NOTES ON CERTAIN ORDOVICIAN FAUNAS OF THE INYO MOUNTAINS, CALIFORNIA

Thesis by

Fred B. Phleger, Jr.

In Partial Fulfillment of the Requirements

for the Degree of Master of Science,

California Institute of Technology,

Pasadena, California

1932

NOTES ON CERTAIN ORDOVICIAN FAUNAS OF THE INYO MOUNTAINS, CALIFORNIA

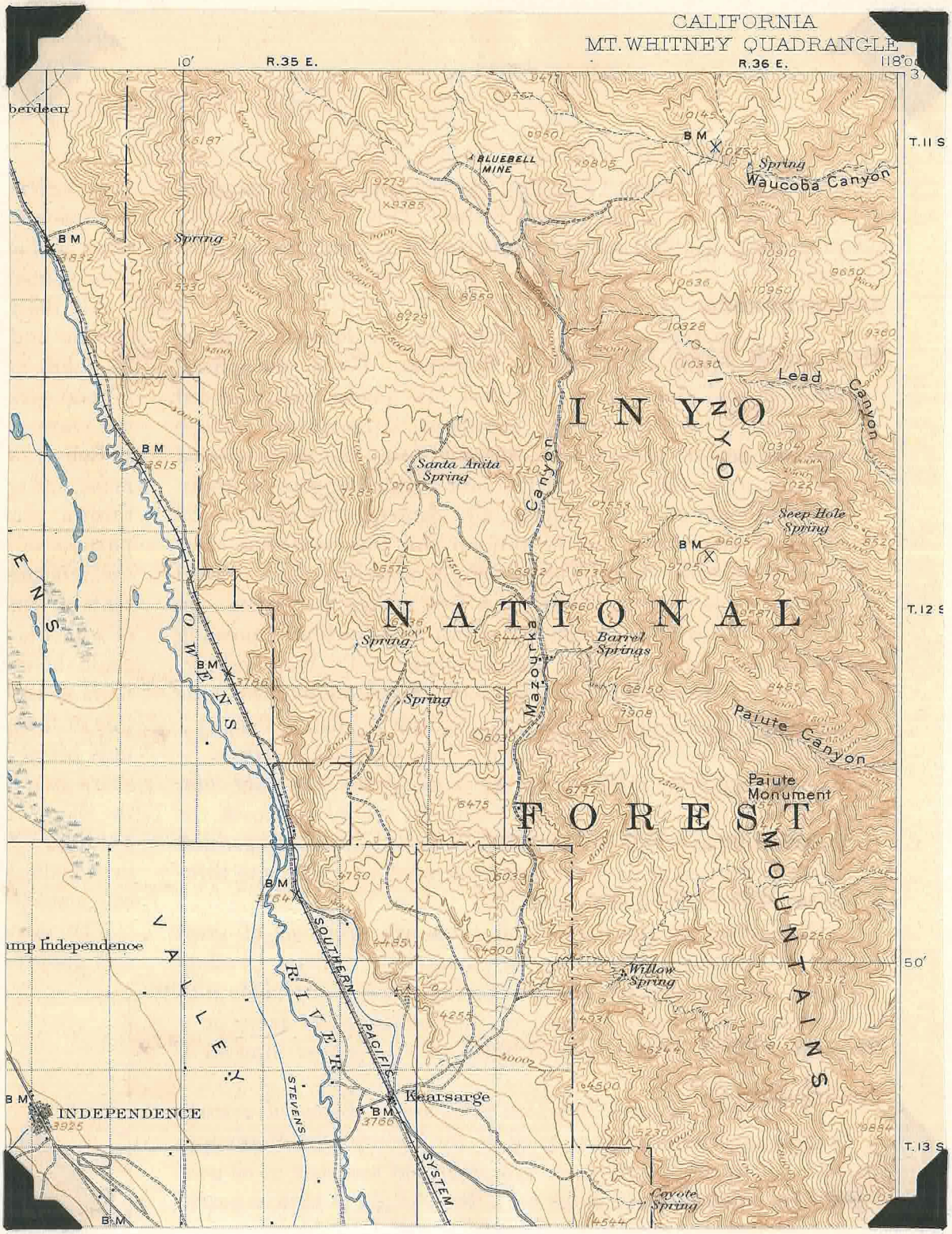
Contents

page

Descriptions of species occurring in the Mazourka formation

List of Illustrations

Index Map


CALIFORNIA
MT. WHITNEY QUADRANGLE
R.35 E.
R.36 E.
T.11 S
T.12 S
T.13 S
BLUEBELL MINE
Spring
Waucoba Canyon
Lead Canyon
INYO
Santa Anita Spring
Mazourka Canyon
Seep Hole Spring
NATIONAL
Barrel Springs
Paiute Canyon
Paiute Monument
FOREST
MOUNTAINS
OWENS VALLEY
SOUTHERN PACIFIC RAILROAD SYSTEM
Willow Spring
Kearsarge
INDEPENDENCE
Coyote Spring
BM

INTRODUCTION

The Inyo range is situated in east central California. It is bordered on the west by Owens valley and on the east by Deep Spring and Saline valleys. The range trends northwest-southeasterly, and is separated on the south from the Coso mountains by a broad depression east of Olancha. Mount Montgomery is its northern extremity. Together with the White mountains, a term now restricted to the northern portion of the range, the Inyos are about 110 miles in length. The average elevation is about 10,000 feet.

The sedimentary rocks of the range have a total thickness of more than 36,000 feet, with every system from the pre-Cambrian to the Jurassic, excepting the Silurian, represented. Structurally, the sedimentary rocks form a broad, low anticline flanked on the west by a complemental syncline, both of which strike to the northwest anf plunge to the southeast. Southwardly the stratigraphic position of the rocks exposed becomes successively higher, with the pre-Cambrian outcropping in the north and the Jurassic in the south. This simple structure has been modified by complex faulting.

During the fall of 1931 the writer spent several days in the Inyo range with Dr. John H. Bradley, Jr. collecting fossils, and it was at his suggestion that the present study was begun. The field work was continued during the following winter and spring.

The purpose of this paper is to describe the faunas and stratigraphy of the Barrel Springs and Mazourka formations of Ordovician age as exposed in the Inyo range north and east of Independence, California.

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.

The first mention of the sedimentary rocks in the Inyo range is in the report of G. K. Gilbert.[1.] A section of the strata exposed on the east side of the range in the pass between Deep Spring Valley and Owens valley is included in his report, and concerns rocks which are now considered

---

1.- Gilbert, G. K., U. S. Geol. Survey W. 100th. Meridian Final Report, Vol. 3, pp. 169, 170, 1875.

of pre-Cambrian and Cambrian age. In 1888 W. A. Goodyear,[1] geologist of the California State Mining Bureau, published his notes on the strata exposed in Mazourka canyon. Mr. Goodyear found impressions of corals in the rocks. This is the first record of fossils collected from the range.

In 1912 and 1913, Adolph Knopf and Edwin Kirk[2] made a reconnaissance geological survey of a large area in the vicinity of Owens valley which includes the Inyo mountains. 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 is a series of arenaceous shales which is probably equivalent, at least in part, to the Palmetto formation of Turner. It is probable that rocks of Richmond age also occur in the range."[3]

1.- Goodyear, W. A., Calif. State Mining Bureau, Eighth Annual Report State Mineralogist, 1888, p. 267.

