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THE SEVY DOLOMITE OF NEVADA

Invertebrate Paleontology
Earth Sciences Division
Natural History Museum

BY

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PROBABLE LUDLOVIAN BRACHIOPODS FROM THE SEVY DOLOMITE OF NEVADA

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ABSTRACT—A thick section of Sevy Dolomite in the Pahrana-gat Range of southeastern Nevada has yielded a small fauna of brachiopods from a horizon approximately 90 feet above the base of the formation. Eleven species are described and illustrated and three of these are new: *Gypidula? biloba*, *Ferganella? lincol-nensis*, and *Atrypella carinata*. The assemblage from the Pahrana-gat Range finds its closest faunal affinities with forms from southeastern Alaska, from Podolia, and from the Ural Mountains of the USSR. In these areas, deposits with similar brachiopods are of Late Silurian (Ludlow) and earliest Devonian (Skala) age. The reported occurrences of *Halysites*, however, favor a Ludlovian assignment for lower Sevy rocks.

The underlying Laketown Dolomite has yielded fossils from a horizon previously reported on by Waite (1956). One diagnostic species, *Protathyris hesperalis*, is reassigned to *Hyattidina* and Waite's suggested correlation with the Borszczów beds of Podolia is abandoned because the fauna from the overlying Sevy beds is of pre-Borszczów age.

INTRODUCTION

THE widespread Sevy Dolomite of western Utah and eastern Nevada has proved nearly barren of recoverable fossils in the past. Its age has been estimated to range from Silurian to Middle Devonian based on lithostratigraphic considerations. In the course of detailed stratigraphic investigations in the Pahrana-gat Range in southeastern Nevada, Reso discovered and collected a small brachiopod fauna from a horizon approximately 90 feet above the base of the very thick section of Sevy Dolomite exposed there. Because the maximum thickness of 1578 feet of Sevy Dolomite is attained in the Pahrana-gat Range (Reso, 1962, p. 251) the age determined by the fossils described and illustrated in this paper probably represents nearly a maximum for the formation and taken in conjunction with Johnson's correlations of the higher Lower Devonian zones (1962b) effectively delimits the age relations of the Sevy. In the course of his field studies, Reso has also collected fossils from the upper member of the Laketown Dolomite (text-fig. 1) at horizons equivalent to the one from which Waite (1956) previously described several brachiopod species.

In the preparation of this paper Reso was responsible for the identification of the stratigraphic position of the various rock units from which fossils were recovered and for their collection. Johnson has prepared the sections on systematic paleontology and correlation of the brachiopod faunas.

We wish to thank Dr. W. A. Oliver, Jr. of the U. S. Geological Survey for identification of corals from the Laketown Dolomite, and Mr.

