NOTES ON CERTAIN ORDOVICIAN FAUNAS OF THE INYO MOUNTAINS, CALIFORNIA

By Fred B. Phleger, Jr.

The purpose of this paper is to describe the faunas and stratigraphy of the Ordovician Barrel Spring and Mazourka formations as exposed in the Inyo range in east-central California.

During the fall of 1931 the writer spent several days collecting in the Inyo range with Dr. John H. Bradley, Jr. The field work was continued during the following winter and spring.

Ordovician rocks outcrop over a large area in the Inyo mountains, mainly in the southern part of the Bishop quadrangle and in the northern part of the Mount Whitney quadrangle. The best exposures for study occur in the vicinity of Mazourka canyon, east of Independence, California.

In 1912 and 1913, Adolph Knopf and Edwin Kirk made a reconnaissance geological survey of a large area in the vicinity of Owens valley which includes the Inyo range.[1] Kirk, in his study of the Ordovician section of the Inyos, recognized four divisions:

"The lowest is the basal sandstone 300 feet thick. Overlying this is a great series of limestones, probably of Beekmantown age. Above these limestones is a series of argillaceous limestones which is equivalent to the upper part of the Pogonip limestone and is of Chazy age. Apparently above these argillaceous limestones there is a series of arenaceous shales which is probably equivalent, at least in part, to the Palmetto formation of Turner. It is possible that rocks of Richmond age also occur in the range."[2]

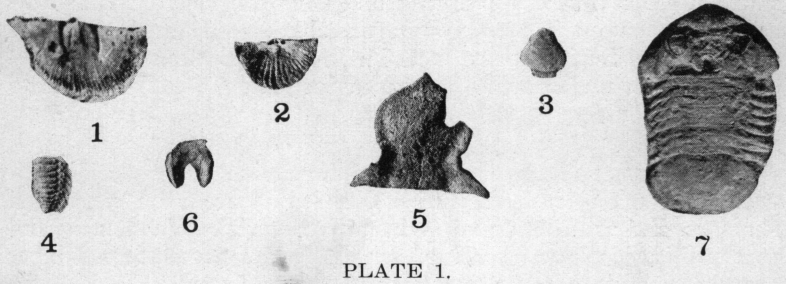

PLATE 1.

[1] Knopf and Kirk, *U. S. Geol. Surv. Prof. Paper 110*, 1918.
[2] *Ibid.*, p. 32.

THE MAZOURKA FORMATION

The term, Mazourka formation, is here proposed to include a succession of argillaceous shales and limestones of lower Middle Ordovician age, 675 feet in thickness, underlain conformably by the Ordovician limestone which Kirk considers of Beekmantown age, and overlain conformably by the Barrel Spring formation. The beds strike north 35 degrees west and dip from 55 to 65 degrees southwest, and are exposed typically in Mazourka canyon between Barrel Spring canyon and the Lead canyon trail. The type section has been measured in an unnamed canyon which is the first tributary canyon entering Mazourka canyon on the east below the Elbow in Mazourka canyon. Two lithologic facies, a lower calcareous shale and an upper argillaceous limestone, mark the formation. The lower 125 feet, constituting the calcareous shale, is interbedded at irregular intervals with thin-bedded lenses of argillaceous limestone. It is dark gray on fresh fracture and weathers to a light gray. The lowest 75 feet is unfossiliferous, but in the overlying 50 feet scattered fragments of crinoids and trilobites occur on weathered surfaces. The shale beds grade into an argillaceous limestone, which is interbedded at infrequent intervals with a few thin shale layers. The limestone is dark gray on fresh fracture and weathers in light and dark discontinuous bands. It is abundantly fossiliferous and continues to the top of the formation.

In the type section the Mazourka formation is overlain with apparent conformity by the basal Devonian quartzite, which weathers white to buff. The absence of the Barrel Spring formation at this place may be due to faulting, since a short distance south of the type section extensive faulting has taken place. Farther south, in Barrel Spring and Mexican canyons, the Mazourka formation is overlain conformably by the basal quartzite of the Barrel Spring formation. The massive Beekmantown limestones, which underlie the Mazourka formation, weather white to buff.

The limestone of the Mazourka formation in most cases appears barren on fresh fracture. The fossils occur on weathered surfaces, and are found mainly in talus material. Weathering and recrystallization have combined largely to obliterate more minute characters and to make identification very difficult. The strata have also been sheared in places.

The Fauna of the Mazourka Formation

The following is a complete list of the fauna collected and identified by the writer from the Mazourka formation, including the forms also collected by Kirk:[3]

****Beatricea** sp. ind.
****(?) Streptelasma** sp. ind.
***Diplograptus** sp.
****Blastoidocrinus carchariedens** Billings
****Prasopora contigua** Ulrich
****(?) Chasmatopora** sp. ind.
****Crania** sp. ind.
****Orthis minusculus** sp. nov.
****Plectorthis mazourkaensis** sp. nov.
****Plectorthis patulus** sp. nov.
***Triplesia** sp.
Ctenodonta hamburgensis (Walcott)
***Modiolopsis** sp.
Pleurotomaria sponsa Billings
Hormotoma sp. ind.
Liospira sp. ind.
***Fusispira** sp.
Maclurites (?) *subannulata* (Walcott)
Maclurites sp. ind.
****Trochonema** sp. ind.
Endoceras proteiforme Hall
****Lloydia obsoletus** sp. nov.
***Nileus** sp.
****Isotelus gigas** DeKay
****Isotelus** sp. ind.
****Bumastus** sp. ind.
****Encrinurus hastula** sp. nov.
****Encrinurus octonarius** sp. nov.
****Cybeloides calliteles** sp. nov.
****Ceraurus infrequens** sp. nov.
Pliomerops barrandei Billings
Leperditia bivia White
****Leperditia nana** Jones
***Leperditella** sp.