2.- Knopf and Kirk, U. S. Geol. Surv. Prof. Paper 110, 1918

3.- op. cit., p. 32.

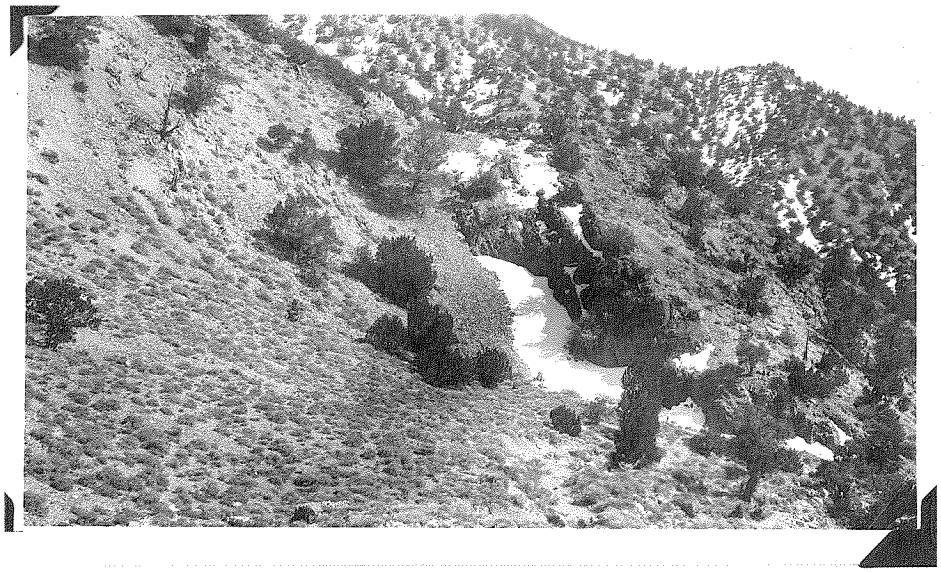


Fig. 1.- The Mazourka formation. At the Elbow in Mazourka canyon, looking southeast.

Fig. 2.- Mazourka formation. At the Elbow in Mazourka canyon, looking north.

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 Springs 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 Springs canyon and the Lead canyon trail. The type section has been measured in an unnamed canyon which is the first tributary 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

Fig. 1.- Contact between limestones of Beekmantown age (right) and the Mazourka formation (left).

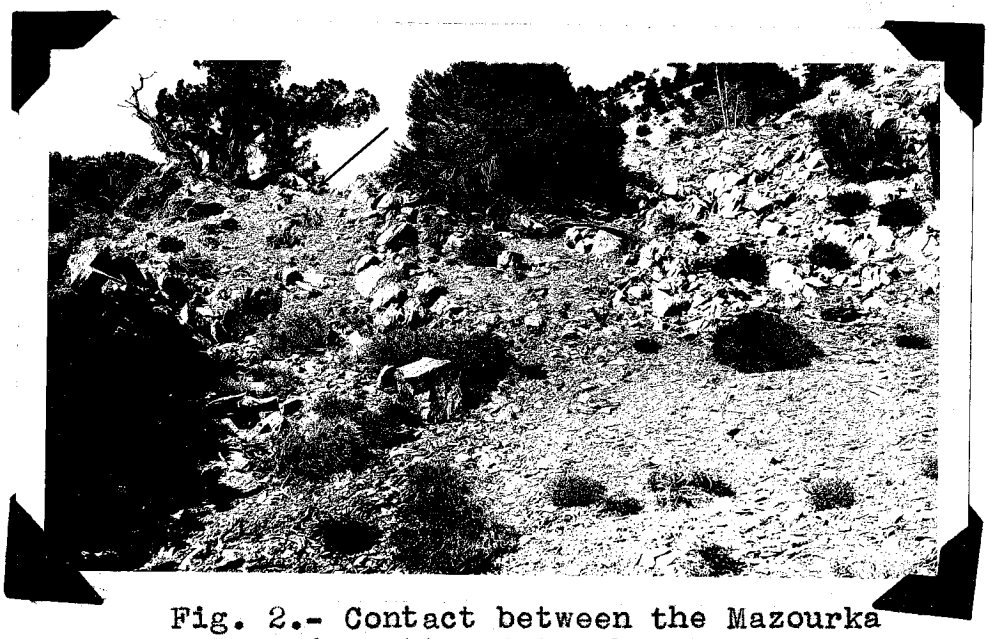


Fig. 2.- Contact between the Mazourka formation (right) and the basal Devonian quartzite (left).

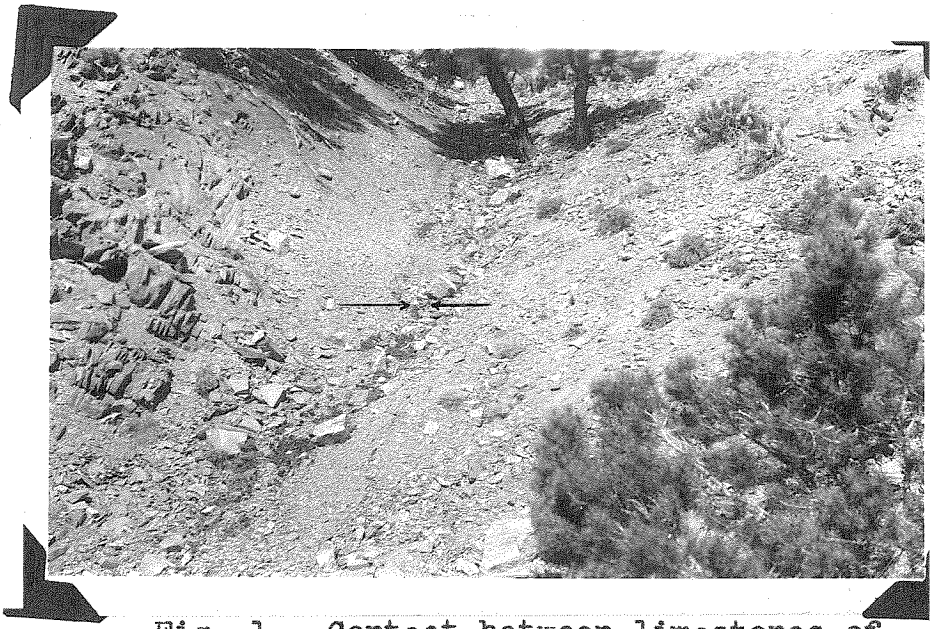


Fig. 1.- Contact between limestones of Beekmantown age (right) and the Mazourka formation (left).