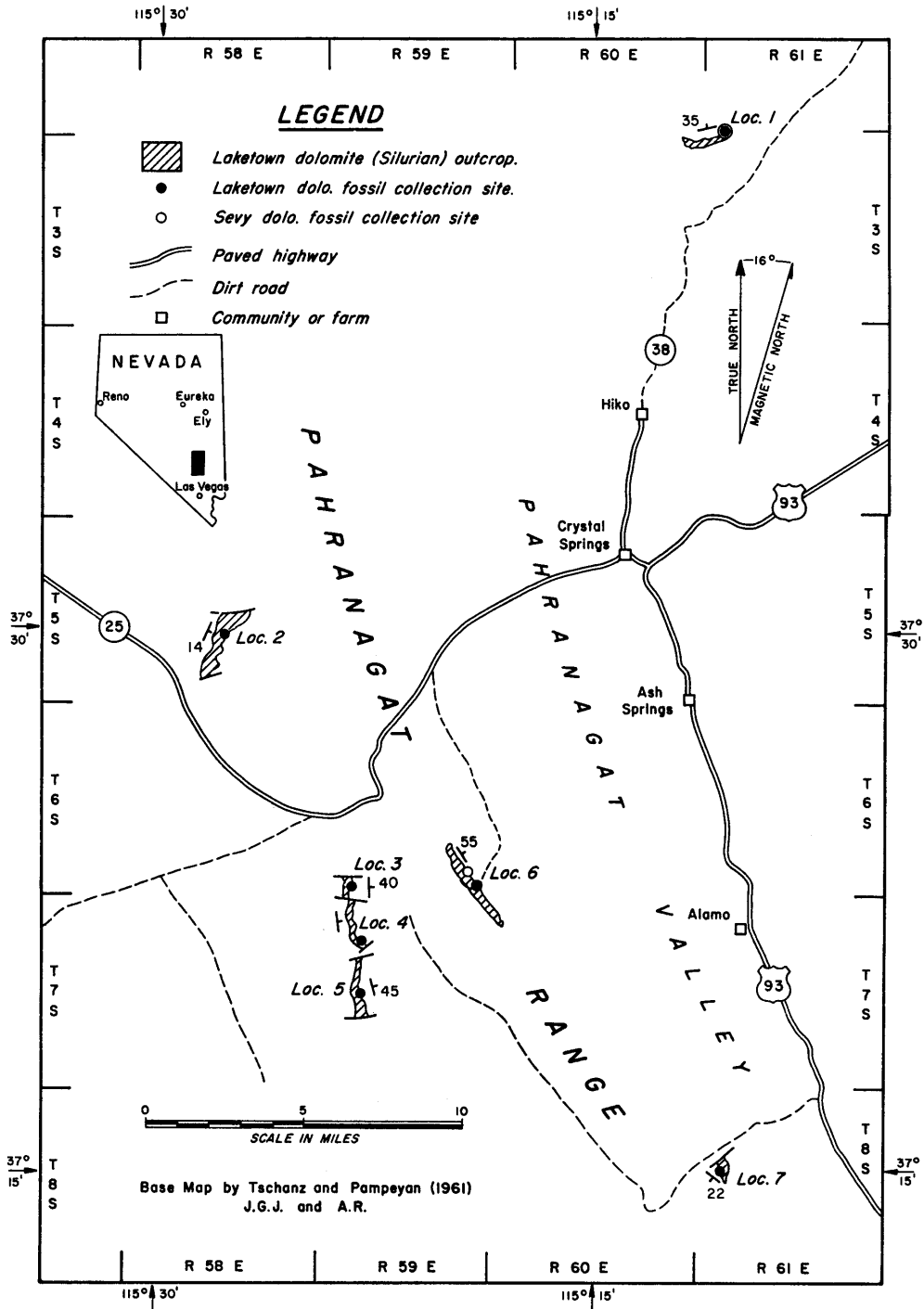
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Takeo Susuki, Department of Geology, UCLA, for photographing the fossil specimens. Our work was also greatly facilitated by loan of fossils from the U. S. National Museum through the courtesy of Dr. G. A. Cooper and from the Museum of Paleontology, University of California, Berkeley through the cooperation of Joseph H. Peck. In addition we are indebted to Professor A. J. Boucot of the California Institute of Technology for critically reading the manuscript and for discussions with Johnson dealing with some of the problems of correlation and systematics of Siluro-Devonian brachiopods. The conclusions presented here, however, are entirely the responsibility of the writers.

STRATIGRAPHY LAKETOWN DOLOMITE

Correlation.—New collections from six localities within the upper member of the Laketown Dolomite, together with the discovery of the basal Sevy fauna reported here necessitates a re-evaluation of the age of the upper Laketown previously discussed by Waite (1956). The Laketown collections yield no forms that are significant for precise age assignment. The transfer of "*Protathyris*" *hesperalis* Waite to *Hyattidina* removes most of the paleontologic evidence for a Ludlow age of the upper Laketown in the Pahrana-gat Range, but from regional considerations the Ludlovian assignment still appears to be the most plausible.

The second Laketown locality reported by Waite (1956, p. 15) at Kings Canyon, Millard County, Utah yields a different fauna of uncertain age. Waite reported *Mesodouvillina geniculata*, *Howellella pauciplicata* and *Camarotoechia pahrana-gatensis* from the Kings Canyon locality.



TEXT-FIG. 1—Index map showing fossil collection sites in the Laketown and Sevy Dolomites, Pahranaगत Range, Nevada.

TABLE 1—FOSSILS FROM THE UPPER LAKETOWN DOLOMITE IN THE PAHRANAGAT RANGE*

Fossil	L2-31	L2-32	L3-27/28	L5-16	L5-17	L6-15
<i>Halysites</i> sp.						X
<i>Favosites</i> sp.						X
<i>Breviphyllum?</i> sp.						X
<i>Disphyllum?</i> sp.	X					X
<i>Clavidictyon</i> sp.						X
" <i>Cladopora</i> " sp.						X
indet. dalmanellid spp.						X
<i>Atrypa</i> spp.		?	X	X		X
<i>Howellella</i> cf. <i>nucula</i> (Barrande)			X			X
<i>Howellella</i> sp.						X
<i>Hyattidina hesperalis</i> (Waite)			X	X	?	?
<i>Camarotoechia pahrnagatensis</i> Waite		X	X		X	
indet. rhynchonellid sp. A.			X		X	
indet. rhynchonellid sp. B.						X

* Corals identified by W. A. Oliver, Jr., U. S. Geological Survey.

