

ON SOME INVERTEBRATE FOSSILS FROM THE LYKINS
FORMATION OF EASTERN COLORADO¹

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The fossils which form the subject of the following account were collected by Mr. Roy M. Butters and kindly placed by him in my hands for study. They were obtained in the Lykins formation of Colorado and represent a horizon in the Paleozoic higher than any at which fossils have heretofore been found along the eastern flank of the Front Range.

A detailed account of the stratigraphic relations and correlation of the Lykins formation has been prepared and will shortly be published by Mr. Butters. To a manuscript of this report, which I have been permitted to read, I largely owe the following data which seemed essential to the understanding of this limited but interesting fauna.

The "Red Beds" of the Front Range in Colorado have been variously classified and named. Their nomenclature and synonymy is, therefore, rather complicated, but as a general statement, it may be said that the Wyoming formation of Emmons has been divided into three formations, of which the Lykins is the highest. Below the Lykins, there occurs a series of strata (the lower Wyoming) which are now known as the Fountain and Lyons formations, while above the Lykins is the Morrison formation. The Lykins, therefore, belongs in the upper "Red Beds" of this area. The Fountain has furnished more or less conclusive paleontologic evidence of Pennsylvanian, or at least of upper Carboniferous, age, while the Morrison has long been known to be Mesozoic. The Lykins formation, from which fossils have not hitherto been known, has usually been assigned to the Triassic, but the evidence herewith presented seems to show conclusively that the formation, or at all events that portion of it from which the fossils were obtained, is Paleozoic. Provisionally, I am assigning the Lykins fauna to the Permian, though more on account of its position at the top of the Paleozoic section than on account of any very close resemblance either to the Permian of Russia, the more or less doubtful Permian of our Western States or the Permian as distinguished from the Pennsylvanian of the Mississippi Valley. The only fauna in

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Colorado which conspicuously resembles the Lykins occurs in the Rico formation of the San Juan region, and the Lykins and Rico are tentatively placed in correlation, in spite of the fact that many of the Rico forms are as yet not known in the Lykins and some of the characteristic Lykins forms are not known in the Rico.

The character of the Lykins formation, as would naturally be supposed, changes from point to point. A well-exposed section at Heygood Canyon which is fairly representative consists, according to Mr. Butters, of sandstone and shale with some beds of sandy limestone. The sandstones are pink or red and mostly soft, while the shales are red. The thickness of the Lykins at this point is 816 feet.

A little south of Heygood Canyon on the north slope of Table Mountain were made three collections of fossils (lots 3264, 3265 and 3266). They occur about 300 feet above the base of the formation and about 25 feet above a 25-foot bed of gypsum. They contain the same species, viz: *Myalina perattenuata*, *Myalina wyomingensis*, *Alula squamulifera* and *Murchisonia buttersi*. The matrix is a compound of fine sand and clay with more or less lime, the color being a rather light brownish gray.

Another collection was made near Stout, Colorado, from a red calcareous sandstone (lot 3262). Only two species are present, *Myalina wyomingensis* and *M. perattenuata*. The horizon is about 30 feet above the "crossbedded sandstone"² in the basal member of a local group of calcareous strata 50 to 60 feet thick consisting of thin limestones, shales and sandstones.

The last collection (lot 3263) was made at Perry Park, one-fourth of a mile south of the lake, in a band about 6 inches thick near the base of the "crinkled sandstone."³ The rock is whitish in color and very fine in texture, apparently a mixture of lime and clay and sand. In this collection, I identify *Myalina wyomingensis*, *Myalina perattenuata*, *Alula squamulifera*, *Alula gilberti?* and *Pleurophorus* sp.

Lot 3263 occurs at a higher horizon than 3262 and recalls, especially by the peculiar and characteristic species *Alula squamulifera*, the fauna of the northern group of collections (lots 3264, 3265, 3266), from which, however, it is separated geographically by a long distance.

The fauna of the Lykins formation is, so far as known, very limited, consisting of only six species, and in addition to describing the two species, which are new, it has seemed desirable to remark briefly upon the other forms.

² Colorado Geol. Survey, First Report, pp. 168-9. 1909.

³ U. S. Geol. Survey, Bull. 285, p. 25. 1905.

Alula gen. nov.

Shell soleniform, very transverse. Beak strongly anterior, but not terminal. Upper and lower margins contracting posteriorly. Posterior outline obliquely truncated. Umbonal ridge angular, with a second plication on the post-cardinal slope. Surface elegantly sculptured by fine radial costæ surmounted by fine, closely arranged scales or interrupted concentric lamellæ. Post-cardinal slope without radial costæ, but with similar squamose ornamentation. On the interior, the right valve has a single long, plate-like anterior tooth, a posterior tooth of similar character, with possibly a small rounded tooth at the umbo. Corresponding structures appear to be developed in the left valve. A large anterior scar is indicated.