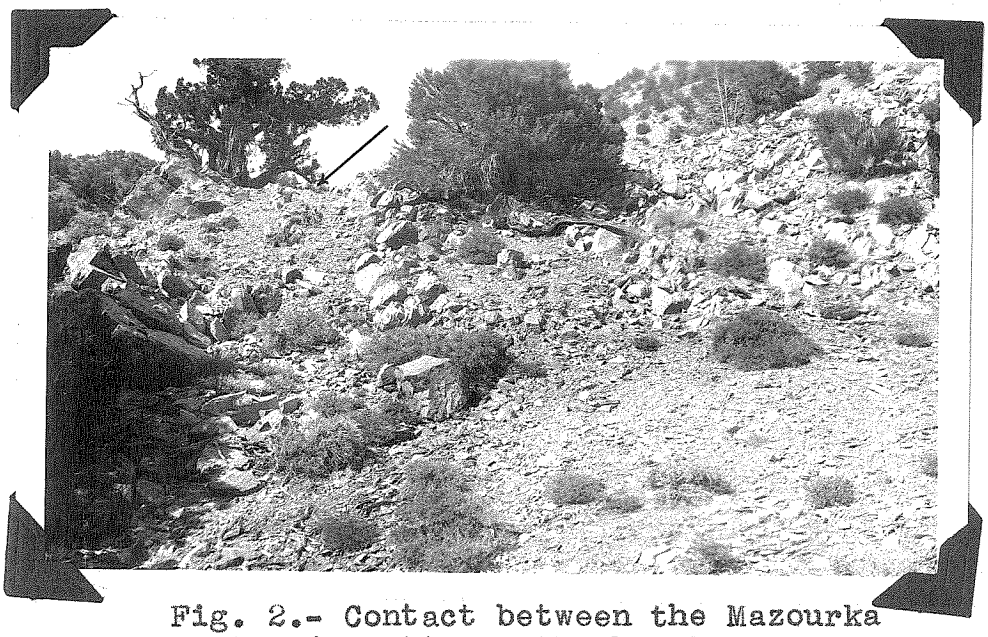


Fig. 2.- Contact between the Mazourka formation (right) and the basal Devonian quartzite (left).

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 Springs formation at this place may be due to faulting, since a short distance south of the type section of the Mazourka formation extensive faulting has taken place. This suggestion is presented only as a possibility. Farther south, in Barrel Springs and Mexican canyons, the Mazourka formation is overlain conformably by the basal quartzite of the Barrel Springs formation. The massive Beekmantown limestones, which underly 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.

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.[1] In the last four columns the occurrence of the same species or closely related forms in other western localities and in the Chazy formation of New York and Canada is noted.

Column 1 includes the species collected by the writer from the Mazourka formation; column 2 includes the forms collected by Kirk from the Mazourka formation; column 3 includes related or identical forms occurring in Walcott's upper Pogonip of Nevada; column 4 includes related or identical forms occurring in Hague's middle Pogonip; column 5 includes related or identical forms occurring in the lower Simpson of Oklahoma[2]; and column 6 includes identical or related forms occurring in the Chazy of New York and Canada.

	1.	2.	3.	4.	5.	6.
Beatricea sp. ind.	x					
(?)Streptelasma sp. ind.	x					
Diplograptus sp.		x				
Blastoidocrinus carchariodens Billings	x					x
Prasopora contigua Ulrich	x					

1.- Kirk, op. cit., p. 35

2.- Edson, F. C., Notes on the Simpson Formation of Oklahoma, Bull. Am. Ass. Pet. Geol., v. 7, 1923, pp. 558-64.

(?)Chasmatopora sp. ind.	x					
Crania sp. ind.	x				x	
Orthis minisculus sp. nov.	x				x	x
Plectorthis mazourkaensis sp. nov.	x	x	x	x	x	x
Plectorthis patulus sp. nov.	x					x
Triplesia sp.		x				
Ctenodonta hamburgensis (Walcott)	x	x	x			
Modiolopsis sp.		x				
Pleurotomaria sponsa Billings	x	x	x	x		x
Hormotoma sp. ind.	x	x				
Liospira sp. ind.	x	x				
Fusispira sp.		x				
Maclurites (?)subannulatus (Walcott)	x		x	x		
Trochonema sp. ind.	x					
Endoceras proteiforme Hall	x	x	x	x		
Lloydia obseletus sp. nov.	x					
Mileus sp. *		x				
Isotelus gigas DeKay	x	x				
Isotelus beta Raymond	x					x
Isotelus sp. ind.	x					
Bumastus sp. ind.	x					

* It is possible that this form is the same as the form collected by the writer and referred to Lloydia obseletus Phleger.

Encrinurus hastula sp. nov.	x					
Encrinurus octonarius sp. nov.	x					
Cybeloides calliteles sp. nov.	x					x
Ceraurus infrequens sp. nov.	x					
Pliomerops barrandei Billings	x	x	x		x	x
Leperditia bivia White	x	x	x	x	x	
Leperditia nana Jones	x					x
Leperditella sp.		x				

The Age of the Mazourka Formation

About 75% of the above fauna which have been specifically identified are of Chazy age. This includes the new species, most of which are closely related to described Chazy forms. About 20% 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 genera three are extremely common throughout the formation. The Mazourka formation is faunally and lithologically 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[1] use of the term includes strata of Beekmantown, Chazy, and Trenton ages, with a maximim thickness of 5000 feet. Emmons[2] and Spencer[3] used the term Pogonip to include beds containing Ordovician fossils between Cambrian strata and the Eureka quartzite, which is stratigraphically lower that a limestone carrying Trenton fossils. Over 15% 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 is probably equivalent, in part at least, to his middle Pogonip. Walcott's faunal list[4] of the upper Pogonip of the Eureka district includes species of Chazy age. About 25% of the fauna from the Mazourka formation are either identical with or closely related to species which Walcott reported. The two formations are essentially contemporaneous.

1.- Hague, Geol. of the Eureka District, Nev., U. S. Geol. Surv. Mon. 20, pp. 48-54.
2.- Emmons, U. S. Geol Surv. Bull. 308, pp. 27-29.
3.- Spencer, U. S. Geol. Surv. Prof. Paper 96, pp. 24,25.
4.- Walcott, C. D., U. S. Geol. Surv. Mon. 8, pp. 65-98.

There is a similarity between the fauna of the lower part of the Simpson formation of Oklahoma[1.] and that of the Mazourka formation. About 20% of the Mazourka forms are represented in the lower Simpson by identical or related forms. It is probable that the two formations are contemporaneous, at least in part.

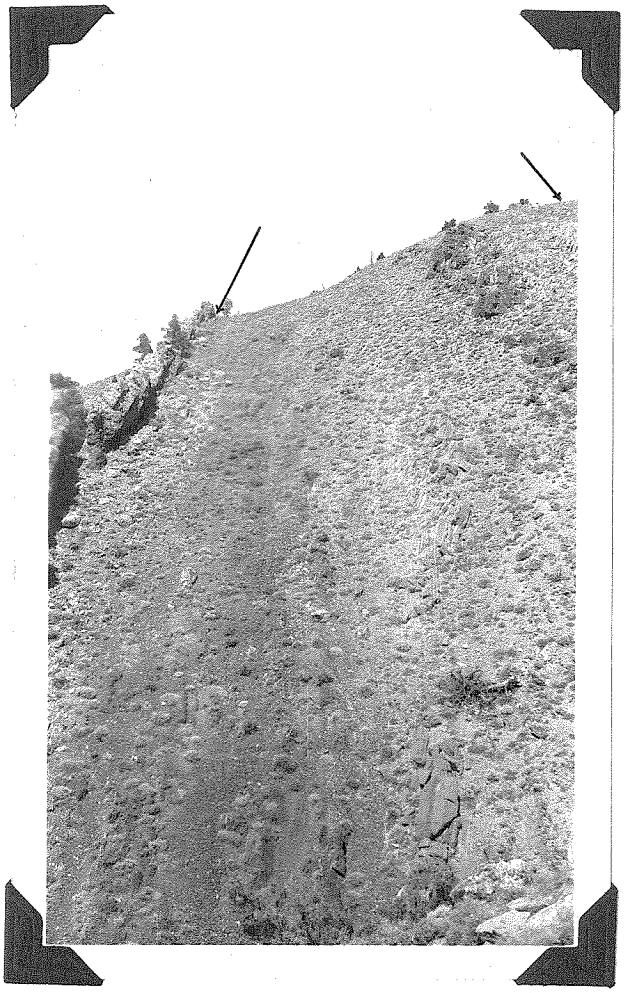
The Swan Peak quartzite of Idaho carries a small fauna of questionably Chazy age. Since no faunal list is given in Mansfields papers,[2.] it can only be said that this formation is a possible correlative of the Mazourka formation.