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[3] *Op. cit.*, p. 35.
* Included in Kirk's faunal list and not collected by the author.
** Species not collected by Kirk.

The Age of the Mazourka Formation

Most of the new species from the Mazourka formation described in this paper are closely related to known Chazy types from other localities. These together with the Mazourka specimens which fall into previously described Chazy species from other localities constitute about 75 per cent of the Mazourka Fauna.

About 20 per cent of the remaining species have been found elsewhere in rocks of Trenton age. The abundance of gastropods is a notable characteristic of the fauna; six genera are represented, and of these three are extremely common throughout the formation. The Mazourka formation is faunally a unit and undoubtedly of Chazy age.

Correlation with Strata Elsewhere

Kirk correlates the Mazourka formation with the upper Pogonip of the Eureka district, Nevada, described by Hague. The term "Pogonip" has been used in Nevada in various ways. Hague's[4] use of the term includes strata of Beekmantown, Chazy, and Trenton ages, with a maximum thickness of 5,000 feet. Emmons[5] and Spencer[6] used the term "Pogonip" to include beds containing Ordovician fossils between Cambrian strata and the Eureka quartzite, which is stratigraphically lower than a limestone carrying Trenton fossils. Over 15 per cent of the Mazourka species are closely related to species reported by Hague from the middle part of his section. Since this middle part of Hague's fauna is of Chazy age, it would appear that the Mazourka formation may be equivalent, in part at least, to his middle Pogonip. Walcott's faunal list of the upper Pogonip of the Eureka district[7] includes species of Chazy age. About 25 per cent of the species from the Mazourka formation are either identical with or are closely related to species which Walcott reported. The two formations may be partially contemporaneous.

There is a similarity between the fauna of the lower part of the Simpson formation of Oklahoma[8] and that of the Mazourka formation. About 20 per cent of the Mazourka forms are represented in the lower Simpson by identical or related forms. It is probable that the two formations are partly contemporaneous.

The Swan Peak quartzite of Idaho carries a small fauna of

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[4] Hague, Arnold, *Geol. of the Eureka Dist., Nev.; U. S. Geol. Surv. Mon. 20*, pp. 48-54.

[5] Emmons, S. F., *U. S. Geol. Surv. Bull. 308*, pp. 27-29.

[6] Spencer, A. C., *U. S. Geol. Surv. Prof. Paper 96*, pp. 25, 26.

[7] Walcott, C. D., *U. S. Geol, Surv. Mon. 8*, pp. 65-98.

[8] Edson, F. C., *Notes on the Simpson Formation of Oklahoma, Bull. Am. Ass. Pet. Geol.*, vol. 7, 1923, pp. 558-64.

questionable Chazy age. Mansfield gives no faunal list in his papers[9] but Richardson* lists eight forms. This formation is a possible correlative of the Mazourka formation.

A fairly close correlation by means of fauna can be made between the Mazourka formation and the type Chazy formation of New York and Canada. About 50 per cent of the Mazourka forms which have been specifically identified are either identical with or closely related to forms occurring in the Chazy of the eastern section.

THE BARREL SPRING FORMATION

The term, Barrel Spring formation, is here proposed to include a succession of quartzites, impure limestones, and argillaceous shales of Middle Ordovician age, in the Inyo mountains. The formation is 130 feet in thickness, overlain conformably by basal Devonian quartzite and underlain conformably by the argillaceous limestones of the Mazourka formation. The type section has been measured in the south fork of Mexican canyon, which is the second canyon north of Barrel Spring canyon. The beds strike north 15 degrees west and dip from 60 to 70 degrees southeast. They are well exposed in Barrel Spring canyon and in each of the next four canyons to the north. Three lithologic facies: a basal quartzite, an impure limestone, and an argillaceous shale, mark the formation. The lower 41 feet, constituting the quartzite, is very resistant and stands out in bold relief. It is white in color and is unfossiliferous. The overlying 25 feet consists of an impure limestone which is only slightly less resistant to weathering than the quartzite, and is also unfossiliferous. It is dark gray on fresh fracture and weathers to a lighter gray. The limestone beds grade into an argillaceous shale which is 64 feet thick and continues to the top of the formation. It is dark gray to black on fresh fracture and weathers to a reddish-brown color. The shale is highly fossiliferous at certain localities.

Fossils appear in most cases on fresh fracture as an iron replacement which weathers to limonite. The better specimens are preserved as molds and casts. The best locality for collecting is in the exposures of the shale member on the north slope of Barrel Spring canyon about one-half mile east of Barrel Spring.

