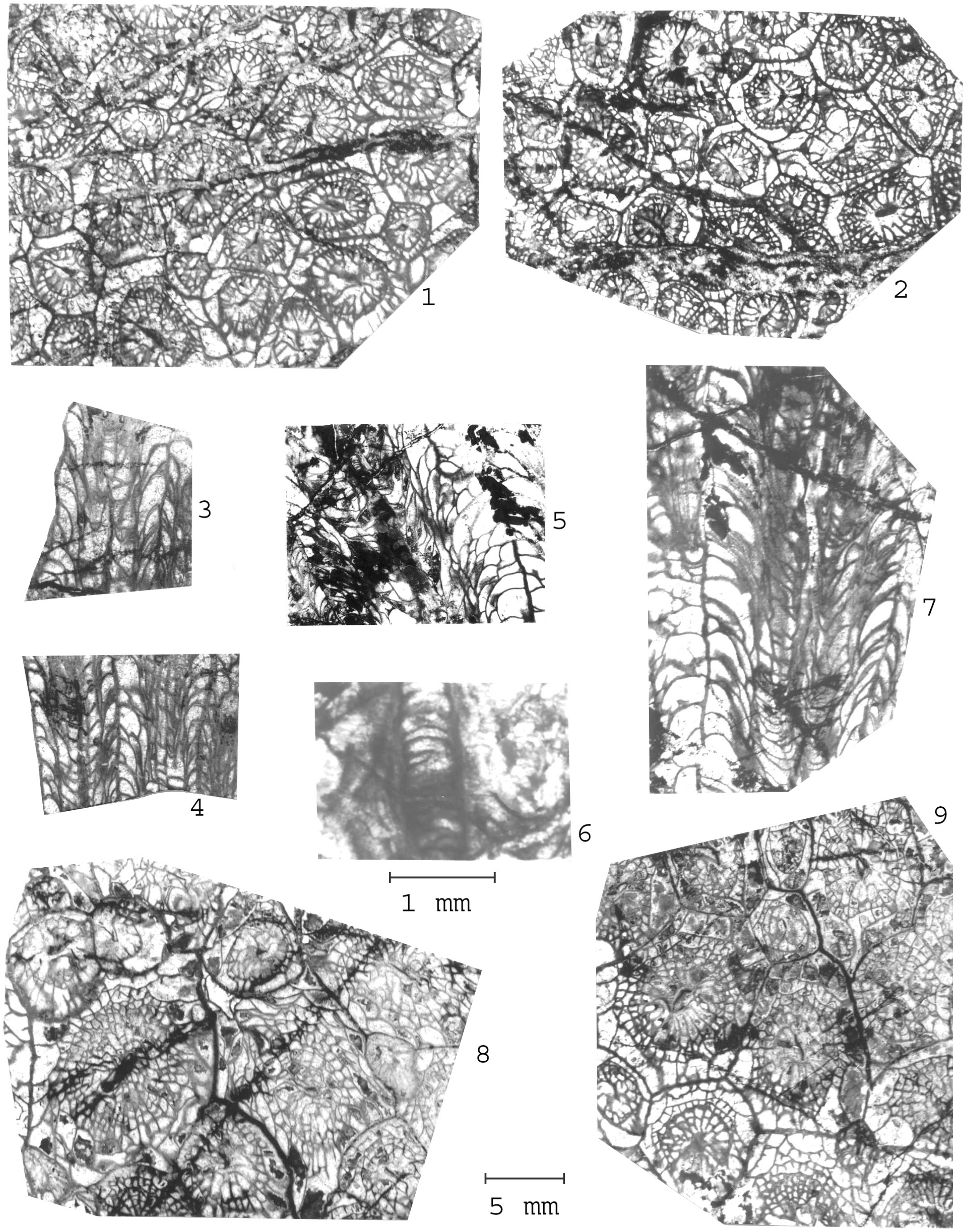

FIGURE 10. Corals from the Quesnel terrane, Harper Ranch subterrane. 1-4, *Petalaxis besti*, SJS 1014, slides C1-C4; 5-9, *Cystolonsdaleia danneri*, n. sp., holotype, USNM 531318, SJS 1015, slides C5, C6, C8, C9, respectively. Five-mm scale is relevant to all figures except 10.6 for which the 1-mm scale applies. Figure 10.6 shows the microstructure of the upper part of the axial column in specimen shown in 10.5.

