

ART. L.—*Discovery of Devonian Rocks in California* ;*
by J. S. DILLER and CHARLES SCHUCHERT.

PART I.

DR. J. B. TRASK† was the first to definitely determine by paleontological evidence the geological age of any portion of the auriferous slates of California. He recognized the Carboniferous on the McCloud River. The Geological Survey of California under Prof. Whitney‡ found the Carboniferous in other localities and discovered the Jurassic and Triassic rocks of Mariposa and Plumas Counties. Dr. C. A. White suggested that a part of the Auriferous slates are older than the Carboniferous.§

The present writer, from a study of the structure of the northern end of the Sierra Nevada concluded as follows: "The stratigraphic relations are such as to render it very probable that there is a great thickness of paleozoic strata exposed in the region and that a large part of the gold-bearing slates are

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† Report on the Geology of the Coast Mountains, State Senate of California, Document No. 14, Session of 1855, p. 50.

‡ The Auriferous Gravels of the Sierra Nevada of California, p. 34, etc.

§ U. S. Geological Survey Bulletin, No. 15, p. 25. See, also, U. S. G. S. Bull. 19, p. 21, by G. F. Becker.

older than the Carboniferous limestone* and "possibly pre-Carboniferous."†

Since then Silurian rocks have been discovered in that region.‡ Important contributions concerning the identification and distribution of the Carboniferous, Triassic and Jurassic rocks of northern California have recently been made by Becker,§ Turner,§ Lindgren,§ Hyatt,|| Fairbanks,¶ Mills,** and Smith.††

A great advance in the study of the Auriferous slates of the Pacific coast is made by Mr. Schuchert in discovering Devonian fossils among the collections of the U. S. Geological Survey from northern California. In 1884 the writer found a number of coralliferous limestones three miles southwest of Gazelle in Siskiyou County and on the eastern branches of Soda Creek about five miles N.E. of Lower Soda Springs (Castle Crag) in Shasta Co. Mr. H. W. Fairbanks‡‡ in 1891 discovered a limestone rich in corals about three miles N.W. of Kennet on the divide between Backbone and Little Backbone Creeks in Shasta Co. Before Mr. Fairbanks' results were published he kindly called the writer's attention to this locality. In October, 1893, accompanied by Mr. T. W. Stanton the writer made collections there and since then other exposures of the same coralliferous limestone have been found and collections made on Hazel Creek a few miles east of Southern's.

All fossils collected in 1884 and 1893, at the localities mentioned, were referred to Mr. Schuchert who has definitely determined them to be Devonian as stated in his portion of this communication.

The outcrop of Devonian rocks three miles southwest of Gazelle is one of the best and most accessible for study yet known in California. They are brought to the surface by an eroded arch which exposes the following series in descending order: quartz and other schists; 70 feet of fossiliferous gray limestone succeeded by a few feet of compact limestone and a thick mass of basic eruptives.

West of the axis of the fold this series of Devonian rock dips westward and appears to pass beneath the Scott Mountains. This view is strengthened by the fact that near Parker's on

* U. S. Geological Survey Bulletin, No. 33. p. 18.

† U. S. Geological Survey, 8th Annual Report, p. 407.

‡ Bull. Geol. Soc. of Am., vol. iii, p. 376.

§ U. S. Geol. Survey, Sacramento and Placerville Atlas sheets, also American Geologist, May, 1893, pp. 307-324 and 425 and April, 1894, pp. 248-249.

|| Bull. Geol. Soc. of Am., vol. iii, pp. 395-412 and vol. v, pp. 395-434

¶ American Geologist, March, 1892, p. 153, February, 1893, p. 69; this Journal, vol. xlv, p. 473, June, 1893; Eleventh Report of the State Mineralogist of Cal., 1893, pp. 24-120.

** Bull. Geol. Soc. of Am., vol. iii, pp. 413-444.

†† Bull. Geol. Soc. of Am., vol. v, pp. 243.