The first two named forms were neither reported from the Pahrnagat Range Laketown by Waite, nor were they found by the writers. *Camarotoechia pahrnagatensis* however, is a common form at the localities on the west side of the Pahrnagat Range. Waite's collections were borrowed from the Museum of Paleontology, University of California, Berkeley. Examination did not reveal any rhynchonellids in the Utah collection (B-1408) and a letter to Mr. Waite failed to reveal the whereabouts of the reported specimens. Of the other two Utah brachiopods,

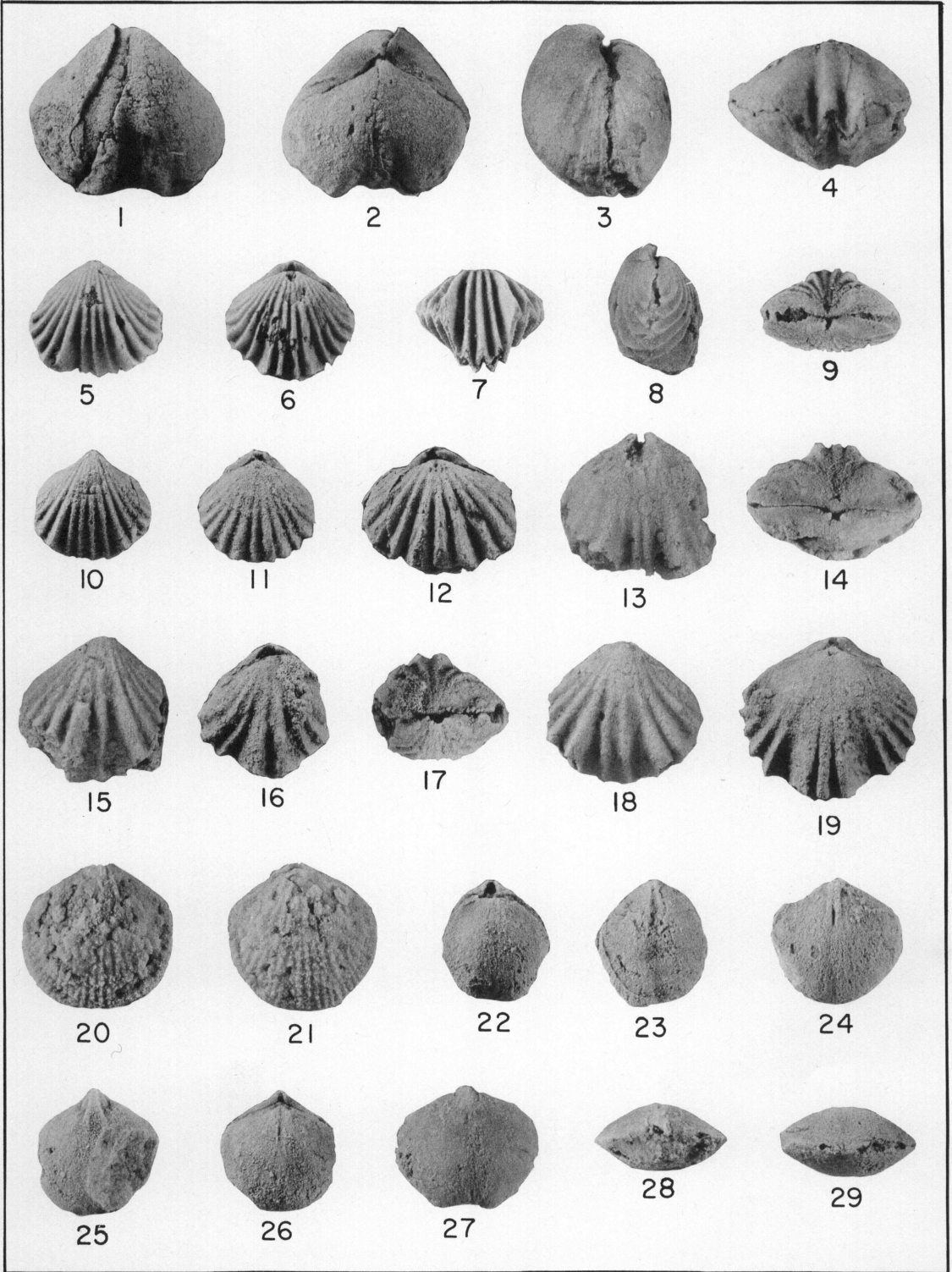
Howellella pauciplicata is found in the Sevy of Nevada rather than in the Laketown, which suggests that the Utah Laketown of Waite may be younger than the Laketown in the Pahrnagat Range. However, in the opinion of the writers, if the reported occurrence of *C. pahrnagatensis* can be reaffirmed at the Utah locality, Waite's original correlation should stand because *H. pauciplicata* may be widely distributed stratigraphically.