A fairly close correlation by means of fauna can be made between the Mazourka formation and the Chazy formation of New York and Canada. About 50% 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.

1.- Edson, F. C., op. cit., pp. 558-64.

2.- Mansfield, G. R., U. S. Geol. Surv. Prof. Paper 152, p. 57. --- U. S. Geol. Surv. Bull. 713, pp. 32,33.

Plate III

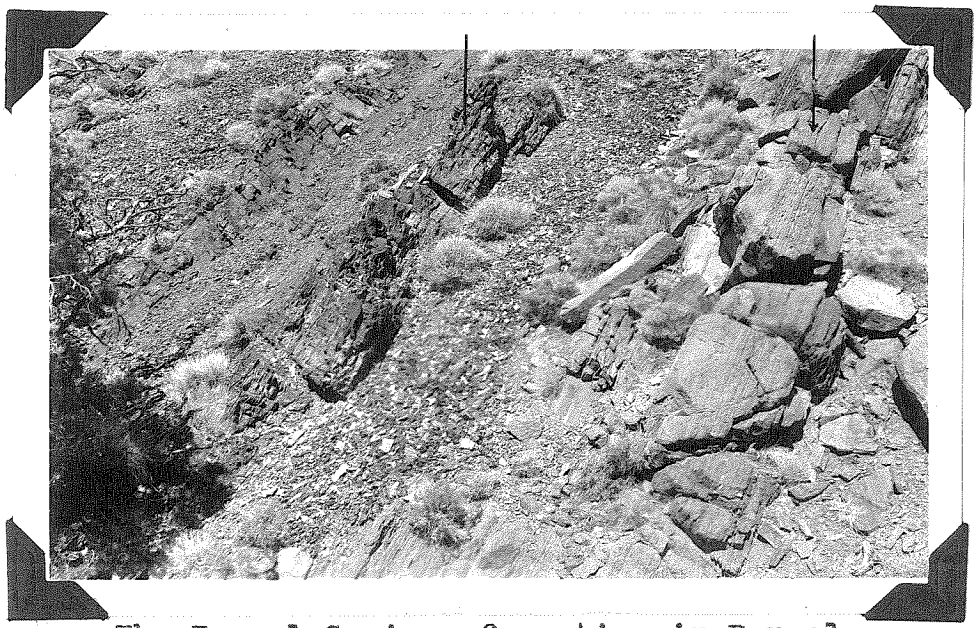


The Barrel Springs formation, looking north. The arrow on the right points to the contact between the Barrel Springs formation and the Mazourka formation. The left arrow points to the contact with the basal Devonian quartzite. View of the type section in the west fork of Mexican canyon.

THE BARREL SPRINGS FORMATION

The term, Barrel Springs 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, is overlain conformably by basal Devonian quartzite and is 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 Springs canyon. The beds strike north 15 degrees west and dip from 60 to 70 degrees southwest. They are well exposed in Barrel Springs 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 unfossiliferour. 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

Plate IV



The Barrel Springs formation in Barrel Springs canyon. The broken arrow on the right points to the impure limestone member. The left arrow points to the fossiliferous shale member.

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 Springs canyon about one-half mile east of Barrel Springs.

Fauna of the Barrel Springs Formation

The following is a list of the fauna collected by the writer from the Barrel Springs 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 Springs formation are either identical with or closely related to species of Trenton age.

Correlation with Strata Elsewhere

Due to the paucity of the fauna of the Barrel Springs formation and also incomplete information concerning Ordovician faunas of Trenton age in the western United States, it is impossible to correlate it with strata elsewhere in the west. Hague[1.] assigns a Trenton age to the uppermost part of his Pogonip formation. It is possible that the Barrel Springs 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 Springs formation is the equivalent of some part of the upper Simpson formation of Oklahoma.[2.] Although no species occur in common at these two localities, there are two or three species which are distantly related.

ACKNOWLEDGEMENTS

The writer wishes to acknowledge the assistance of Dr. John H. Bradley, Jr. at whose suggestion this problem was begun and whose constant supervision has made its completion possible. The writer is grateful to Mr. Willis P.

1.- Hague, op. cit., pp. 48-54.
2.- Edson, op. cit., pp. 558-64.

ropenoe for help in facilitating the work and for many valuable suggestions.

Descriptions of Species Occurring in the Mazourka Formation

PHYLUM Coelenterata

CLASS Hydromedusae

ORDER Stromatoporoidea Nicholson and Murie

GENUS Beatricea Billings

Beatricea sp. ind.

According to Foerste, the divisions of the genus Beatricea are made entirely on the basis of external characteristics. Specimens of Beatricea collected by the writer from the Mazourka formation have been recrystallized to such an extent that the more delicate features have been obliterated. In lacking external ornamentation, the form resembles B. undulata cylindrica Foerste. In one or two specimens, however, there are definite transverse markings which are apparently growth lines; these markings do not occur in B. undulata cylindrica. The present specimens occur as erect columnar growths, frequently branched. There is a central filled quartz area with an average diameter of 5mm. The walls average about 3mm. in thickness.

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

SUBPHYLUM Cnidaria

CLASS Anthozoa

SUBCLASS Tetracoralla Haeckel

FAMILY Zaphrentidae Milne Edwards and Haine

GENUS Streptelasma Hall

(?)Streptelasma sp. ind.

The specimens which are questionably referred to this genus may be representatives of the genus Zaphrentis, since the calyx is not preserved. In the appearance of the septa on the outside of the cup they compare somewhat favorably with Streptelasma profundum (Conrad); the septa are about 45 in number. Corals are rare in the Mazourka formation; only two specimens which preserve the general form have been collected.

PHYLUM Echinodermata

CLASS Blastoidea

ORDER Protoblastoidea Bather

FAMILY Blastoidocrinidae Bather

Genus Blastoidocrinus Billings

Blastoidocrinus carchariedens Billings

Blastoidocrinus carchariedens Billings, Geol. Surv. Canada, 1859, p. 18, pl. 1, figs. 1a-n.

Fragmental calyxes showing the apical plate with most of the brachioles distinct, the deltoid plates and the dorsal cup, are very abundant in the Mazourka formation. The specimens have been flattened and distorted by compression and damaged by weathering. Only one specimen shows clearly the five triangular deltoid plates resembling sharks' teeth, and the five ambulacra with the sixteen brachioles distinct. The apical plate is definitely star-shaped.