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[9] Mansfield, G. R., *U. S. Geol. Surv. Prof. Paper 152*, p. 57. *U. S. Geol. Surv. Bull. 713*, pp. 32, 33.

* Richardson, G. S., *Am. Jour. Sci.*, Vol. 186.

Fauna of the Barrel Spring Formation

The following is a list of the fauna collected by the writer from the Barrel Spring formation:

Orthis tricenaria Conrad
Orthis decipiens sp. nov.
Plectambonites angulatus sp. nov.
Orthoceras sp. ind.
Remopleurides occidens sp. nov.
Isotelus gigas DeKay
Isotelus spurius sp. nov.

Five of the seven forms which are present in the fauna of the Barrel Spring formation are either identical with or are closely related to species of Trenton age.

Correlation with Strata Elsewhere

Due to the paucity of the fauna of the Barrel Spring formation and also because of incomplete information concerning Ordovician faunas of Trenton age in western United States, it is impossible to correlate this formation with strata elsewhere in the west. Hague[10] assigns a Trenton age to the uppermost part of his Pogonip formation. It is possible that the Barrel Spring formation is contemporaneous with some part of Hague's upper Pogonip, although no related species occur in common at both localities.

It is also possible that the Barrel Spring formation is the equivalent of some part of the upper Simpson formation of Oklahoma. Although no species occur in common at the two localities, there are two or three species which are distantly related.

ACKNOWLEDGMENTS

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The types described in this paper, the gift of Dr. Bradley and the author, are in the Los Angeles Museum.

[10] Hague, *op. cit.*, pp. 48-54.

DESCRIPTIONS OF SPECIES OCCURRING IN THE MAZOURKA FORMATION

PHYLUM Molluscoidea
CLASS Brachiopoda Duméril
ORDER Protremata Beecher
SUPERFAMILY Orthacea Walcott and Schuchert
FAMILY Orthidae Woodward
SUBFAMILY Orthinae Schuchert and Cooper
GENUS Orthis Dalman

Orthis minusculus sp. nov.
Plate II, Figs. 6, 7

Shell small, semi-oval; sides gently convex or concave just below the cardinal extremities, gently converging for about one-half the length, forming a broadly rounded curve latero-anteriorly, the anterior margin only gently convex. Width of pedicle valve of a cotype 10 mm., length 7 mm. Valves equally convex. The brachial valve is uniformly convex, with a narrow, fairly distinct mesial sinus extending the full length of the shell. The pedicle valve is uniformly convex, with a small portion at the cardinal angles depressed; the beak is large, broadly convex, and appears to overhang the hinge line a little. The surface is marked by twenty simple rounded plications, averaging three plications to three millimeters at the anterior margin. Internal characteristics unknown.

This species resembles *Orthis euryone* Billings, from the Canadian beds of Quebec, except that it has fewer plications, the mesial sinus in the brachial valve is narrow and distinct and extends the entire length of the shell, and the brachial valve is not flat. *O. minusculus* is closely related to *O. ignicula* Raymond, from the Chazy of Valcour Island, N. Y., but it does not have the difference in convexity of valves shown in *O. ignicula*. *O. acutiplicata* Raymond, from the Chazy of Valcour Island, has fewer plications than *O. minusculus*. A close relative seems to be *O. laurentia* Billings, from the Gamachian of Canada. In the description given by Billings, however, no mention is made of a mesial sinus. The difference in relative convexity of valves is greater in *O. laurentia* than in the species here described.