‡‡ Eleventh Report of State Mineralogist of Cal. (1893), p. 48.

the road to Callahan's, about thirteen miles southwest of Gazelle, and also near Oro Fino in Scott Valley, fossiliferous limestone occurs with *Pentacrinus* and appears to be Triassic.

The Devonian limestone four to six miles northeast of Castle Crag, is a veritable coral reef about 60 feet in thickness. It overlies a great mass of dark shales which are apparently older than any of the rocks exposed near Gazelle. This view is sustained by Mr. Schuchert who gives paleontological evidence to show that the fossiliferous rocks of Kennet, Hazel and Soda Creeks belong to a lower horizon in the Devonian than those of Gazelle. The slates, overlying the limestones are much less crystalline than near Gazelle and no eruptives were noticed in the immediate vicinity. These rocks, as well as those near Gazelle, were formerly supposed to be Carboniferous.*

There are two outcrops of Devonian limestone on Hazel Creek about four and five miles respectively east of Southern's. They have a number of fossils in common and probably exposed the same limestone. It overlies a large mass of black slate and dips easterly beneath the Carboniferous, which contains fossils on Tom Dow's Creek. The strike of the Carboniferous at that point is east of north, dipping towards the southeast and probably connects with the well known locality of Grizzly Peak about fourteen miles further to the northeast.

According to Mr. Storrs, who collected the fossils on Hazel Creek, the dip of the limestone is easterly and overlies a great mass of black slate. Its strike is a little east of north, connecting it directly with that of the same horizon on Soda Creek as well as that near Kennet further southward.

Three miles west of Kennet, a mile beyond Mr. Matson's lime kiln at a locality discovered by Mr. Fairbanks,† the limestone in places is composed almost wholly of branching corals and is in reality a coral reef about 50 feet in thickness. It is much warped but generally dips to the eastward beneath the Carboniferous which occurs along the McCloud River.

The region directly westward of the great bend of Pitt River has yielded many fossils belonging to the Jurassic, Triassic, Carboniferous and Devonian systems. All of which are arranged in successive belts increasing in age westward in the Klamath Mountains, indicating the presence of rocks of still greater age about the central portion of that mass. The general strike of the Devonian rocks from near Kennet is about north 18° east, which is in line with the outcrop of Hazel Creek and Soda Creek, over thirty miles away. If they are really continuous for this distance as appears probable it suggests as previously urged by the writer that the axis of folding joins the Klamath Mountains to the Coast Range rather than to the Sierra Nevada.

J. S. D.

* U. S. Geological Survey, Bull. 33, p. 11.

† Eleventh report of the State Mineralogist of Calif., p. 48.

PART II.

During the field seasons of 1884 and 1893, the U. S. Geological Survey acquired six lots of Devonian fossils, collected by Messrs. Diller, Stanton, and Storrs, from six localities in Shasta and Siskiyou counties, California.

These fossils, comprising about thirty species, most of which are corals, demonstrate the undoubted presence of middle Devonian deposits in California where rocks of this age have long been looked for by geologists, more particularly since the recent discovery of Silurian fossils.* In the geological literature treating of California, the writer finds that Mr. Fairbanks was probably the first to refer certain strata provisionally to the Devonian. He says: "In my former paper I traced the Paleozoic rocks of Shasta county, part Carboniferous and part probably Devonian, south along the main Coast range to San Francisco Bay."† This is the only specific reference to probable Devonian rocks in California. The locality on which Mr. Fairbanks based his conclusions is near Kennet on the Sacramento River, and is described by him as follows: "The fossils in the limestone [of Backbone Creek] are exclusively corals, and in places the branching stems [*Cladopora*] form almost the complete mass and weather out finely on the surface. In fact the great mass of the limestone seems to be made of corals."‡

The most southerly of these localities (No. 1 of the annexed table) is three miles northwest of Kennet. The next two (Nos. 4 and 5) are about twenty-two miles north on Hazel Creek, and two others (Nos. 2 and 3), ten miles above the latter on one of the branches of Soda Creek, about five miles northwest of Castle Crag. This fauna indicates a single terrane, since the localities each have from one to four species in common, as the annexed list of fossils shows.