Genus *Petalaxis* Milne-Edwards and Haime, 1852
Petalaxis besti Wilson, 1982
10.1-10.4

DESCRIPTION.- Corallum cerioid, composed of corallites 5-8 mm in diameter. Major septa 17-18, commonly approach axis, one continuous with median lamella. Minor septa may appear as spines penetrating tabularium. Axial structure composed of one lenticular median lamella. Dissepimentarium generally composed of one rank of steeply dipping lonsdaleoid dissepiments. Tabularium composed of concave upward variably spaced tabulae.

MATERIAL.- One colony, seven transverse, four longitudinal sections.

REMARKS.- The present specimen resembles the type of *P. besti* quite closely, differing only in smaller average corallite diameter and generally larger lonsdaleoid dissepiments.

OCCURRENCE. - SJS 1014, Harper Ranch subterrane of Quesnel terrane.

Petalaxis occidentalis (Merriam, 1942)
Figure 9.1-9.3

DESCRIPTION.- Corallum cerioid, composed of corallites 4-5 mm in diameter. Major septa 17-19, of moderate length, one septum continuous with median lamella. Minor septa commonly penetrate tabularium. Axial structure consists of elongate median lamella. Dissepimentarium with one or two ranks of steeply dipping lonsdaleoid dissepiments. Tabularium consists of very steeply dipping tabulae that flatten out or rise slightly to median lamella.

MATERIAL. - One colony, two transverse, one longitudinal section.

DISCUSSION. - The characteristics of this specimen correspond in all respects to the types of *P. occidentalis*.

OCCURRENCE. - SJS 1045, Central Belt of Northern Sierra Nevada.

Genus *Lytvophyllum* Dobrolyubova, 1941 (in Soshkina et al. 1941)
Lytvophyllum? sp. 1
Figure 6.1-6.7

DESCRIPTION.- Corallum fasciculate, composed of cylindrical corallites 4-5 mm in diameter. Major septa generally about 17, rarely up to 22, moderately long, one septum continuous with median lamella. Nature of minor septa uncertain because of poor preservation. Axial lamella rounded, as much as 1 mm in diameter. Dissepimentarium consists of one to three ranks of elongate, steeply dipping, largely lonsdaleoid dissepiments. Tabulae somewhat concave upward.

MATERIAL. - One colony, eight transverse, 13 longitudinal sections.

REMARKS.- This species resembles *L.? sustutense* Fedorowski, Bamber, and Stevens 2007 in number of septa and broad dilation of the median lamella. It differs in the presence of up to three ranks of steeply dipping, elongate dissepiments.

OCCURRENCE.- SJS 1032, Central Belt of Northern Sierra Nevada.

Lytvophyllum? sp. 2
Figure 5.1-5.3

DESCRIPTION. - Corallum fasciculate with corallites 5-6 mm in diameter. Major septa 18, most extend into axial region, straight to quite irregular, one septum connected to median lamella. Minor septa generally very short, may be reduced to small prongs on wall. Median lamella generally very slightly dilated, rarely rounded. Dissepimentarium impersistent, very narrow, may consist of one rank of steeply dipping, rarely lonsdaleoid dissepiments. Tabularium consists of very steeply declining tabulae.

MATERIAL. - One colony, three transverse, one longitudinal section.

REMARKS.- This species differs from all other species questionably assigned to the genus *Lytvophyllum* in that the axial lamella is not consistently dilated (however, note corallite in lower part of Figure 5.1 and the one in the upper part of Figure 5.3), distal portions of major septa may be highly irregular, and tabulae dip very steeply downward to the axial lamella.