Horizon and locality: Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

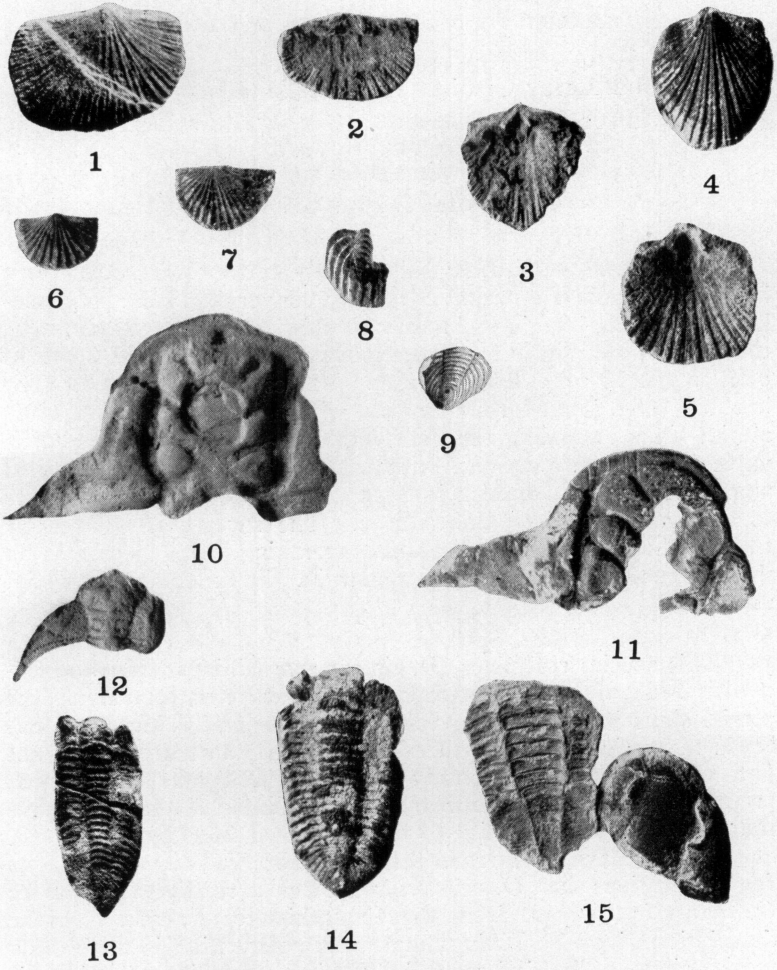

PLATE 2.

FAMILY Plectorthidae Schuchert and Cooper
SUBFAMILY Plectorthinae Schuchert and Cooper
GENUS Plectorthis Hall and Clarke

Plectorthis mazourkaensis sp. nov.
Plate II, Figs. 3, 4, 5

Valves subequally convex, the pedicle valve a little more so than the brachial; the lateral margins are rounded anteriorly, straight or slightly rounded posteriorly. Outline semioval to subquadrate; the hinge line a little less than the greatest width. The width of an average specimen varies from 17 to 18 mm., length from 16 to 17 mm., forming a ratio of breadth to length of approximately 1:1, the breadth in some cases being 1 to 2 mm. greater than the length. The surface of both valves is marked by from 18 to 20 primary plications, subangular to rounded, increasing to about 35 at the anterior margin by bifurcation 5 to 8 mm. from the beak. Usually one minor and less prominent plication is added in this manner to each major plication, frequently two, rarely none. No example of implantation was seen. At the anterior margin there are five to six plications to 4 mm.

In the brachial valve a shallow but fairly distinct mesial sinus extends from the beak, usually broadening anteriorly. In front of the cardinal angle on either side is a flat, depressed area.

The pedicle valve is gently convex, with a slight flattening at the cardinal angles, and the suggestion of a low median fold. Umbo flattened, with the beak not perceptably incurved; the foramen is triangular; the cardinal area is concave, about 1 mm. deep. The muscle scars are vague in the specimens at hand, but they seem to form a subelliptical area, extending anteriorly from the region of the beak about one-fifth the length of the shell; the components are not easily distinguishable but there is a faint median ridge extending most of the length. In the interior of the pedicle valve the plications are clearly observed extending from the anterior margin almost to the cardinal area.

This is the most common species in the Mazourka formation. It is closely related to *Plectorthis exfoliata* (Raymond), from the lower Chazy at Valcour, New York, except that the bifurcation takes place regularly in all the Mazourka specimens. *P. whitfieldi* (N. H. Winchell) has a longer and more complex muscle impression. *P. jamesi* (Hall), from the Maysville of Ohio, is considerably longer than it is wide, and it also has a tendency towards gibbosity in the brachial valve, as well as a greater number of plications which bifurcate near the anterior margin. No specimen examined shows the quadrate muscle scar of *P. scovillei* (Miller),

from the Richmond of Ohio. A very distant relative, *Dalmanella hamburgensis* (Walcott), is found in the Pogonip of Nevada.

Horizon and locality: Mazourka formation, in Mazourka canyon about one-half mile below the Lead canyon trail, Inyo mountains, California.

Plectorthis patulus sp. nov.
Plate II, Figs. 1, 2

Valves subequally convex, the pedicle valve only a little more convex than the brachial; outline transversely oval to subquadrate, lateral margins straight, rounded anteriorly and slightly convex on the anterior margin; the hinge line is a little less than the greatest width of the shell. Width of both valves 17 to 25 mm., length 11 to 15 mm., forming a ratio of breadth to length of about 5:3. The surface of both valves is marked by 20 to 22 primary, subrounded plications which increase by bifurcation anywhere from the posterior to the anterior margin to from 40 to 48 plications at the anterior margin; in most cases one plication is added to each primary plication by bifurcation, but in some cases two and not infrequently three are added in this manner; there is rarely any distinction in prominence at the anterior margin between the primary and secondary plications. At the anterior margin there are four plications to 4 mm.

The brachial valve is evenly convex with a shallow, distinct mesial sinus extending from the beak the entire length of the valve, greatly widening anteriorly.

In the pedicle valve the umbo is high, sloping equally in all directions; there is a slight flattening at the cardinal angles; the beak is not perceptably incurved; the cardinal area is narrow, the greatest width being 2 mm.; foramen triangular.

In *Plectorthis exfoliata* Raymond from the Chazy at Chazy, N. Y., the bifurcation is neither so regular nor so abundant as in *P. patulus*. *P. patulus* differs from *P. mazourkaensis* from the Mazourka formation in the ratio of breadth to length, being considerably wider than long; also in having a greater number of secondary plications, and the fact that these plications are as prominent at the anterior margin as the primary plications; and in having a wider foramen and a considerably smaller muscle impression. The specimens at hand show no evidence of the gibbosity in the brachial valve shown in *P. jamesi* (Hall), from the Maysville. They have fewer and more prominent plications than *P. kankakensis* (McChesney), from the Fernvale of Illinois. *P. neglecta* (James), from the Maysville of Ohio, has very narrow grooves between the plications. No near relatives of *P. patulus* have been listed from any formation east of Illinois.

