

THE  
AMERICAN JOURNAL OF SCIENCE

[FOURTH SERIES.]

ART. XXVIII.—*A New Devonian Formation in Colorado;*  
by WHITMAN CROSS.

THE existence of Devonian formations in the San Juan region of Colorado was first established through the discovery of invertebrate fossils by F. M. Endlich of the Hayden Survey, during the summer of 1874.\* The Devonian character of the fauna discovered by Endlich was announced by F. B. Meek,† later questioned by C. A. White‡ and R. P. Whitfield,§ reaffirmed by C. Schuchert,\*\* and finally established by G. H. Girty†† upon the basis of extensive collections from many localities obtained during the survey of the San Juan country under the direction of the writer. The limestone formation, from which Endlich collected a few fossils and which has yielded the extensive fauna studied by Girty, was described by A. C. Spencer,‡‡ at the time the writer's assistant in the Colorado work, as the *Ouray Limestone*. It has been found, since the cited publications by Spencer and Girty, that the upper part of the lithologic unit, the Ouray limestone, contains a Mississippian Carboniferous fauna. This has now been described by Girty,§§ in his review of the known Carboniferous

\* Ann. Rep. U. S. Geol. and Geog. Survey, etc., for 1874, pp. 211-214.

† Bull. U. S. Geol. and Geog. Survey, etc., 2d Ser., No. 1, 1875, p. 46.

‡ Bull. U. S. Geol. and Geog. Survey, Terr., 2d Ser., No. 1., 1875, p. 47.

§ U. S. Geol. Survey. Monog. XII, 1886, p. 56.

\*\* Bull. U. S. Geol. Survey, No. 87, p. 166.

†† Devonian fossils from Colorado. The Fauna of the Ouray Limestone. U. S. Geol. Survey, 20th Ann. Rep., Pt. II, 1900, pp. 25-81.

‡‡ "Devonian Strata in Colorado," this Journal (4), ix, 1900, p. 125.

§§ "The Carboniferous Formations and Faunas of Colorado;" Profession. Paper No. 16, U. S. Geol. Survey, 1903.

invertebrates of Colorado. The Ouray limestone has been studied in several quadrangles of the San Juan region, the original locality at which its Devonian fauna was first discovered by Endlich has been revisited, and its position as a well determined unit in the Paleozoic section of Colorado must be considered as established. The present paper refers to the immediately underlying formation, in which Endlich found fish remains, and which is now for the first time given a distinctive name.

The locality at which Endlich first observed the Devonian strata lies upon the southern slope of the Needle Mountains, about 10 miles east of the Animas canyon at Rockwood, and on the western rim of the Vallecito canyon. The beds are very near the base of the Paleozoic section which dips southerly under the influence of the post-Laramie domal uplift about the Needle Mountains center. Erosion has removed the sediments over a large area, in places exposing the coarse-grained granite upon which they rest and here and there leaving tongues or isolated patches of the lower formations.

The Devonian invertebrates were found by Endlich at a triangulation station, obscurely referred to in his report as "Station 48," which is easily identifiable from the topographic report of 1874 as the point of elevation 12,305 feet, according to the Hayden map, directly overlooking the Vallecito canyon and a little south of the boundary of the Needle Mountains quadrangle. A stone monument still stands at the point, upon a remnant of Ouray limestone very rich in fossils and near the base of the formation. A branch of the Vallecito, heading west of the point, cuts it off from the main sloping mesa of sedimentary rocks, which begins a half mile to the southwest. In the absence of sufficient geographic terms for descriptive purposes, the writer proposes the name "Devon Point" for this knoll capped by Ouray limestone, the "Station 48" of the Hayden survey, which must become a classic spot in the discussion of the Colorado Devonian. The name Endlich Mesa has already been given, upon the Needle Mountains topographic map, to the gently dipping surface of granite and thin overlying Paleozoic beds which lie between the Vallecito and the Florida rivers, and is terminated by the headwaters of the latter stream. Devon Point lies on the eastern edge of Endlich Mesa.