OCCURRENCE. - SJS 1066, Bilk Creek terrane.

Family GEYEROPHYLLIDAE Minato, 1955
Genus *Darwasophyllum* Pyzhyanov, 1964
Darwasophyllum? sp.
Figures 9.4-9.6, 9.8, Figure 8.5

DESCRIPTION.- Nature of corallum uncertain, loosely fasciculate, or solitary. Wall greatly thickened with stereoplasm. Major septa 20-27, rather long, one septum connected to median lamella. Minor septa very short in young corallites, extend as prongs into tabularium in mature specimens. Axial structure composed of a median lamella 1.5 mm in diameter, rounded but irregular because of projections of numerous septal lamellae. In longitudinal section axial lamella appears composed of very fine, sharply domed laminae (Figure 9.8). Dissepimentarium sporadically developed, lonsdaleoid dissepiments rare. Tabularium generally composed of steeply dipping, irregularly disposed tabulae that intersect axial structure horizontally or in some cases rise steeply to become part of it.

MATERIAL.- One colony?, six transverse, four longitudinal sections.

REMARKS.- The present specimens resemble *Darwasophyllum* in several respects, but lack the numerous lonsdaleoid dissepiments of that genus. Corallites are numerous in the present sample, but it is uncertain whether or not the corallum is fasciculate. This species probably belongs to a heretofore undescribed genus related to the genus *Darwasophyllum.*

OCCURRENCE. - SJS 1034, Eastern Klamath terrane.

DISCUSSION

The Early Permian genera *Lytvophyllum*? and *Cystolonsdaleia* provide the most obvious tie between the terranes of the McCloud Belt. *Lytvophyllum*? is now known to be present in all parts of the McCloud Belt except the Grindstone and Chilliwack terranes, and *Cystolonsdaleia* is now known to occur in four terranes of the McCloud Belt.

The newly recorded occurrence of the Permian genus *Heterocaninia?* in the Bilk Creek terrane now more tightly allies this terrane with the Eastern Klamath terrane, and the record of *Petalaxis besti* Wilson, 1982 in the Quesnel terrane strengthens correlation with the Stikine and Eastern Klamath terranes. Finally, the presence of *Petalaxis occidentalis* (Merriam 1942) in the Central Belt of the Northern Sierra Nevada adds to the previously documented occurrences of this Early Permian species in the Eastern Klamath and Grindstone terranes. Thus, the coral faunas in the various terranes of the McCloud Belt are quite similar to one another, implying, as do the fusulinids, that these terranes were closely associated during Early Permian time.

Of the genera mentioned above, *Lytvophyllum*?, *Cystolonsdaleia*, and *Heterocaninia*? are unknown in the Early Permian faunas of cratonal North America (Fedorowski et al., 2007). In contrast, two other Early Permian genera, *Protowentzelella* and *Tschussovskenia*, which are very abundant along much of the western and northern margins of the North American craton (Fedorowski et al., 2007), are very rare in rocks of the McCloud Belt. Thus, a comparison of the coral faunas of the McCloud Belt with those of the western and northern margins of cratonal North America suggests that these two regions were widely separated during Early Permian time.

ACKNOWLEDGMENTS

I am very grateful for the support of J. Fedorowski and E.W. Bamber. I also thank two anonymous readers for their reviews of the manuscript. Finally, I could not have accomplished preparation of the figures without the help of Poh Hoon Chan.

REFERENCES

Belasky, P., Stevens, C.H., and Hanger, R. 2002. Early Permian location of western North American terranes based on brachiopod, fusulinid, and coral biogeography: *Palaeogeography, Palaeoclimatology, and Palaeoecology,* 179:245-266.

Belasky, P. and Stevens, C.H. 2006. Permian faunas of westernmost North America. In Haggart, J.W., Enkin, R.J., and Monger, J.W.H. (eds.), *Paleogeography of the North American Cordillera: Evidence for and against large-scale displacements.* Geological Association of Canada Special Paper, 46:71-80.