Type, *Alula squamulifera*.

In a general way, these shells suggest a very transverse type of *Parallelodon*, and I believe that they belong to the same family, though clearly representing a distinct genus. In configuration, they differ from *Parallelodon* in contracting posteriorly instead of anteriorly; in not having the angular and projecting anterior extremity, and in possessing a second plication between the umbonal ridge and the cardinal border. Interiorly, they differ in having a single posterior tooth; in having a linear anterior tooth similar to the posterior one, and probably in lacking the flexuous dental arrangement at the umbones. A certain resemblance to some species of *Pleurophorus* exists in the angular umbonal ridge and the post-umbonal fold, but the *Pleurophori* are not radially striated, and, while they have a similar posterior tooth, the remainder of the dentition is quite different.

It is not certain that any American species other than the type can be referred to this genus, but, if so, they are probably to be found among the forms which I provisionally included under *Pleurophorella*. A resemblance to *Alula squamulifera*, more or less marked, is found in *P. geinitzi*, *P. gilberti*, *P. lanceolata* and *Allerisma (Pleurophorella?) reflexum*. Of these, the most similar is *P. gilberti*. Typical *Pleurophorella*, as exemplified by *P. papillosa*, is probably safely distinct, although its internal characters are as yet unknown, because of the deeply introverted lunule and the escutcheon, both characters apparently wanting to *Alula*, and because of the absence of radiating costæ in the sculpture, although a somewhat similar feature exists in the characteristic papillæ, which show a tendency to radial arrangement. There is, however, scarcely any comparison in this item of sculpture. As a provisional arrangement, I am removing to the present genus *A. gilberti*, *A. geinitzi* and *A. ? lanceolata*. *Allerisma reflexum*, in spite of a general resemblance to this series of forms, probably has quite different, although indeterminate, relations, distinctly not with typical *Allerisma*. As a result of a better knowledge

of *Allerisma costatum* and a renewed consideration of its characters, I believe that my original estimate of its relationship to *Pleurophorella papillosa* was erroneous. The strong concentric plications which stop abruptly at the umbonal ridge indicate a different type of shell. It is somewhat doubtful whether a papillose surface is a real character of *A. costata*, which is apparently a much flatter shell, with thin test and possibly different structure in the lunule and escutcheon. It clearly does not belong with *Alula*, however, but has all the superficial characters of typical *Sanguinolites*.

Alula squamulifera

Shell rather small, very transverse. Width about 3.5 times the greatest height. Greatest height near the anterior end at the umbo, which is situated about one-sixth of the entire width back from the anterior margin. Ventral border gently convex in the anterior half, nearly straight or faintly concave posteriorly. Dorsal outline gently concave or nearly straight, contracting posteriorly with the ventral. Posterior outline oblique and more or less sharply truncate. Anterior outline straight above, strongly rounding below. Convexity usually rather high, though variable, sometimes rather tumid in the umbonal region. Beaks large, prominent and incurved, situated relatively close to the anterior extremity. Umbonal ridge prominent, usually strongly angular toward the posterior end, more obscure in the umbonal region. The post-cardinal slope is divided by a second plication about intermediate between the umbonal ridge and the cardinal line, above which the narrow strip of shell is nearly horizontal. Surface marked by fine, radiating ribs which are confined to the portion of the shell below and in front of the umbonal ridge. This sculpture might better be described as made by narrow striae, the elevations between which are covered with closely arranged, fine, flat scales, which recur at equal intervals on adjacent ribs and have also the appearance of interrupted concentric lamellae. The ribs are more than radiating rows of scales, since the spaces between them are depressed. The scales are sometimes more or less curved with the convex side uppermost, especially at the anterior end, where they are replaced by two or more rows (the radiating arrangement often not being apparent) of minute spines or papillae. Apparently, these spines become more or less compressed toward the middle of the shell and then coalesce at their edges. If they are not quite in alignment, the curved appearance noted above results. The post-cardinal slope, which, as already mentioned, lacks radiating ribs, is nevertheless marked by these flattened scales, which tend to be arranged in concentric rows without, however, becoming connected into continuous lamellae. No radial arrangement is here apparent.

The internal structures are imperfectly known. The right valve bears two linear teeth, one before and one behind the beaks. The posterior tooth is long, about two-thirds the entire length back of the beaks. The anterior tooth is much shorter, about one-half the length of the anterior outline. Whether a small cardinal tooth was developed between these at the umbo is not clearly shown, but such a structure is indicated. In the left valve, there appear to be linear sockets corresponding to the teeth of the right. A large anterior scar is indicated.