Below the triangulation monument of Devon Point there are but about 25 feet of the Ouray limestone. Intervening between the limestone and the granite are two distinct formations referred to by Endlich\* in the following terms, which (as to the upper

\* *Loc. cit.* pp. 211, 212.

one) specifically apply to the exposures southwest of Devon Point about one-half mile, where the sediments reappear beyond the stream above mentioned, which has cut through them into the granite. They apply as well, however, to the strata at Devon Point.

“Resting immediately upon this granite, which showed a very marked stratification, conformable with that of the superincumbent sedimentary beds, a white to red and brown quartzite was found. At some points the contact of the latter with the granite was so intimate that specimens could be obtained, showing both the granular quartzite and the coarse-grained granite on the same piece. No definite relation of the colors exhibited by the quartzite could be established, save the general rule that the nearer it was to the underlying metamorphic rock, the more intensely it was colored.” \* \* \* “Above the quartzite is a thin stratum of yellow siliceous shales, containing narrow interstrata of softer shales. In these the well-known and characteristic pseudomorphs after salt were found. During the formation of the Devonian beach that now remains quartzite and quartzitic shales, portions of the water, that even at so early a geological period contained sodium chloride, were separated from the main body. Upon evaporation the mineral constituents of the water crystallized. Subsequent inundations of the places that had scarcely been laid dry, brought with them sand and silt, covering the newly formed crystals. By the gradual percolation of water through the cover the salt was dissolved, and a quantity of the material composing the cover found its way into the cavities thus produced. It will be noticed, therefore, that whenever these pseudomorphs of sand after salt are found *in situ*, the crystals will be observed on the *lower* side of the stratum containing them. Occurrences of this kind are not infrequent in younger formations both of this country and Europe. Besides these pseudomorphs, scales and fragments of bones are found, belonging to some fish of considerable size. Too little material could be collected to admit of any identification, even only generically. Small scutellae also occur, probably belonging to the same animal. This stratum, as well as the quartzite underlying it, can be traced on the southern side of the granite strip.”\*

In the summer of 1901 the southern portion of the Needle

\* Endlich conceived the granite of this region to be an extreme product of the metamorphism of early Paleozoic sediments, and this view seems to have influenced his statement that at Devon Point the granite “showed a very marked stratification, conformable with that of the superincumbent sedimentary beds.” In fact, the granite is unusually coarse-grained, massive, and homogeneous in composition, exhibiting nothing to warrant the repeated references to its origin from sediments.

Mountains quadrangle was mapped geologically by the writer, assisted by Ernest Howe and J. Morgan Clements. Devon Point and the exposures to the southwest were visited, but as the remark of Endlich concerning the fish remains had escaped attention, they were overlooked in the effort to secure fossils from the Ouray limestone. In 1903, however, a special trip was made by the writer and Mr. Albert Johannsen to Devon Point and the adjacent exposures in special search for the fish remains.

The relation of the beds at this locality is shown in the accompanying detailed section.

*Section of Paleozoic Formations, Devon Point, Colorado.*

TOP.	FEET.
Ouray limestone remnant, estimated.....	25
Elbert formation.	
12. Red shale or clay. Strong red color, uniform composition; when dry makes soft, crumbling flakes at exposures.....	5
11. Sandstone or quartzite. A layer of variable grain, fine or coarse, not persistent, gray, full of fragments of fish scales in some places; free from them in others.....	± 1
10. Calcareous shales and thin limestone, buff or gray in color, breaking up readily into slabs or flakes. Salt casts are common in this division. A thin, discontinuous red purplish, sandy layer full of scale fragments occurs locally.....	25
9. Thin layers of quartzite, limestone, and red calcareous shale, alternating. Limestone is arenaceous, dull gray, few layers reaching 6 inches in thickness...	8
8. Quartzite, fine-grained, gray, hard, in layers 2 or 3 inches thick.....	2- $\frac{1}{2}$
7. Red, calcareous shale.....	1- $\frac{1}{3}$
6. Limestone, yellow, earthy.....	- $\frac{2}{4}$
5. Calcareous and sandy shales, variegated, yellow, buff, lilac.....	1- $\frac{1}{3}$
4. Quartzite, fine-grained, yellow-brown.....	1-
3. Sandy shale, a harder layer in middle. Red, greenish, or mottled.....	5-
2. Sandy limestone, shaly in part, rich in fish scales and plates.....	± 1-
1. Red shale, calcareous, and sandy, with specks of bone or shell.....	2-