Measurements

Width of smallest specimen	21mm.
Width of largest specimen	31mm.
Width of average specimen	25mm.

Horizon and locality: Chazy of the islands of Montreal, Jésus, and Bizard, Canada, - Valcour island, New York; Mazourka formation, ½ mile south of the Lead canyon trail in Mazourka canyon, Inyo mountains, California.

CLASS Crinoidea Miller

Crinoid fragments

Crinoid fragments, especially stems, are very abundant in the Mazourka formation. Two or three incomplete calyxes have been found which are too fragmentary to identify. A portion of an anchor has also been collected.

PHYLUM Molluscoidea

CLASS Bryozoa Ehrenberg

SUBCLASS Gymnolaemata Allman

ORDER Trepostomata Ulrich

SUBORDER Amalgamata Ulrich and Bassler

FAMILY Monticuliporidae Nicholson

GENUS Prasopora Nicholson

Prasopora contigua Ulrich

Prasopora contigua Ulrich, 14th. Ann. Rep. Nat. Hist. Surv. Minnesota, p. 87. --Geol. Minnesota, 3, pt. 1, p249, pl. 16, figs. 24-26. --J. F. James, Jour. Cincinnati Soc. Nat. Hist., 16, 1894, p. 180.

This is one of the most common species in the Mazourka formation, occurring mainly in the banded limestone of the upper part of the formation. The majority of the specimens are somewhat larger than those originally described by Ulrich; the smallest specimen is 15mm. wide, the largest specimen is 77mm., whereas an average specimen is about 50mm. wide. The zoaria vary in external form, but most are hemispheric, with a flat or slightly concave base; some are discoidal. This latter form may be due to compression, since certain associated fossils are distorted. In many cases there is an obliteration of the internal cell structure, probably due

to recrystallization. The more minute structure has been largely obscured, but some specimens preserve it remarkably well. The opening left by the cystiphragms was observed in only a few zoecia. Only about a third of the angles of junction between the zoecia are occupied by mesopores. No acanthopores have been observed.

Horizon and locality: Black River of Goodhue and Dakota counties, Minnesota; Mazourka formation, Inyo mountains, California.

ORDER Cryptostomata Vine

FAMILY Phylloporinidae Ulrich

GENUS Chasmotopora Eichwald

(?)Chasmatopora sp. ind.

One specimen of an anastomose bryozoan obtained from the Mazourka formation is so recrystallized that the zoecia cannot be recognized with certainty.

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

CLASS Brachiopoda Dumeril

ORDER Neotremata Beecher

SUPERFAMILY Craniacea Waagen

FAMILY Craniidae King

GENUS Crania Retzius

Crania sp. ind.

Three fragmentary brachial valves of a Crania have been collected from the Mazourka formation. They are rounded in shape and possess well-defined growth-lines. One shell has a diameter of 11mm.

ORDER Protremata Beecher

SUPERFAMILY Orthacea Walcott and Schuchert

FAMILY ORthidae Woodward

SUBFAMILY Orthinae Schuchert and Cooper

GENUS Orthis Dalman

Orthis minisculus sp. nov.

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 laterally anteriorly, the anterior margin only gently convex. Width of pedicle valve of cotype 10mm., length 7mm. 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 umbo 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. panderiana Hall and Clarke, from the Canadian beds of Quebec, has fewer plications, the length and breadth are about equal, the mesial sinus does not extend the entire length of the shell, and the brachial valve is not flat. Its closest relation seems to be O. laurentia Billings. In the description given by Billings, however, no mention is made of a mesial sinus. The difference in relative convexity of the valves is greater than in O. laurentia than in the species here described.

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

FAMILY Plectorthidae Schuchert and Cooper

SUBFAMILY Plectorthinae Schuchert and Cooper

GENUS Plectorthis Hall and Clarke

Plectorthis mazourkaensis sp. nov.

Valves subequally convex, the pedicle valve a little more so than the brachial, the lateral margins are straight or slightly incurved, rounding anteriorly. Outline semioval to subquadrate; the hinge line a little less than the greatest width. The width of an average specimen varies from 17mm. to 18mm., length from 16mm. to 17mm., forming a ration of breadth to length of approximately 1:1, the breadth in some cases being 1 to 2mm. greater than the length. The surface of both valves is marked by 18 to 20 primary plications, subangular to rounded, increasing to about 35 at the anterior margin by bifurcation 5 to 8mm. 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 5 to 6 plications to 4mm.

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 1mm. 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 rigde 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 Cincinnatian beds 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. scovelli (Miller), also from the Cincinnatian beds. A very distant relative, Dalmanella hamburgensis (Walcott), is found in

the Pogonip group 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.

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 25mm., 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 primary 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 4mm.

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; a slight flattening at the cardinal angles; the beak is not perceptably incurved; the cardinal area is narrow, the greatest width being 2mm.; foramen triangular. The muscle scars in the valves examined form an indistinct, very small, oval to subtriangular impression, extending about 2mm. from the region of the beak.

This species is fairly common in the Mazourka formation. It differs from Plectorthis mazourkaensis, from the same 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 Cincinnatian beds. They have fewer and more prominent plications than P. kankanensis (McChesney), from the Richmond 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 Mollusca
CLASS Pelecypoda
ORDER Prionodesmacea Hall
(Section Taxodonta Neumayr)
SUPERFAMILY Nuculacea
FAMILY Ctenodontidae Dall
GENUS Ctenodonta Salter

Ctenodonta hamburgensis (Walcott)

Tellinomya hamburgensis Walcott, C. D., Mon. U. S. Geol. Surv., 8, 1884, p. 76, pl. 11, figs. 1, 1a.
Ctenodonta hamburgensis Ulrich, Geol Minnesota, 3, pt. 2, 1894, p. 605, pl. 42, figs. 91, 92.

Two specimens from the Mazourka formation agree well with Ctenodonta hamburgensis (Walcott) from the Pogonip of Nevada. The fine concentric striae which Walcott mentioned do not appear from the illustrations to be as fine as his description would indicate. The smooth, glistening appearance of the surface might have been due to the state of preservation. The specimens at hand show no such property. The "Scarcely perceptible radiating striae" are also absent in the

specimens from the Mazourka formation. Ulrich observed a lack of the above characteristics in his specimens of C. hamburgensis, from the Trenton shales of Minnesota. He makes the following statement:

> "Respecting the generic position of the shell there may be some doubt, because we have as yet no knowledge of the interior. Nor does the species fit very well into any of the sections into which the genus has been divided. Certain it is that it is not very closely related to any of the numerous species described. Perhaps it is most like C. socralis, with which it is also associated, but it will be distinguished readily enough by its shorter and rounder form, fuller umbones, and more distinctly striated surface."

Horizon and locality: Upper part of Pogonip group, Nevada; Mazourka formation, about one-half mile below the Lead canyon trail in Mazourka canyon, Inyo mountains, California.

CLASS Gastropoda

SUBCLASS Streptoneura Spengel

ORDER Aspidobranchia Schweigger

SUBORDER Rhipidoglossa Troschel

FAMILY Pleurotomaridae d'Orbigny

GENUS Pleurotomaria Sowerby

Pleurotomaria sponsa Billings

Pleurotomaria sponsa Billings, Geol. of Canada, Pal. Fos., v. 1, 1865, p. 226.