Of described species, this appears most closely to resemble *A. gilberti*, though it is not certain that the two are congeneric. The chief difference of a possible generic character lies in the fact that White's figure appears to represent *A. gilberti* as having a well-marked escutcheon, a structure probably not present in *A. squamulifera*. Specifically, the latter appears to be a more slender form, more convex, and with a sharper umbonal ridge (these characters, however, may be enhanced by compression in the Colorado form). It is also distinctly, though finely, costate, although *A. gilberti* in fact is covered with granules arranged in rows, so as to resemble minute radiating liræ.

HORIZON AND LOCALITY: Lykins formation; Heygood Canyon (lots 3264, 3265, 3266) and Perry Park (lot 3263), Colorado.

Alula gilberti White?

Alula squamulifera is abundant in lot 3263, but specimens are in an unsatisfactory condition of preservation. Many of them show a lower convexity and less angular umbonal ridge than the types. One example is sufficiently shallow, broad and ill-defined as to umbonal ridge to resemble *Allerisma gilberti* rather closely. The sculpture is obscure but presents suggestions of radiating costæ or of rows of papillæ. The depressed specimens which are provisionally placed with *A. squamulifera* appear to show a gradation toward but not into the only one referred to White's species, and the facts which I have been able to observe leave me in doubt as to whether we have three species of not necessarily generically identical shells, or a fairly continuous series of mutations with *A. squamulifera* at one end and *A. gilberti* (or the form here identified as such) at the other.

HORIZON AND LOCALITY: Lykins formation; Perry Park, Colorado (lot 3263).

Myalina wyomingensis Lea

Myalinas are extremely abundant in four of the five collections examined, but most of the specimens are small. They vary in specific character. Some of the larger and more typical specimens agree in every determinable character with forms from the Rico formation of the San Juan region which I identified as *Myalina wyomingensis*.⁴ The great majority are of much smaller size, more like the form from Ouray which I somewhat provisionally called *M. cuneiformis*.⁵ They naturally have the anterior lobe less strongly developed than the larger or mature examples which accompany them. They seem as a rule to be less strongly

⁴ U. S. Geol. Survey, Prof. Paper 16, Plate VIII, Fig. 8. 1903.

⁵ *Ibid.*, Plate VIII, Figs. 16 and 17.

oblique than the type specimens of *M. cuneiformis*, though some of them have the lobe scarcely more apparent. I am regarding part of these small specimens as being young examples of *M. wyomingensis*, and this may also be the true relationship of the Ouray specimens referred to *cuneiformis*. Typical *cuneiformis* should probably be kept distinct for the time being.

HORIZON AND LOCALITY: Lykins formation; Heygood Canyon (lots 3264, 3265 and 3266), Stout (lot 3262) and Perry Park (lot 3263), Colorado.

Myalina perattenuata Meek and Hayden

The Myalinas of the Lykins formation in addition to showing variation in the amplitude of the posterior wing vary conspicuously in the development of the anterior lobe. Some specimens have scarcely any perceptible development of this feature. These, although they are not sharply distinguished from the typical *M. wyomingensis*, I am separating as a different species under the title *M. perattenuata*. A similar phenomenon was observed in the Myalinas of the Rico formation of the San Juan region, and a similar course was pursued in regard to them. These Lykins specimens, however, are for the most part much smaller than those from the Rico formation and in this character approximate *M. cuneiformis*, but most of them are distinctly less oblique. A not very considerable breakage along the hinge line of these small shells however, or a concealment of the true outline in that region, makes an appreciable difference in their apparent obliquity.

HORIZON AND LOCALITY: Lykins formation; Heygood Canyon (lots 3264, 3265 and 3266), Stout (lot 3262) and Perry Park (lot 3263), Colorado.

Pleurophorus sp.

A very imperfect internal mold showing best the impression of the hinge structures in the umbonal region, where they possess the characteristic dental arrangement of *Pleurophorus*. For the rest, there is indicated a transverse, oblong shell of medium size with rather strongly projecting anterior end.

HORIZON AND LOCALITY: Lykins formation; Perry Park, Colorado (lot 3263).

Murchisonia buttersi sp. nov.

Shell of medium size, slender, with high, many-whorled spire. Length of the type specimen as restored about 25 mm. Diameter of final whorl 11 mm. Number of volutions 10. Volutions angular with a thick, prominent carina situated considerably below the middle, the height of the upper zone being to that of the lower about as 2 to 1. Upper and lower zones more or less planate

and standing at approximately a right angle to one another. The lower is gently concave, more so than the upper, although the upper spoons outward as it approaches the carina. Suture deeply depressed.