TOP.	FEET.
Ignacio formation.	
5. Quartzite conglomerate with small pebbles, gray or pink, hard and causing a distinct ledge (may belong to Elbert) .....	3- $\frac{1}{2}$
4. Quartzose sandstone and sandy shale, dark dull red, in layers 6 inches or less in thickness .....	5
3. Quartzite, fine-grained, hard, gray, in beds 1 to 5 feet in thickness with thin shale partings. Cross-bedding common .....	24
2. Sandstone and quartzite, fine and uneven grain in beds 2 or 3 feet thick, with red, sandy shale layers between .....	17
1. Crumbling shaly sandstone, dark, dull red in color, mainly of quartz with some red feldspar grains. A coating of limonite on particles causes color.....	2- $\frac{1}{2}$
	52-

Base of section is coarse biotite-granite.

The quartzite formation, measuring 52 feet in thickness at Devon Point, is called the Ignacio quartzite in the Silverton folio (now in press) and it is believed to be of Upper Cambrian age, since the only fossil thus far found in it is a small shell which, according to Mr. Charles D. Walcott, is apparently an *Obolus*, closely related to *O. loperi*, known elsewhere in Colorado. The strata between the quartzites and the Ouray limestone, carrying fish remains at the base and also near the top, seem unquestionably to form a lithologic stratigraphic and faunal unit, and for these strata the name *Elbert formation* is here proposed. The name is derived from Elbert creek, a western tributary of the Animas, entering it just above Rockwood, which flows for several miles on a broad bench between the Animas canyon and the high scarp formed by the Hermosa Upper Carboniferous formation. On this bench the Ignacio, Elbert and Ouray formations are particularly well exhibited. The first name is from the Ignacio lakes, lying on this bench and drained by Elbert creek.

The Elbert formation has been observed below the Ouray limestone in several quadrangles of the San Juan region and many exposures have been studied. While the reader is referred for details to the Needle Mountains, Durango, Engineer Mountain, and Silverton folios, now in press, or soon to be completed, some statements of its characteristics may be made.

Its general lithologic character is fairly well illustrated by the section at Devon Point, although many of them have been noted. The most persistent feature is the crumbling calcareous

shale division, with its casts of salt crystals, by which it may quickly be recognized in nearly all localities. Especially where the formation is found capping a bench or isolated knoll, as at Overlook Point and several other places on the granite surface north from Endlich Mesa, the thin limestone slabs covered with these casts are often very abundant. As was noted by Endlich, the casts were found on the under-surface of layers and testify to peculiar local conditions. While commonly on earthy limestone, the casts have been noted on coarse quartzose sandstone. The most important variation in the lithologic character of the Elbert formation is in the appearance of dense, earthy limestone of conchoidal fracture, in several beds in its upper portion. This development is most notable on the west flank of the Needle Mountains, and also at Bluebird Park, in the northwestern section of the Needle Mountains quadrangle.

The only fossils as yet obtained from the Elbert formation are fish remains, and the most productive locality discovered is that of Devon Point, already described. The remains were found at the base, and also very near the top of the section referred to the Elbert, showing the formation to be a well defined unit as to its fauna. Fish remains have also been discovered at two other localities, to be briefly mentioned.

At about one mile south of Rockwood, and close to the railroad track, a block of pale reddish quartzite was found at the base of the talus slope, upon which were rather indistinct remains of three individual fishes. The ledge of quartzite just above this talus heap belongs to the Ignacio Cambrian quartzite, but the sloping bench between that ledge and the cliff of Ouray limestone some yards farther back is occupied by the Elbert formation. Repeated search has failed to reveal the stratum from which the fish-bearing slab came, and no other remains were obtained. It is almost certain, however, that the slab in question came from a thin bed in the lower part of the Elbert section.