Specimens of this species from the Mazourka formation correspond to Billings's description in everything except the surface markings. The surface of the present specimens is finely striated in a definite pattern. On the lower whorl there are about three fairly prominent striations in two millimeters, with innumerable fine growth lines between. On the upper whorls only the ornamental striae can be observed, and they are present about ten in 2mm. Both the growth lines and the ornamental striae curve sharply back and become tangential to the slit band. The general form resembles Holopea, except that there is a definite convex slit band on the outer edge of the lower whorl which gradually becomes concealed on the upper whorls. No specimen has the aperture complete, but a more or less oval

shape is suggested.

Measurements

Width	15mm.
Height	15mm.
Width of slit band	1.3mm.
Apical angle	80 degrees, plus or minus 5 degrees.

In Kirk's faunal list from the present formation was included a Pleurotomaria which was referred to P. lonensis Walcott, of the upper Pogonip of Nevada. All complete pleurotomarids in the writer's collection distinctly belong to P. sponsa. None of them suggest the strong revolving lines of P. lonensis, the apical angle is sharper, and the slit band on the outer whorl is less keel-like.

Horizon and locality: Chazy of Table Head, Newfoundland; moderately rare in the middle and upper parts of the Mazourka formation, Inyo mountains, California.

GENUS Hormotoma Salter

Hormotoma sp. ind.

Two badley weathered specimens of Hormotoma have been collected from the Mazourka formation. The apical angle is about 12 degrees and the width at the base is about 13mm. There is an obscurely-defined slit band; no ornamentation

or growth lines can be observed. There appears to be nine whorls which embrace only slightly. Aperture subrounded to semioval.

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

GENUS Liospira Ulrich and Scofield

Liospira sp. ind.

In the upper part of the Mazourka formation gastropods are numerous. Unfortunately they are poorly preserved, usually appearing as markings on weathered surfaces. One specimen of Liospira is sufficiently intact to show a part of all the whorls and the low spire. The whorls are angular and there is a slit band present on the outer edge of the lower whorl. The spire is low with an angle of about 150 degrees.

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

FAMILY Euophalidae de Koninck

GENUS Maclurites Lesuer

Maclurites (?) subannulatus (Walcott)

Maclurea subannulata Walcott, Mon. U. S. Geol. Surv., 8,

1884, p. 82, pl. 11, figs. 18a,b.

The specimens of Maclurites (?) subannulatus (Walcott) collected from the Mazourka formation do not show surface markings.

Gastropods are very common in the Mazourka formation, and this fact is helpful in recognizing the formation elsewhere than at the type locality. The state of preservation, however, is very poor. The gastropods are usually preserved as markings, frequently faint, on weathered surfaces, and except in rare instances have not been observed on fresh fracture.

Horizon and locality: Upper Pogonip, Eureka district, Nevada; Mazourka formation, in Mazourka canyon between the Lead canyon trail and the Elbow, Inyo Mountains, California.

Maclurites sp. ind.

A very large and fragmentary Maclurites occurs in the writer's collection from the Mazourka formation. The width of the specimen is about 95mm. There are about three and one-half whorls preserved, and the spire is very low.

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

FAMILY Trochonematidae Zittel

GENUS Trochonema Salter

Trochonema sp. ind.

One poorly preserved specimen of this genus has been collected from the Mazourka formation. Both the spire and the aperture have been destroyed, making specific identification impossible, but many of the external characters of the lower whorl have remained intact. The lower whorl is 16mm. wide and 4.5mm. high, with a strong keel on the upper and lower margins, and a less distinct rib a little above the middle. The whorl is traversed by many fine growth striae which curve backwards on the upper and lower sides. Although the aperture is not distinctly preserved, it appears to be subquadrate in outline. The spire had an apical angle of about 150 degrees.

CLASS Cephalopoda

ORDER Nautiloidae Zittel

SUBORDER Holochoanites Hyatt

Group Endoceratida Hyatt

FAMILY Endoceratidae Hyatt

GENUS Endoceras Hall

Endoceras proteiforme Hall

Endoceras proteiforme Hall, Pal. of New Yorkm v. 1, p. 208, pl. 48, fig. 1. -- Foerste, Jour. Sci. Lab. Denison Univ., v. 20, 1924, p. 209, pl. 21,22,23. --Grabau and Shimer, N. Am. Index Fossils, 2, 1910, p. 42, figs. 1239, 1240.

For full synonymy see R. S. Bassler, Bull. 92, U.S.N.M.

One fairly good specimen of this species was found in the Mazourka formation. The large tapering siphuncle has withstood weathering better than the rest of the specimen and stands out in comparatively bold relief; a transverse section of the septa is thus presented and the funnels can be made out with some certainty. The specimen is not complete and has been deformed; the original cross-section was probably circular but is now elliptical; also, recrystallization has obliterated traces of the endocones.

There are fragments of other straight cephalopods

present in the fauna which might be referred to the same genus, but the material is too poorly preserved to identify.

Horizon and locality: Middle Ordovician at Middleville, Lowville, etc., New York; Mazourka formation, one-half mile below the Lead canyon trail in Mazourka canyon, Inyo mountains, California.

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

Lloydia obseletus sp. nov.

Cephalon moderately convex, broadly rounded anteriorly. Glabella long, 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 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 Holotype

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

Lloydia obseletus is closely related to L. stremuus (Billings, but it differs in having the eyes close to the glabella. L. oblongatus differs from L. obseletus 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.

SUBFAMILY Asaphinae Raymond

GENUS Isotelus DeKay

Isotelus gigas DeKay

Isotelus gigas DeKay, Annals Lyceum Nat. Hist. New York, 1, 1824, p. 176, pl. 12, fig. 1. -- Clarke, Geol. Minnesota, 3, pt. 2, 1894, p. 107, figs. 6-8.---- Weller, Geol. Surv. New Jersey, Pal., 3, 1903, p. 192, pl. 14, figs. 6,7. -- Raymond, Ann. Car. Mus., 7, 1910, p. 53, pl. 15, figs. 1,2.

For full synonymy see R. S. Bassler, Bull. 92, U.S.N.M.

A free cheek from the Mazourka formation is referred to Isotelus gigas. The palpebral lobe appears to be less than 8mm. from the posterior margin of the cephalon, and the genal spine projects about 6mm. posterior to the region of the genal angle. In front of the palpebral lobes the facial suture describes a broadly rounded curve. The outer portion of the free cheek, which

is prolonged into the genal spine, is more convex than the internal part and is separated from it by a well-defined furrow. Several fragmentary cranidia and pygidia which occur in the writer's collection are also referred to this species.

Horizon and locality: Mohawkian and Cincinnatian, U. S. and Canada; Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

Isotelus beta Raymond.

Asaphus beta Raymond, Ann. Car. Mus., v. VII, no. 1, 1910, p. 67, pl. 19, figs. 4-7.

Isotelus beta Raymond, Ann. Car. Mus., 3, 1905, p. 342, pl. 12, fig. 9.

Raymond found some small pygidia at Crown Point and various other Chazy localities which he called Isotelus beta. The following is his description:

> "pygidium broadly rounded, with a narrow, depressed border. Axis high, extending back to the border. Faint annulations are observable on the axis, and there are traces of ribs on the pleurae."