Dobrolyubova, T.A. 1936. Corals of the Upper Carboniferous of the western slope of the central Urals and their stratigraphic significance. *Trudy Vsesoyuznogo Nauchno-Issledovatelskogo Instituta, Mineralnogo Syriya*, 103:1-68 [In Russian, English summary].

d'Orbigny, A.. 1852. Cours elementaire de paleontology et de geologie stratigraphique, 2(1):1-382.

Dybowski, W.N. 1873. Monographie der Zoantharia Sclerodermata Rugosa ous der Silurformation Estlands, Nordlivlands und der Insel Gotland. *Archiv fur Naturkunde der Livlands, Estlands, Kurlands,* 1:257-414.

Fedorowski, J. 1965. Lower Permian Tetracoralla of Hornsund, Vestspitsbergen. In Birkenmajer, K. (ed*.), Geological Results of the Polish 1957-1958, 1959, 1960 Spitsbergen Expeditions, Part 4. Studia Geologica Polonica,* 17:7-173.

Fedorowski, J. 1967. The Lower Permian Tetracoralla and Tabulata from Treskelodden, Vestspitsbergen. *Norsk Polarinstitutt Skrifter,* 142:5-44.

Fedorowski, J. 1975. On some Upper Carboniferous Coelenterata from Bjornoya and Spitsbergen. Acta Geologica Polonica, 25:27-78.

Fedorowski, J., Bamber, E.W., and Stevens, C.H. 2007. *Lower Permian Colonial Rugose Corals, Western and Northwestern Pangaea: Taxonomy and Distribution.* NRC Research Press, Ottawa, Ontario, Canada.

Fomichev, V.D. 1953. Rugose Corals and Stratigraphy of the Middle and Upper Carboniferous and Permian Deposits of the Donets Basin. *Trudy Vsesoyuznyi Nauchno-Issledovatel'sk Geologicheskyi Institut (VSEGEI), Gosudarstvennoe Isdatel'stvo Geologicheskoi Literatury*, Moscow. [In Russian].

Heritsch, F. 1939. Die Korallen des Jungpalaozoikums von Spitsbergen. Arkiv for Zoologi, 31A:1-138.

Kossovaya, O.L. 1997. Rugose corals from standard sections of the Gzhelian-Artinskian stages of northern Timan and the western slope of the Urals. In Stukalina, G.A. (ed.) *Atlas of reference complexes of Palaeozoic benthic fauna of northeastern European Russia. Ostracods, brachiopods, rugosans. Izdatelstvo Vserossiiskii Nauchno-Issledovatelskii Geologicheskii Institut im. A.P. Karpinskogo (VSEGEI),* St. Petersburg. 3:53-96, 106-115, 128-154.

Meek, F.G. 1864. Description of the Carboniferous fossils, In Meek, F.G. and Gabb. W.M. *Palaeontology of California. Geological Survey of California*, 1. Caxton Press, Philadelphia.

Merriam, C.W. 1942. Carboniferous and Permian corals from central Oregon. *Journal of Paleontology*, 16:372-381.

Miller, M.M. 1987. Dispersed remnants of a northeast Pacific fringing arc: Upper Paleozoic terranes of Permian McCloud faunal affinity, western U.S. *Tectonics*, 6(6):807-830.

Milne-Edwards, H. and Haime, J. 1852. A monograph of the British fossil corals. *Palaeontographical Society*, London. 147-210.

Minato, M. 1955. Japanese Carboniferous and Permian corals. *Journal of the Faculty of Science, Hokkaido University, Series 4, Geology and Mineralogy*, 9:1-202.

Minato, M. and Kato, M. 1965. Durhaminidae (Tetracoral). *Journal of the Faculty of Science, Hokkaido University, Series 4, Geology and Mineralogy*, 13:1:11-86.

Monger, J.H.W. and Ross, C.A. 1971. Distribution of fusulinaceans in western Canadian Cordillera. *Canadian Journal of Earth Sciences*, 8:259-278.