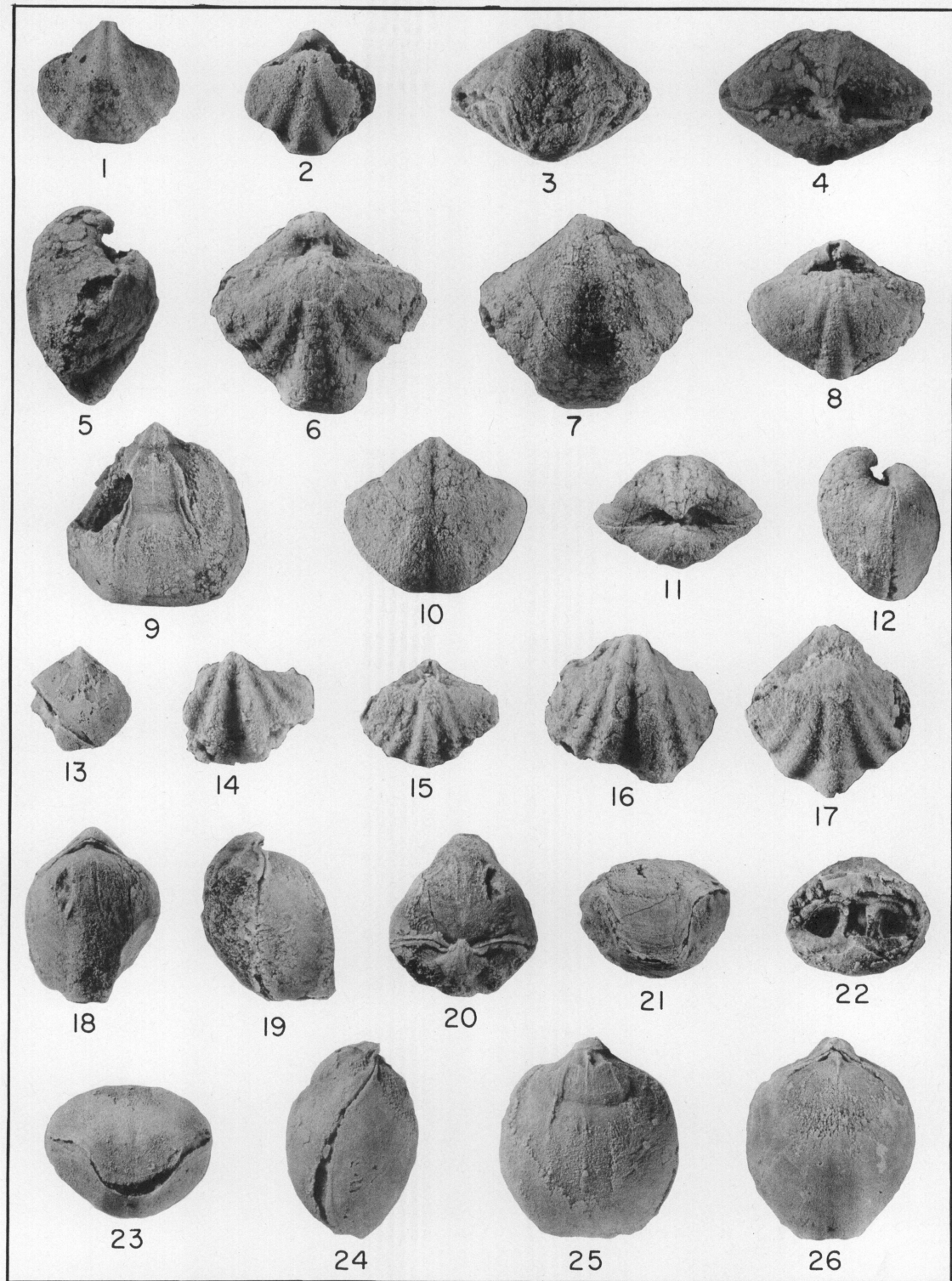
Examination of table 1 and text-figure 1 reveals that the upper Laketown coral-bearing