Later he found little pygidia very abundant at McCulloch's sugar bush at Chazy, associated with cranidia and free cheeks of a corresponding size:

"These little trilobites agree with Isotelus harrisi in having the eyes rather far forward, but the cranidium is not so short and wide as in that species. The pygidia are less broadly bordered and the genal spines are shorter and less flattened than in I. platymarginatus. The name beta is therefore retained for the present. The thorax is unknown."

In the Mazourka formation several pygidia have been found which correspond very well to the above description. They are, however, somewhat larger. In one case a pygidium is found associated with a free cheek and part of a glabella. In another case a portion of a thorax is preserved with two pygidia. All the specimens have been obscured by weathering.

Horizon and locality: Chazy of Valcour Island and other localities, New York; Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

Isotelus sp. ind.

Two fragmentary specimens of isoteliform cranidia have been collected from the Mazourka formation. Although badly weathered, they differ greatly in shape from Isotelus gigas DeKay, from the same formation.

FAMILY Illaenidae Corda

GENUS Bumastus Murchison

Bumastus sp. ind.

Several fragments of Bumastus have been collected by the writer from the Mazourka formation. It is probable that more than one species is represented. One specimen shows eight thoracic segments and most of the cranidium.

Horizon and locality: Mazourka formation, Inyo mountains, California.

ORDER Proparia Beecher

FAMILY Encrinuridae Angelin

GENUS Encrinurus Emmrich

Encrinurus hastula sp. nov.

Cranidium sub-lunate in outline, the anterior 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 at 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 broddly 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 in 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 longer than wide. 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

	Average specimen	Small specimen
Cranidium		
Width	21mm.	10mm.
Length		4mm.
Length of glabella		4mm.
Width of glabella	9mm.	5mm.
Thorax		
Length	23mm.	12mm.
Width	19mm.	12mm.
Pygidium		
Length	20mm.	10mm.
Width	17mm.	10mm.

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. tuberculosis Collie, from the Trenton of New Jersey, by having more pleurae on the pygidium, and also fewer annulations on the madian 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, from the Clinton of Georgia, has only six pleurae in 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. Tubercules 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.

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 have been obscured. There are eight segments in 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	9mm.
Width	10mm.
Width of axial lobe at anterior margin	4mm.

Width of axial lobe at posterior margin 1.5mm.

Width of pleural lobes 3mm.

Encrinurus octonarius differs from E. hastula Phleger, which is also from the Mazourka formation, in being equal in length and breadth and in only eight pleurae. E. americanus Vigdes has six pleurae on the pygidium. E. thresheri Foerste has seven lateral segments on the pygidium and the segments are narrower than the intervening grooves. Tubercules are also present on the median lobe.

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

GENUS Cybeloides Slocum

Cybeloides calliteles sp. nov.

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 there is 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 segments 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 1mm. wide at their extremities.

Cybeloides calliteles differs from C. mirus Billings, from the Chazy of Table Head, 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.

Cephalon broad, roughly crescentiform, four-tenths as long as wide. Glabella only moderately convex, expanding forward at a rate of 1mm. in 3mm. length. The front of the glabella is gently rounded; there are three pairs of glabellar furrows; the first pair slopes posteriorly more than the other two pairs, and the second

pair slopes posteriorly only slightly, and the third pair is shorter than the other two and appears to be joined to the occipital furrow by faint longitudinal constrictions, 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 entire length of 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 not clear in the holotype, but appear to be produced laterally and posteriorly into short, curved spines. The eyes appear to be small, situated high on the cheeks, and a little nearer the glabella than to the posterior margin of the cephalon. No surface characteristics shown. Thorax and pygidium unknown.

Measurements of Holotype

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

Ceraurus infrequens is rather closely related to C. bispinosis Raymond and Barton, but in the latter the

glabellar furrows are neither so distinct nor so continuous. C. misneri Foerste differs in having the third glabellar furrow "distinctly separated from the median part of the glabella," and also in having the occipital furrow convex posteriorly where it crosses the glabella. C. pleurexanthemus Green 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)

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.

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. The following is Billings's original description of P. barrandei:

"Head moderately convex; glagella quadrate, a little

narrower behind than in front; sides straight, separated from the cheeks by the narrow well-defined dorsal furrows, neck segment with a tubercule in the middle; neck furrow extending all across; two glabellar furrows on each side extending one-third across; anterior lobes equal to half the whole glabella, and subdivided by two short oblique furrows pointing inwards and backwards, situated halfway between the anterior line and the anterior angles, and near but not cutting the front margin; a small pit in the middle of the front margin is visible on casts of the interior. The eyes appear to be small and situated opposite the posterior half of the second lobe, and a little less than one-third the length of the head from the side of the glabella.

"Pygidium moderately convex, axis conical, with six segments (the last one triangular, terminating in an acute point, and having a rudely semicircular pit just above the middle); side lobes with five ribs on each side, all extending beyond the margin and terminating in flattened pointed spines. The last two ribs are parallel with the axis; the next two diverge a little but are still a little parallel; the three anterior pairs diverge more widely, the anterior being at right

angles to the axis for about half the length, the outer half curved backwards. In some specimens the anterior ribs are broadly curved, for the inner half. The spinose terminations of the ribs are separated from each other about the width of the rib. The length of the pygidium, measuring to the tips of the spines, is a little more than half the width.

"The surface appears to be finely tubercular."

A comparison of this species with the description and illustration of Pliomerops barrandei (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 of the 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.

No pygidia were reported in association with the specimens from Nevada. Several characteristic pygidia have been found in association with the specimens from the Mazourka formation.

Horizon and locality: Chazy of Quebec; Point Rich, Table Head, Boone Bay, and other localities, Newfoundland; this is the most abundant trilobite in the Mazourka formation, occurring at nearly all localities, Inyo mountains, California.

SUBCLASS Eucrustacea Kingsley

SUPERORDER Ostracoda Latreille

FAMILY Leperditiidae Jones

GENUS Leperditia Roualt

Leperditia bivia White

Leperditia bivia White, Rep. U. S. Geogr. Surv. West 100th. Merid., 4, 1897, p. 58, pl. 3, figs. 7a,d. --Walcott, U. S. Geol. Surv. Mon. 8, 1884, p. 88.

Several specimens of Leperditia bivia White have been collected from the Mazourka formation. The presence of two large pores at the ventral border of the right valve which White mentioned in his original description has not been observed in the specimens at hand, but this is probably due to the fact that the borders have been somewhat obscured

by weathering. The angles at the end of the hinge line and the laterally flattened anterior and posterior borders are very prominent in the better preserved specimens. The surface is comparatively smooth. The eye tubercule has not been detected.

Horizon and locality: Type specimens from Schell Creek range, Nevada; Upper Pogonip, Eureka district, Nevada; Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

Leperditia nana Jones

Leperditia canadensis, var. nana Jones, Geol. Surv. Canada 1858, p. 92, pl. 2, figs. 6,7,9,10.
Leperditia nana Rayomnd, Ann. Car. Mus., 7, 1911, p. 254.
For full synonymy see R. S. Bassler, Bull 92, U.S.N.M.