Pitcher, M.G. 1960. Fusulinids of the Cache Creek Group, Stikine River area, Cassiar District, British Columbia, Canada. *Brigham Young University Geology Studies*, 7(7):1-64.

Pyzhyanov, I.V. 1964. Novyy rod chetyrekhluchevykh korallov iz srednekammennougolnykh otlozheniy Darvaza*: Tadzhik SSR, Upr. Geol. Okhr. Nedr. Tr., Paleontol. Stratigr.*, 1:169-174.

Ross, C.A. and Ross, J.R.P. 1983. Late Paleozoic accreted terranes of western North America. *Pre-Jurassic Rocks in Western North American Suspect Terranes.* In Stevens, C.H. (ed.), Pacific Section SEPM, 7-22.

Sando, W.J. 1985. *Paraheritschioides,* a new rugose coral genus from the Upper Pennsylvanian of Idaho. *Journal of Paleontology*, 59:979-985.

Skinner, J.W. and Wilde,G.L. 1965. Permian biostratigraphy and fusulinid faunas of the Shasta Lake area, northern California. *University of Kansas, Protozoa, Paleontological Contribution*, 6.

Skinner, J.W. and Wilde, G.L. 1966. Permian fusulinids from Pacific northwest and Alaska. *University of Kansas, Paleontological Contribution,* 4:1-16.

Soshkina, E.D., Dobrolyubova, T.A., and Porfiriev, G.S. 1941. Permskie Rugosa evropeyskoy chasti SSSR: *Paleontologiya SSSR*. Monograph*, 5(3)(1).*

Stevens, C.H. 1967. Leonardian (Permian) compound corals of Nevada. *Journal of Paleontology*, 41:423-431.

Stevens, C.H. 1997. Affinities of Early Permian fusulinid faunas in the Golconda allochthon, central Nevada, and northern Sierra Nevada. In Ross, C.A., Ross, J.R.P., and Brenckle, P.L. (eds.), *Late Paleozoic Foraminifera; Their Biostratigraphy, Evolution and Paleoecology; and The Mid-Carboniferous Boundary. Cushman Foundation for Foraminiferal Research Special Publication*, 36:145-148.

Stevens, C.H. and Rycerski, B. 1983. Permian colonial rugose corals in the western Americas – Aids in positioning of suspect terranes. In Stevens, C.H. (ed.), *Pre-Jurassic Rocks in Western North American Suspect Terranes. Pacific Section, SEPM,* 23-36.

Stevens, C.H. and Rycerski, B. 1989. Early Permian colonial rugose corals from the Stikine River area, British Columbia, Canada. *Journal of Paleontology*, 63:158-181.

Stevens, C.H., Yancey, T.E., and Hanger, R.A. 1990. Significance of the provincial signature of Early Permian faunas of the Eastern Klamath terrane. *Geological Society of America Special Paper*, 255:201-218.

Wilson, E.C. 1982. Wolfcampian rugose and tabulate corals (Coelenterata; Anthozoa) from the Lower Permian McCloud Limestone of northern California. *Contributions in Science, Natural History Museum of Los Angeles County*, 337:1-90.

Wilson, E.C. 1985. Rugose corals (Coelenterata, Anthozoa) from the Lower Permian McCloud Limestone at Tombstone Mountain, northern California. *Contributions in Science, Natural History Museum of Los Angeles County*, 366:1-11.

Wilson, E.C. and Langenheim, R.L., Jr. 1962. Rugose and tabulate corals from Permian rocks in the Ely quadrangle, White Pine County, Nevada. *Journal of Paleontology*, 36:495-520.

Yabe, H. and Hayasaka, I. 1920. Geographical research in China, 1911-1916: *Palaeontology of southern China, Atlas of Fossils*, Tokyo Geographical Society, 221.

APPENDIX

Sample Localities

SJS 685 McCloud Limestone in 1st major roadcut in limestone south of McCloud River bridge on west side of McCloud Reservoir, Eastern Klamath terrane, Shasta County, California, 122º34.58'W, 41º7.76'N. Collected by C.H. Stevens, 1976. Location 2 (Figure 3).