Horizon and locality: Mazourka formation, in Mazourka canyon one-half mile below the Lead canyon trail, Inyo mountains, California.

PHYLUM Arthropoda
CLASS Crustacea
SUBCLASS Trilobita Walch
ORDER Opisthoparia Beecher
FAMILY Asaphidae Burmeister
GENUS Lloydia Vogdes

Lloydia obsoletus sp. nov.
Plate II, Fig. 15

Cephalon moderately convex, broadly rounded anteriorly. Glabella large, oblong, most elevated opposite the eyes and gently sloping downward to the anterior margin; sides sub-parallel, front margin gently rounded; occipital furrow somewhat indistinct in the type specimen, but appearing to extend in a straight line across the glabella. Eyes large, about one-half as wide as the glabella, crescentiform, situated very near the glabella and about halfway between the posterior and anterior margins.

The thorax is a little longer than the cephalon, with a distinct axial lobe about two-thirds as wide as the pleural lobes, and divided into eight smooth segments. The pleural segments appear to extend laterally into short, blunt spines.

The pygidium is rather long, subrounded to subtriangular, with a well-defined axial lobe which is about half as wide as the pleural lobes and extends almost to the posterior margin. The axial lobe narrows posteriorly and there is no trace of segmentation.

MEASUREMENTS OF COTYPES

Cranidium	
Length	15 mm.
Width	10 mm.
Distance from eyes to posterior margin of glabella	6 mm.
Thorax	
Length	16 mm.
Width	16 mm.
Width of axial lobe	8 mm.
Pygidium	
Length	11 mm.
Width	15 mm.

Lloydia obsoletus is closely related to *L. strenuus* (Billings), from the Beekmantown of Quebec, but it differs in having the eyes close to the glabella. *L. oblongatus* (Billings) differs from *L. obsoletus* mainly in having small eyes situated well away from the glabella.

Horizon and locality: Mazourka formation, about one-half mile below the Lead canyon trail in Mazourka canyon, Inyo mountains, California.

ORDER Proparia Beecher
FAMILY Encrinuridae Angelin
GENUS Encrinurus Emmrich

Encrinurus hastula sp. nov.
Plate II, Figs. 13, 14

Cranidium sub-lunate in outline, the anterior and lateral margins more or less regularly rounded, with the posterior margin broadly sinuous, and the posterior extremities bluntly subtriangular. The facial sutures originate in front of the genal angles and pass obliquely forward and around the eyes, intersecting the anterior margin at points a little nearer together than the breadth between the eyes. Eyes small and prominent, situated on conical protuberances fairly close to the glabella. The glabella is prominent and is separated from the fixed cheeks by deep, dorsal furrows. The sides are nearly parallel for the posterior third of the length, but converge slightly farther forward. The anterior margin is broadly rounded. There are two pairs of prominent glabellar furrows which curve posteriorly only slightly; each furrow extends about one-third the width of the glabella. The neck segment is prominent, with median spine, and is separated from the glabella by a well-defined occipital furrow.

The thorax consists of eleven segments. The median lobe is about equal in length to the pleural lobes and is slightly more convex, with an increased convexity on the first two or three segments. The segments of the pleural lobes end laterally in blunt spines which curve posteriorly at their extremities.

The pygidium is subtriangular in outline, slightly wider than long. The lateral margins are straight or slightly convex, with the posterior extremity rounded or subtriangular. The axial lobe is narrow, with tapering sides, terminating in the posterior margin of the pygidium and showing about twenty segments. There are twelve segments on the pleural lobes. The anterior segments are directed laterally for a short distance and are there deflected posteriorly through a broad curve. The posterior deflection of the succeeding segments becomes more marked, until the twelfth pair extends parallel to the axial lobe.

MEASUREMENTS OF COTYPES

Cranidium	Average Specimen	Small Specimen
Width	21 mm.	10 mm.
Length	.....	4 mm.
Length of glabella	.....	4 mm.
Width of glabella	9 mm.	5 mm.

Thorax		
Length - - - - - - - -	23 mm.	12 mm.
Width - - - - - - - -	19 mm.	12 mm.
Pygidium		
Length - - - - - - - -	20 mm.	10 mm.
Width - - - - - - - -	17 mm.	10 mm.

Encrinurus trentonensis Walcott, from the Trenton of New Jersey, is a smaller form with the pleurae of the pygidium arising from alternating median segments. *E. hastula* may be distinguished from *E. tuberculosus* Collie, from the Trenton of New Jersey, by having more pleurae on the pygidium, and also fewer annulations on the median lobe. *E. deltoides* Shumard, from the upper Medinan of Illinois, may be distinguished by its greater number of segments (24) along the median lobe, and less number of segments (8) along the lateral lobes of the pygidium. *E. americanus* Vogdes, from the Clinton of Georgia, has only six pleurae on the pygidium. *E. thresheri* Foerste, from the upper Medinan of Indiana, has seven lateral segments in the pygidium and the segments are narrower than the intervening grooves. Tubercles are also present on the median lobe.