About thirty miles to the northwest of the Hazel Creek localities, at a place three miles southwest of Gazelle, Siskiyou county (locality 6), there is another outcrop of Devonian limestone yielding a larger fauna of corals and some Mollusca. Fossils were collected from this limestone, both in 1884 and in 1893. This horizon appears to be higher or younger faunally than that just mentioned, since but one of its species is known to occur in the Devonian limestone of Shasta county. All of the fossils studied are from limestone, and nothing as yet is known of a sandstone or shale fauna.

* Geol. of the Taylorville region of Cal., by J. S. Diller. Bull. Geol. Soc. America, vol. iii, p. 376, 1892.

† American Geologist, vol. xi, p. 70, 1893.

‡ Eleventh Rep. State Mineralogist of Cal., p. 48, 1893.

Notes on the fossils.

Favosites canadensis, *Cladopora labiosa*, *C. acupicta*, and *Syringopora maclurii*, are characteristic forms of the great coral reef of the Corniferous limestone, as developed in eastern North America. The material from the Shasta county localities agrees closely with the descriptions of these species, and the identifications, therefore, are regarded as fairly accurate. Associated with these fossils are a number of other corals, which could not be identified specifically, however, since some are new and of others the material is not well preserved. These corals are given in the first five columns of the annexed list.

The *Alveolites* provisionally referred to *A. minimus* Davis, is represented in Nevada by *A. multilamella* Meek.* The corallites in the California specimens are quite tortuous, and have thinner walls, thus differing distinctly from Meek's species. Externally the present specimens agree with the figures of *A. minimus*, but, no positive identification can be made as Davis† gives no description of any of his species and usually no figures of their internal structure.

Acervularia pentagona Goldfuss, sp., as identified by Meek,‡ occurs at "Treasure Hill, Nevada, in silver bearing Devonian Beds." The California specimens are found in masses six inches in diameter, and appear to have a somewhat larger number of septa than the Nevada form. These differences, however, are not sufficient for specific separation. All the other known species of American *Acervularia* have larger corallites than *A. pentagona*.

The California examples of *Diphyphyllum fasciculum* Meek,§ agree fairly with the Nevada specimens from "Argyle and Treasure Hills, White Pine Mining District." A closely related form, with fewer and not so closely approximating corallites, also occurs at localities 2 and 3. Meek has united these in his *D. fasciculum*.

The *Endophyllum* occurring near Gazelle is interesting since it is the first known occurrence of this genus in America. It differs chiefly from *E. bowerbanki* and *E. abditum* Edwards and Haime,|| of the Devonian of Devonshire, in having much smaller corallites.

A form of *Gypidula* from the same locality may prove to be the same as *Pentamerus comis* or *P. lotis* Walcott,¶ occur-

* Op. cit., p. 25, Pl. II, figs. 7-7b.

† Kentucky Fossil Corals; Kentucky Geol. Survey Reports, 1885.

‡ Geol. Expl. 40th Paral., vol. iv, 1877, p. 31. Pl. II, figs. 5, 5a.

§ Op. cit., p. 29, Pl. II, figs. 4-4b.

|| Mono. British Fossil Corals, Pt. IV, p. 233, 1853.

¶ Mono. viii, U. S. Geol. Survey. pp. 159-161, 1884.

ring respectively in the Eureka and White Pine Mining Districts of Nevada. The California specimens consist of separated and distorted valves.

Correlation with other regions.