The most conspicuous superficial feature consists of narrow angular costæ, leaving between them broad shallow interspaces, which cross the upper portion of the volutions transversely or in a direction longitudinal to the shell as a whole. They are straight, but are slightly oblique, retrally directed from above downward. These plications are perhaps restricted to the three or four older volutions, and there is some irregularity in their arrangement. They die down before reaching the carina. In addition, the whole surface of the upper zone is marked by microscopic transverse and revolving liræ producing a more or less cancellated effect. The revolving liræ are rounded, closely arranged and prone to be wavy. The transverse liræ are finer, sharper and more irregular, more of the nature of incremental lamellæ, and the costæ may perhaps be looked on as fascicles of these markings. The lower zone of the volution is marked similarly to the upper, but the angular costæ are less strong. They have a slight forward obliquity from the carina. There appear to be two, possibly more, strong rounded revolving liræ on the final volution at a point, as it would appear, about half-way down from the carina, and the volutions so embrace as to leave about two of these line visible above the deeply sunk suture. The final volution is not well shown by the specimens examined, so that the sculpture below these two liræ, the relative distance at which they occur below the carina, the shape of the aperture, etc., are not known. The carina is the site of the slit band. The band is occupied by two rather coarse, rounded liræ, separated by a narrow stria and appears to be defined by two delicate lamellose lines, one above and one below, bounded on the median side by slight striae. The two revolving liræ which occupy the whole of the band and are more projecting than the edges are rendered nodose by the costæ described as crossing the upper and lower surfaces of the volution. That is, the swellings occur where the costæ would cross them, but the costæ are evanescent on the upper surface near the band, and the nodes are much more prominent than the costæ and much more elongated spirally.

In its specific relations, this shell is most nearly related to *Murchisonia lasallensis* and *M. terebra*. It differs from both in the presence of transverse plications. From *terebra*, which seems to be more nearly related than the other, it apparently differs also in having the carina containing two crenulated liræ instead of one, in having two revolving liræ just above the suture and in other details of sculpture.

Generically, this shell can hardly be classed with typical *Murchisonia*, though it belongs to a group frequently cited under that genus. In some important respects, it is comparable with such representatives of the genus *Worthenia* as *W. tabulata*. This is especially true of the structure of the slit band, which seems to be identical in both. Given a much higher spire and more gradually enlarging volutions, with some modifications in the modeling of the whorls, especially the lower part, it is easy

to conceive how such a configuration as that of *M. buttersi* might be evolved from that of *Worthenia tabulata*. The sculpture also appears to be of the same general character, the most essential difference being the development of transverse costæ and of revolving liræ more prominent than the rest on the lower half of the inferior zone. Some important characters of *M. buttersi* are still unknown, but if these show no additional differences, it may prove to be a rather extreme form of *Worthenia*.

HORIZON AND LOCALITY: Lykins formation; Heygood Canyon, Colorado (lots 3264 and 3266).

PLATE I

LYKINS FOSSILS

Myalina perattenuata (p. 6)

- FIG. 1. A large right valve referred to this species.
2. A left valve of more nearly the average size.
Lykins formation, Heygood Canyon, Colorado (lot 3266).

Myalina wyomingensis (p. 5)

3. A large left valve.
Lykins formation, Heygood Canyon, Colorado (lot 3265).

Alula squamulifera (p. 4)

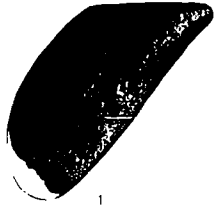
4. Side view of an internal mold of a right valve.
4a. A view obliquely down on the cardinal margin of the same specimen, showing the impression left by the linear anterior and posterior teeth, x 2.
5. Squeeze of a right valve showing the surface characters.
5a. Same, x 2. Even with this magnification, the fine squamose character of the costæ cannot be shown.
Lykins formation, Heygood Canyon, Colorado (lot 3266).

Alula gilberti? (p. 5)

6. Side view of a doubtfully identified right valve.
Lykins formation, Perry Park, Colorado (lot 3263).

Murchisonia buttersi (p. 6)

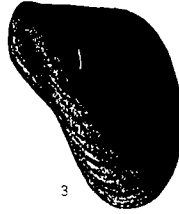
7. Side view of a squeeze made from the type specimen.
8. Another squeeze made from the same specimen, x 2.
Lykins formation, Heygood Canyon, Colorado (lot 3264).



1



2



3



4



5



4'



7



5



5'



8