Horizon and locality: Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

Encrinurus octonarius sp. nov.
Plate II, Fig. 9

Pygidium fairly convex, subtriangular in outline, length and breadth equal. The lateral margins are straight, with the posterior extremity subtriangular. The axial lobe is a little greater in width than the pleural lobes at the anterior end of the pygidium, but it rapidly tapers posteriorly to about half the width of the pleural lobes at the posterior extremity. The axial lobe shows ten segments clearly and there are ten or twelve more posterior to these which are obscured in the holotype. There are eight segments on the pleural lobes. The anterior segments are deflected posteriorly through a broad curve. The posterior segments extend directly posteriorly. The rest of the pleurae are transitional between these two extremes. Cephalon and thorax unknown.

Measurements of Holotype

Length - - - - - - - - - - - - - - - -	9 mm.
Width - - - - - - - - - - - - - - - -	10 mm.
Width of axial lobe at anterior margin - - -	4 mm.
Width of axial lobe at posterior margin - - -	1.5 mm.
Width of pleural lobes - - - - - - - - -	3 mm.

Encrinurus octonarius differs from *E. hastula* Phleger, which is also from the Mazourka formation, in being equal in length and breadth and in having only eight pleurae. *E. americanus* Vogdes has six pleurae on the pygidium. *E. trentonensis* Walcott, from the Trenton of New Jersey, differs from *E. octonarius* in that the pleurae arise from alternating segments of the median lobe.

Horizon and locality: Mazourka formation, in Mazourka canyon at the Elbow, Inyo mountains, California.

GENUS Cybeloides Slocom

Cybeloides calliteles sp. nov.
Plate II, Fig. 8

Pygidium suboval to subtriangular, about as wide as long, with a narrow, well-defined median lobe and well-defined side lobes. The median lobe is traversed by five furrows, forming five small segments with a sixth larger segment at the posterior extremity. The side lobes are produced in five pointed spines which curve distally until parallel to the axial lobe. The first spine extends laterally for about one-third its length and is there abruptly rounded for the second third, whereas the last third is parallel to the axial lobe. The fifth spine extends straight backwards, curving slightly outward and around the posterior segment of the median lobe. The shape of the second, third, and fourth spines is transitional between these two extremes. The spines are separated from each other by deep furrows which become 1 mm. wide at their distal extremities.

Cybeloides calliteles differs from *C. mirus* Billings, from the Chazy of Tablehead, Newfoundland, in having fewer segments in the pygidium, and in having more pleurae. It differs from *C. primus* (Raymond), from the Chazy of New York, in having fewer segments and in lacking nodes along the axial lobe of the pygidium.

Horizon and locality: Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

FAMILY Cheiruridae Salter
SUBFAMILY Cheirurinae Raymond
GENUS Ceraurus Green

Ceraurus infrequens sp. nov.
Plate II, Fig. 12

Cephalon broad, roughly crescentiform, four-tenths as long as wide. Glabella only moderately convex, expanding forward at a rate of 1 mm. in a length of 3 mm. The front of the glabella is gently rounded; there are three pairs of glabellar furrows; the third pair is shorter than the other two and appears to be joined to the occipital furrow by faint longitudinal depressions, forming a third lobe roughly quadrangular in shape. The lobation is faint and not well-defined. The frontal lobe constitutes a little less than one-half the glabella. The occipital furrow is narrow but well-impressed. Occipital segment narrow, slightly elevated, curving a little anteriorly in traversing the middle of the glabella. The fixed cheeks are weakly convex, increasing somewhat in convexity in the palpebral region. The genal angles are produced laterally into short, curved spines. The eyes appear to be small, situated high on the cheeks, and a little nearer to the glabella than the posterior margin of the cephalon. No surface characteristics shown. Thorax and pygidium unknown.

MEASUREMENTS OF HOLOTYPE

Length of cephalon	8 mm.
Width of cephalon	27 mm.
Front width of glabella	8 mm.
Rear width of glabella	5 mm.
Length of glabella	8 mm.
Length of frontal lobe	3.6 mm.

This species differs from *Ceraurus granulosus* Raymond and Barton, from the Chazy of Valcour Island, in not having a rectangular-shaped glabella. *C. infrequens* is rather closely related to *C. bispinosus* Raymond and Barton from the Black River of Quebec, but in the latter the glabellar furrows are neither so distinct nor so continuous. *C. pleurexanthemus* from the Black River and Trenton does not have the rapid forward expansion seen in *C. infrequens.*

Horizon and locality: Mazourka formation, in Mazourka canyon at the Elbow, Inyo mountains, California.

SUBFAMILY Pliomerinae Raymond

GENUS Pliomerops Raymond

Pliomerops barrandei (Billings)

Plate II, Figs. 10, 11

Amphion barrandei Billings, *Pal. Fossils,* 1, *Geol. Surv. Canada,* 1865, p. 208, figs. 277a, b.

Pliomerops barrandei Raymond, *Ann. Car. Mus.,* 7, 1910, p. 76, fig. 7.