The corals of the Devonian limestone of Shasta county are believed to indicate the lower portion of the middle Devonian or approximately the Corniferous terrane as developed in New York, Kentucky, Michigan, and Ontario. It should be borne in mind, however, that since many species of corals have a great geographical and considerable vertical distribution, great reliance cannot always be placed on them for limited correlation. Mr. Walcott* has identified twenty-five species of this class in the Devonian of Nevada. Some of them hold a different stratigraphic position from the same species in eastern America. He writes: "Among the corals, *Cladopora pulchra*, *Syringopora hisingeri*, and *Cyathophyllum corniculum*, of the great Corniferous coral reef of the east, occur at the upper horizon, and *Syringopora perelegans*, of the same formation in New York, ranges throughout the group in Nevada."†

The fossils from near Gazelle, in Siskiyou county, here considered as of later or younger age than those of the Shasta county limestone agree, in a few cases specifically with the Devonian fauna of the White Pine Mining District in Nevada. Two species, *Acervularia pentagona* and *Diphyphyllum fasciculum*, certainly occur in both regions, while *Pentamerus comis* or *P. lotis* also seems to be present. A single small *Bellerophon* was found with these species, and may prove to be a young specimen of *B. perplexa* Walcott, as found in the Eureka District of Nevada. The Devonian strata of the White Pine Mining District are silver-bearing, while the middle Devonian horizons of Shasta and Siskiyou counties are a part of the Auriferous series of California.

List of species known to occur in the Devonian of California.

		(Shasta County.)					
		1	2	3	4	5	6
<i>Favosites clelandi</i>	Davis?	x					
"	<i>canadensis</i> Billings	x	--	--	x		
"	species No. 1	--	--	--	--	--	x
"	" No. 2	--	--	--	--	--	x
"	" No. 3	--	--	--	--	--	x
"	" No. 4	--	--	--	--	--	x
<i>Cyathophyllum robustum</i>	Hall, 1876?	--	--	--	x		
"	branching form No. 1	--	?	x			
"	" " No. 2	x	--	--	?	x	

* Mono. viii. U. S. Geol. Survey. pp. 100-106, 1884.

† Op. cit., p. 4.

List of species known to occur in the Devonian of California.

	(Shasta County.)					
	1	2	3	4	5	6
<i>Diphyphyllum</i> , sp. undet., or <i>Syringopora</i> ..	--	x				
“ <i>fasciculum</i> Meek	--	?	?	--	--	x
<i>Acervularia pentagona</i> (Goldfuss) Meek ..	--	--	--	--	--	x
“ sp. undet	--	--	--	--	--	x
<i>Endophyllum</i> , n. sp.	--	--	--	--	--	x
<i>Cladopora acupicta</i> Davis	x					
“ <i>labiosa</i> Billings	x	--	--	x		
<i>Alveolites</i> cfr. <i>minimus</i> Davis?	x	--	x	--	x	
<i>Syringopora Maclurii</i> Billings	--	--	--	x		
<i>Monticulipora</i> , species No. 1	x	--	--	x		
“ “ No. 2	--	x				
<i>Leptotrypa</i>	--	--	x			
<i>Gypidula</i> cfr. <i>comis</i> Owen, and <i>G. lotis</i> Walcott	--	--	--	--	--	x
<i>Conchidium?</i> A small strongly plicated form	--	--	--	--	--	x
<i>Terebratuloid</i> cfr. <i>Newberria</i>	--	--	--	--	--	x
<i>Loxonema</i> cfr. <i>delphicola</i> Hall	--	--	--	--	--	x
“ or <i>Murchisonia</i>	x					
<i>Murchisonia</i>	--	--	--	--	--	x
<i>Bellerophon</i> , much like the Russian <i>B. septentrionalis</i> Tschernyschew, but may be a young specimen of <i>B. perplexa</i> Walcott	--	--	--	--	--	x
<i>Mytilarca</i> sp. undet.	--	--	--	--	--	x
<i>Orthoceras</i>	--	--	--	--	--	x
Large crinoid columns	x	--	--	--	x	x
	9	4	4	6	3	17

C. S.

U. S. Geol. Survey, Washington, D. C., March 14, 1894.