Another, and somewhat different, occurrence of fish remains was found on Little Cascade creek, about one-half mile south of Columbine lake and seven and one-half miles north of Rockwood. At this point the shales containing salt casts are succeeded by several massive limestones alternating with shaly strata. Several thin layers rich in finely comminuted fish scales or plates occur beneath the limestones, and in one of the limestones, resting with irregular contact upon such a layer, a few large plates were found.

All the fish remains above mentioned have been examined by Dr. C. R. Eastman, who, in the accompanying paper, describes the fauna represented by them and discusses their interest from the paleontological standpoint. From the strati-

graphic point of view, the discovery of this distinct ichthyic fauna leads to certain correlations and gives much desired information concerning the lower Paleozoic section of western Colorado.

The most evident correlation of the Elbert formation is with the so-called "Parting Quartzite" of central Colorado, in which Spurr found fish remains determined by Eastman as of Upper Devonian character, and related to certain forms from the Elbert formation.

The name "Parting Quartzite" was used by Emmons in the Leadville monograph\* for a quartzite formation 70 feet or less in thickness, occurring below the "Blue Limestone" in which Lower Carboniferous fossils had been found, and the "White Limestone," supposed to be of Silurian age. The "Parting Quartzite" was also provisionally assigned to the Silurian.

At Aspen, on the northeastern flank of the Elk mountains, Spurr † found the beds corresponding in stratigraphic position to the Parting Quartzite of Leadville, to consist of alternating dolomite, dolomitic shale, and quartzite, the last on the whole subordinate, but the old name for the formation was retained. From certain shaly beds at Aspen, Spurr and Tower obtained the fish remains referred to by Dr. Eastman in the accompanying paper. Upon the provisional determinations of this material by Walcott and Girty, the Devonian age of the "Parting Quartzite" was advocated by Spurr. He also pointed out the resemblance of the fish-bearing formation of Aspen to the beds observed by Walcott ‡ in the lower Kanab valley of Arizona, briefly stated to contain "placogonoid fishes of a Devonian type."

The stratigraphic equivalence of the Elbert formation of the San Juan region with the "Parting Quartzite" is further supported by the correlation of the Ouray and Leadville (Blue) limestones, rendered necessary by the studies of Girty, who shows that both possess an upper Devonian invertebrate fauna in their lower portions and a Mississippian fauna in their uppermost strata. The Carboniferous forms only were found at Leadville, and the Devonian fauna was the first obtained from the Ouray limestone.

The correlation of the Elbert formation and the "Parting Quartzite" with the strata of the Kanab valley, already suggested by Spurr, is of special interest in view of the relations of the Elbert fishes and the suggestions made by Eastman regarding the geographic connections of that fauna. Unfortu-

\* Mon. U. S. Geol. Survey, vol. XII, p. 61.

† "Geology of the Aspen Mining District, Colorado," U. S. Geol. Survey, Mon. XXXI, 1898, pp. 13-22.

‡ This Journal (3), vol. xx, 1880, p. 224.

nately the fossils obtained by Walcott in the Kanab section are not at present available for comparison with the Colorado forms. As Spencer pointed out in discussing the relations of the Ouray limestone,\* "it is very probable that the lower part of the Red Wall limestone [Kanab section] is equivalent in age, as well as in position, to the Devonian limestone of Colorado."

While certain correlations for both the Elbert and Ouray formations seem definitely indicated by present knowledge, meagre as it is in some directions, there is a marked contrast between the lower Paleozoic section of western Colorado and that of the Front range, especially as exhibited near Canyon City.

A marked difference also exists between the Kanab section and that of central Nevada, and other localities of the Great Basin. The faunal problem involved is pointed out by Dr. Eastman, and it is clear that the conditions controlling the character of the sedimentary beds form also a most inviting subject for investigation.

\* This Journal (4), vol. ix, 1900. p. 133.