Pliomerops nevadensis (Walcott), *Mon. U. S. Geol. Surv.,* 8, 1884, p. 94, pl. 12, fig. 13.

Kirk reported the presence of *Pliomerops nevadensis* (Walcott) in the beds of the Mazourka formation. The present species is very abundant and is undoubtedly the species to which Kirk had reference.

A comparison of the description and illustration of *Pliomerops barrandei* (Billings) with that of *P. nevadensis* (Walcott), from the Pogonip of Nevada, brings to light only obscure differences. The first glabellar furrow of *P. nevadensis* may be, and probably is, the equivalent of the anterior oblique depression of *P. barrandei.* From Walcott's restored illustration, it would seem that this furrow was not actually observed to cut the front margin of the glabella. Also, the fragmentary condition of his material was mentioned in Walcott's description. It is probable, since so many specimens of *P. barrandei* from the Mazourka formation clearly show the arrestment of the first glabellar furrow before reaching the margin, and in all other regards resemble *P. nevadensis,* that Walcott's species is synonymous with *P. barrandei.*

Horizon and locality: Chazy of Quebec; Point Rich, Table Head, and other localities, Newfoundland; the most abundant trilobite in the Mazourka formation.

DESCRIPTIONS OF NEW SPECIES OCCURRING IN THE BARREL SPRING FORMATION

PHYLUM Molluscoidea
CLASS Brachiopoda Duméril
ORDER Protremata Beecher
SUPERFAMILY Orthacea Walcott and Schuchert
FAMILY Orthidae Woodward
SUBFAMILY Orthinae Schuchert and Cooper
GENUS Orthis Dalman

Orthis decipiens sp. nov.
Plate I, Fig. 2

Shell transversely oval in outline, wider than long, with divergent sides. The greatest width is at the hinge. The width of the brachial valve of the holotype at the hinge is 10 mm., at the anterior margin the width is somewhat less. The length is 6 mm. The brachial valve is moderately and uniformly convex, with a narrow, indistinct mesial sinus extending posteriorly from the hinge area for about half the length of the shell. The cardinal area is narrow. The surface is marked by about 30 simple rounded plications. At the anterior margin there are three plications to two millimeters.

Orthis decipiens differs from *O. ignicula* Raymond, from the Chazy of New York, in lacking a broad depression towards the anterior margin and also in having a very narrow cardinal area. It differs from *O. minusculus* Phleger, from the Mazourka formation of the Inyo mountains, in having a greater number of plications and in having more plications per unit width at the anterior margin. It also lacks the distinct and continuous mesial sinus of *O. minusculus*. It differs from *O. euryone* Billings, from the Canadian beds of Quebec, mainly in the convexity of the brachial valve.

Horizon and locality: Barrel Spring formation, in Barrel Spring canyon, Inyo mountains, California.

SUPERFAMILY Strophomenacea Schuchert
FAMILY Strophomenidae King
SUBFAMILY Rafinesquinae Schuchert
GENUS Plectambonites Pander

Plectambonites angulatus sp. nov.
Plate I, Fig. 1

Shell subquadrate in shape, usually wider than long, with a pair of lateral pointed projections at the hinge line. Measurements of an average specimen: width at mid-length 15 mm., width at hinge area 21 mm., length 10 mm. Surface finely striated, with three to four striations to one millimeter at the anterior margin. Pedicle valve evenly convex, but gently arched along the median line from beak to front; beak very small; delthyrium, known only from a cast, appears small but comparatively wide. On the interior of the pedicle valve the muscle scars form a bilobed area divided longitudinally by a slightly elevated area. Each lobe is long and slender with an abruptly rounded anterior projection; the outer ridges of the abductor areas are nearly straight with a very slight tendency to be curved in part.

Plectambonites angulatus differs from *P. curdsvillensis* Foerste, from the Trenton Curdsville formation of Kentucky, in not having a thickening near the anterior and lateral margins, in having less crescentic-shaped muscle scars, and in having fewer striae per millimeter width. It differs from *P. sericeus* (Sowerby) mainly in having no alternation in the prominence of the striae and in being somewhat larger.

Horizon and locality: Barrel Spring formation, in Barrel Spring canyon east of Barrel Spring, Inyo mountains, California.

PHYLUM Arthropoda
CLASS Crustacea
SUBCLASS Trilobita Walch
ORDER Opisthoparia Beecher
FAMILY Remopleuridae Corda
GENUS Remopleurides Portlock

Remopleurides occidens sp. nov.
Plate I, Figs. 3, 4

Cranidium rather strongly convex, anterior margin abruptly elevated; width of the neck segment and also the portion of the cranidium in front of the eyes a little more than half the width between the eyes. The facial suture originates at or very near the posterior margin of the palpebral lobes and curves upward and outward around the lobes in the form of a half oval, and there proceeds directly forward to produce a gently rounded curve anteriory. The occipital furrow is well-defined and deeply incised, traversing the cranidium in a straight line.

The thorax is a little wider than the cranidium, rather strongly convex, consisting of eleven segments. The axial lobe is wide and stands out in bold relief; it tapers sharply posteriorly to the pygidium. The side lobes are narrow, only slightly convex, produced in pointed pleurae which curve backwards and decrease in length posteriorly.