Two small specimens collected from the Mazourka formation agree well with Raymond's description of Leperditia nana, although no illustrations of the species were available. In the Mazourka specimens no muscle scars or eyes spots have been observed. The height of the shell is very little greater at the back than at the front. Dimensions: length 2mm., height 1mm. L. nana Jones differs from L. bivia

White, which also occurs in the Mazourka formation, in being a much smaller species, and also in having a slightly different shape.

Horizon and locality: Canadian beds of Greenville,, Quebec; Chazy of Valcour Island, New York; Mazourka formation, in Mazourka canyon at the Elbow, Inyo mountains, California.

Descriptions of Species Occurring in the Barrel Springs Formation

PHYLUM Molluscoidea

CLASS Brachiopoda Dumeril

ORDER Protremata Beecher

SUPERFAMILY Orthacea Walcott and Schuchert

FAMILY Orthidae Woodward

SUBFAMILY Orthinae Shhuchert and Cooper

GENUS Orthis Dalman

Orthis tricenaria Conrad

Orthis tricenaria Conrad, Proc. Acad. Nat. Sci. Philadelphia, 1, 1843, p. 333. --Hall, Pal. New York, 1, 1847, p. 121, pl. 32, fig. 8. --Walcott, Mon. U. S. Geol Surv., 8, 1884, p. 74, pl. 11, fig. 4.

For full synonymy see R. S. Bassler, Bull. 92, U.S.N.M.

Several more or less fragmentary specimens of Orthis tricenaria Conrad from the Barrel Springs formation show between 35 and 40 simple plications on both valves. No growth lines are preserved. In some specimens of the brachial valve a faint mesial sinus is present.

Horizon and locality: Weller says that this form always indicates a lower Trenton horizon in New Jersey; Trenton of New York; Pogonip of Nevada; Barrel Springs formation, in Barrel Springs canyon about one-half mile east of Barrel Springs, Inyo mountains, California.

Orthis decipiens sp. nov.

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 cotype at the hinge is 10mm., at the anterior margin the width is somewhat less. The length is 6mm. 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 from 22 to 24 simple rounded plications. At the anterior margin there are three plications to two millimeters. Pedicle valve and internal characteristics unknown.

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. minisculus Phleger, from the Mazourka formation of the Inyo mountains, California, in having a greater number of plications per unite width at the anterior margin. It also lacks the distinct and continuous mesial sinus of O. minisculus. It differs from O. euryone Billings, from the Canadian beds of Quebec, mainly in the convexity of the brachial valves, and also in having fewer plications.

Horizon and locality: Barrel Springs formation, in Barrel Springs canyon about one-half mile east of Barrel Springs, Inyo mountains, California.

SUPERFAMILY Stophomenacea Schuchert

FAMILY Strophomenidae King

SUBFAMILY Rafinesquinae Schuchert

GENUS Plectambonites Pander

Plectambonites angulatus sp. nov.

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 15mm., width at hinge area 21mm., length 10mm. Surface finely striated, with three to four plications 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 bi-lobed 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 adductor areas are nearly straight with a very slight tendency to be curved in part.

Plectambonites angulatus differs from P. curdsvillensis Foerste, from the Trenton 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 unite 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: Fairly common in the Barrel Springs formation, in Barrel Springs canyon one-half mile east of Barrel Springs, Inyo mountains, California.

PHYLUM Mollusca

CLASS Cephalopoda

SUBCLASS Tetrabranchiata Owen

ORDER Nautiloidea

FAMILY Orthoceratidae M'Coy

GENUS Orthoceras Breyn

Orthoceras sp. ind.

A small, badley weathered Orthoceras was collected from the Barrel Springs formation. Only the general outline of the shell and siphuncle is preserved; the siphuncle projects forward from the shell outline, but this is probably due to differential weathering. The reconstructed length of the specimen is 20mm., and in this length it widens to a

diameter of 4mm. About 8mm. of the posterior end of the shell is not occupied by the siphuncle. No surface markings can be observed.

Horizon and locality: Barrel Springs formation, in Barrel Springs canyon about one-half mile east of Barrel Springs, Inyo mountains, California.

PHYLUM Arthropoda

CLASS Crustacea

SUBCLASS Trilobita Walch

ORDER Opisthoparia Beecher

FAMILY Remopleuridae Corda

GENUS Remopleurides Portlock

Remopleurides occidens sp. nov.

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 anteriorly. 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 preserved as a distinct unit. One specimen shows a pygidium which is produced in two pairs of short spines curving sharply to a directly posterior direction.

Measurements of Cotypes

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

Remopleurides occidens is closely related to R. canadensis Billings, but it differs in being more convex and in lacking glabellar furrows. R. missouriensis Foerste

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 differs from R. occidons 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 trilobite in the Barrel Springs formation, in Barrel Springs canyon, Inyo mountains, California.

FAMILY Asaphidae Burmeister

SUBFAMILY Asaphinae Raymond

GENUS Isotelus DeKay

Isotelus gigas DeKay

Isotelus gigas DeKay, 1824, Annals Lyceum Nat. Hist. New York, 1, p. 174, pl. 12, fig. 1; pl. 13, fig. 1.

For full synonymy see R. S. Bassler, Bull. 92, U.S.N.M.

Weller says in his description of Isotelus gigas from New Jersey that the glabella is obscurely defined. Two specimens from the Barrel Springs formation have glabellas that are fairly well-defined posteriorly but not

so well-defined anteriorly. The anterior border of the cranidium is somewhat less broadly rounded than in the specimens from New Jersey. One of the distinctive features of the specimens from the Barrel Springs formation is the presence of a distinct nipple-like protuberance made at the anterior margin of the cranidium where the facial sutures meet.

The lobation of the pygidia varies with size. In the small specimens lobation is distinct, and there is a suggestion of segmentation; in the larger specimens the lobation is less distinct and the segmentation is entirely lacking; in the largest specimens both lobation and segmentation are entirely absent.

The hypostoma is a subquadrate to suboval body, lenticular in section, taporing to two abruptly-rounded spine-like points, with a deep, widely rounded buccal notch between them. On the dorsal surface a distinct ridge extends from the end of the spines anteriorly to a point slightly forward of the buccal notch; the surface from the ridge slopes abruptly to the outside margin and more gently inward to the buccal area. Muscle scars small, round, situated well forward from the buccal notch.

Measurements of Plesiotype

Cranidium

Length	16mm.
Width at palpebral lobes	12mm.
Width at posterior margin	21mm.

Pygidium	Small	Average	Large
Width	14mm.	20mm.	27mm.
Length	9mm.	13mm.	17mm.

Hypostoma

Width	6mm.
Length	6mm.
Length of spine	3mm.

Horizon and locality: Trenton of New York and New Jersey; Barrel Springs formation, in Barrel Springs canyon about one-half mile east of Barrel Springs, Inyo mountains, California.

Isotelus spurius sp. nov.

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 on one mold of a pygidium.

Measurements of Cotype

Cephalon	
Length	9mm.
Width	17mm.
Distance from eyes to posterior margin	4mm.
Distance between eyes	7mm.
Pygidium	
Length	7mm.
Width	13mm.

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 median part of the cranidium, however, 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 lobe of the thorax.

Horizon and locality: Barrel Springs formation, in Barrel Springs canyon about one-half mile east of Barrel Springs, Inyo mountains, California.