SJS 833 Clast from Jurassic conglomerate on south side of U.S. Highway 50, 300 m west of turnoff onto Greenstone Road west of Placerville, Eldorado County, California, 120º54.08'W, 38º41.40'N. Presumed to have been derived from nearby Central Belt of Northern Sierra Nevada. Collected by Phillip Burnham, 1977. Location 4 (Figure 3).

SJS 863 Thin limestone bed in Happy Creek volcanic series about 700 m due south of hill 4704 in extreme northeast corner of T.42N., R.32E., near Quinn River Crossing, Humboldt County, Nevada, 118º24.9'W, 41º31.8'N. Bilk Creek terrane. Associated with *Cuniculinella fusiformis*, a species representing McCloud fusulinid zone F of Skinner and Wilde (1965). Collected by Keith Ketner, ~1977. Location 6 (Figure 3).

SJS 897 Near stratigraphic top of limestone mass near Quinn River Crossing, Humboldt County, Nevada. Bilk Creek terrane. Location similar to SJS 863. Collected by C.H. Stevens, 1982. Location 6 (Figure 3).

SJS 1014 About 1/2 way up west side of a limestone hill called McGregor Hill on the north side of Ida Lake NW1/4 sec.16, Tp.20, R.16W, Kamloops Lake quadrangle, British Columbia, Canada, 120º7.2'W, 50º44.46'W. Quesnel terrane, Harper Ranch subterrane. Associated with *Pseudoschwagerina,* which occurs in fusulinid zone E of Skinner and Wilde (1965). Collected by Ted Danner, letter dated 1985. Location 7 (Figure 4).

SJS 1015 Same locality as SJS 1014. Collected by Ted Danner, letter dated 1985. Location 7 (Figure 4).

SJS 1022 Block in melange immediately east of Melones fault zone, S1/2 SE1/4 sec.33, T.24N., R.9E., approximately 5 km southwest of Quincy, Plumas County, California, 120º54.08'W, 39º54.28'N. Presumed to be derived from nearby Central Belt of Northern Sierra Nevada. Collected by Larry Standlee, 1985. Location 5 (Figure 3).

SJS 1032 Limestone block in debris flow near center W1/2 sec.17, on bank of Oroville Lake, Cherokee 7 1/2 minute quadrangle, Butte County, California, 121º33.25'W. 39º40.2'N. Central Belt of Northern Sierra Nevada. Collected by Rodney Watkins, 1986. Location 3 (Figure 3).

SJS 1034 On road near McCloud Reservoir, nearest outcrop of McCloud Limestone to dam on south side of now flooded Battle Creek. Shoeinhorse Mountain quadrangle, Shasta County, California, 122º15.3'W, 40º55.9'N. Eastern Klamath terrane. Collected by C.H. Stevens, 1984. Location 1 (Figure 3).

SJS 1045 Same locality as SJS 1032. Collected by Rodney Watkins, 1987. Location 3 (Figure 3).

SJS 1066. Limestone mass near Quinn River Crossing, Humboldt County, Nevada. Bilk Creek terrane. Similar location to SJS 863. Collected by Elizabeth Jones, 1988. Location 6 (Figure 3).

SJS 1080 Limestone boulder in phyllitic matrix near Parish Camp near Lake Oroville, Butte County, California. Central Belt of Northern Sierra Nevada. Exact location uncertain, near SJS 1032. Collected by Gregg Griffin, 1988. Location 3 (Figure 3).

SJS 1085 Little limestone knob east of the major limestone outcrop near Quinn River Crossing, Humboldt County, Nevada. Bilk Creek terrane. Similar location to SJS 863. Collected by Elizabeth Jones, 1989. Location 6 (Figure 3).

SJS 1088 Little hill east of Quinn River crossing. Location similar to SJS 863. Collected by R. Hanger, 1989 and E. Jones, 1990. Location 6 (Figure 3).

SJS 1294 Same locality as SJS 1032. Collected by Rodney Watkins,

1986. Location 3 (Figure 3).