The pygidium is very small and rarely well preserved. One specimen shows a pygidium which is produced in two pairs of short spines curving sharply to a directly posterior direction.

MEASUREMENTS

	Small	Average	Large
Cranidium			
Length	4 mm.	5 mm.	6 mm.
Width	4 mm.	5 mm.	6 mm.
Width directly in front of palpebral lobes	2 mm.	3 mm.	4 mm.
Thorax			
Length		11 mm.	13 mm.
Width		8 mm.	10 mm.
Posterior width		3.5 mm.	5 mm.
Pygidium			
Length		1 mm.	
Width		2 mm.	

Remopleurides occidens is closely related to *R. canadensis* Billings, from the Chazy of Valcour Island, but it differs in being more convex and in lacking glabellar furrows. *R. missouriensis* Foerste from the Kimmswick of Missouri differs from *R. occidens* in having a more rounded cranidium; and also the facial suture immediately anterior to the palpebral lobes is only slightly indented, whereas in *R. occidens* it is well indented. *R. affinis* Billings from the Beekmantown of Quebec differs from *R. occidens* in having the part of the cranidium anterior to the eyes less quadrate in shape, with the sides sloping and the front less abruptly rounded.

Horizon and locality: The most common fossil in the Barrel Spring formation, in Barrel Spring canyon, Inyo mountains, California.

FAMILY Asaphidae Burmeister
SUBFAMILY Asaphinae Raymond
GENUS Isotelus DeKay

Isotelus spurius sp. nov.
Plate I, Fig. 7

Cephalon short, wide, gently convex, and either abruptly descending at the margins, or with a slightly flattened border. The eyes are large, situated about halfway to the front of the cephalon, moderately close together. The facial suture begins at a point well within the genal angles and proceeds forward and outward at an angle of about forty-five degrees; after swinging around inside the eye it proceeds forward and outward at about sixty degrees and meets the antero-lateral margin. Glabella not defined, glabellar furrows absent. The free cheeks are large, rounded at the genal angles.

The thorax has eight flat segments, with a wide axial lobe occupying more than two-thirds the width. Pleurae short, rounded.

The pygidium is wider than long, with a subrounded outline. It is gently convex, with a slightly flattened border. The axial lobe is only obscurely defined and apparently narrows abruptly posteriorly; no segmentation has been observed. A median furrow has been observed in one mold of a pygidium.

MEASUREMENTS

Cephalon

Length	9 mm.
Width	17 mm.
Distance from eyes to posterior margin	4 mm.
Distance between eyes	7 mm.

Pygidium

Length	7 mm.
Width	13 mm.

Isotelus spurius is distinct in the abrupt rounding of the cranidium antero-laterally; in other species this region is more or less broadly rounded. It resembles *Homotelus* in this respect, and also in the abrupt descent of the anterior part of the cranidium; the absence of a median pustule on the cranidium, how-

ever, excludes it from that genus. *Isotelus spurius* differs from *I. latus* Raymond, from the Trenton of Ottawa, Ontario, in having larger eyes situated farther forward, and also in having a wider median thoracic lobe.

Horizon and locality: Barrel Spring formation, in Barrel Spring canyon east of Barrel Spring, Inyo mountains, California.

PLATE I

1. *Plectambonites angulatus* Phleger. Cast of interior of pedicle valve of cotype. L. A. M. No. A3158-76.

2. *Orthis decipiens* Phleger. Cast of interior of brachial valve of holotype. L. A. M. No. A3158-70.

3, 4. *Remopleurides occidens* Phleger. Cranidium and thorax of cotypes. L. A. M. Nos. A3158-75, 73.

5, 6. *Isotelus gigas* DeKay. Cranidium and hypostoma of plesiotypes. L. A. M. Nos. A3158-71, 74.

7. *Isotelus spurius* Phleger. Dorsal view of cotype. L. A. M. No. A3158-69.

PLATE II

1, 2. *Plectorthis patulus* Phleger. Exterior and interior of pedicle valves of cotypes. L. A. M. Nos. A3158-26, 22.

3, 4, 5. *Plectorthis mazourkaensis* Phleger. Interior, exterior and interior views of pedicle valves of cotypes. L. A. M. Nos. A3158-23, 52, 25.

6, 7. *Orthis minusculus* Phleger. Pedicle and brachial views of cotypes. L. A. M. Nos. A3158-30, 29.

8. *Cybeloides calliteles* Phleger. Pygidium of holotype. L. A. M. No. A3158-32.

9. *Encrinurus octonarius* Phleger. Pygidium of holotype. L. A. M. No. A3158-67.

10, 11. *Pliomerops barrandei* (Billings). Cranidia of plesiotypes. L. A. M. Nos. A3158-12, 13.

12. *Ceraurus infrequens* Phleger. Cranidium of holotype. L. A. M. No. A3158-56.

13, 14. *Encrinurus hastula* Phleger. Dorsal views of cotypes. L. A. M. Nos. A3158-65, 66.

15. *Lloydia obsoletus* Phleger. Mold of Thorax and pygidium and cephalon of cotypes. L. A. M. No. A3158-14.