EXPLANATION OF PLATE 19

All figures $\times 2$

- FIGS. 1-3—*Gypidula? biloba* Johnson n. sp., holotype (UCLA 35048) pedicle, brachial, and lateral views.
 4—*G? biloba* Johnson n. sp., paratype (UCLA 35049) anterior view.
 5-8—*Ferganella? lincolnensis* Johnson n. sp., holotype (UCLA 35050) pedicle, brachial, anterior and lateral views.
 9—*F? lincolnensis* Johnson n. sp., paratype (UCLA 35051) posterior view.
 10—*F? lincolnensis* Johnson n. sp., paratype (UCLA 35052) pedicle view.
 11—*F? lincolnensis* Johnson n. sp., paratype (UCLA 35053) brachial view.
 12—*F? cf. lincolnensis* Johnson n. sp., paratype (UCLA 35054) brachial view.
 13—*Camarotoechia? cf. reesidei* Kirk & Amsden (UCLA 35059) pedicle view.
 14,19—*Camarotoechia? reesidei* Kirk & Amsden (UCLA 35058) posterior and brachial views.
 15—*C? reesidei* Kirk & Amsden (UCLA 35056) pedicle view.
 16,17—*C? reesidei* Kirk & Amsden (UCLA 35055) brachial and posterior views.
 18—*C? reesidei* Kirk & Amsden (UCLA 35057) pedicle view.
 20,21—*Atrypa* sp. (UCLA 35060) pedicle and brachial views.
 22,23—*Hyattidina hesperalis* (Waite) (UCLA 35075) brachial and pedicle views of internal mold.
 25,26—*H. hesperalis* (Waite) (UCLA 35077) pedicle and brachial views of internal mold.
 27,28—*H. hesperalis* (Waite) (UCLA 35076) pedicle and posterior views (apparent sulcation due to breakage).
 24,29—*Nucleospira hecetensis* Kirk & Amsden? (UCLA 35074) pedicle and anterior views of internal mold.





collections, referred to here as the *Breviphyllum*? fauna with *Howellella* cf. *nucula* at locality 6 and occurring without associated brachiopods at localities 1 and 7 on the east side of the range, compose a different assemblage than generally accompanies *C. pahrnagatensis* at western localities 2-5. The two faunas are judged to be stratigraphically distinct even though they have not been found in sequence at a single locality. Their relative age is as yet uncertain.

SEVY DOLOMITE

Faunal composition.—All of the brachiopod species described and illustrated in this paper come from a single small collection of about 300 individuals taken from the Sevy Dolomite (UCLA loc. 4498; loc. 6, text-fig. 1). The specimens are in nearly all cases silicified completely through the core and are found free, or have been etched free with acid.

No corals were found at the collecting locality and the only non-brachiopod is a single high-spired gastropod of the *Loxonema* type. The brachiopod assemblage is remarkable by the total absence of orthoid and strophomenoid genera, and is dominated by the spire-bearers and rhynchonellids. In addition there are a few gypidulinid specimens.

Age and Correlation.—The basal Sevy fauna is isolated stratigraphically and geographically and therefore cannot be integrated into any provincial zonal scheme. It has nothing in common with the much younger fauna (of probable

Siegenian or late Gedinnian age) of the Rabbit Hill Formation (Johnson and Masursky, in preparation).

Faunal affinity with more distant areas is found in the direction of Alaska and the Ural Mountains of the USSR rather than with the eastern part of North America. Because of these affinities, some preliminary remarks can be made concerning the expected correlations and a tentative age-assignment can be made.

The most obvious and immediate correlation is with a small brachiopod collection described from Heceta Island, southeastern Alaska by Kirk and Amsden (1952, locality 2689). The two faunas are very similar in generic composition and have several species in common. However, the Alaskan collection is of uncertain age and is of little value for a precise age assignment. Faunas from the other localities which bear pentamerinids described by Kirk and Amsden are very different and may be from wholly different horizons than faunas here considered.

Berry and Boucot (1962, p. 25) state that the Sevy brachiopods are similar to those from the Gazelle Formation of northern California, a statement evidently based on the presence of *Atrypella* in both formations. However, examination of the Gazelle brachiopods collected by Churkin (1961) fails to show any further similarities.

The faunal similarity with Uralian assemblages described by Khodalevich (1939) is remarkable considering the geographic separation.

EXPLANATION OF PLATE 20

Atrypella specimens $\times 1$, all others $\times 2$

- FIGS. 1,2—*Macrolepura*? sp. (UCLA 35068) pedicle and brachial views.
 3-7—*Macrolepura*? sp. (UCLA 35067) anterior, posterior, lateral, brachial, and pedicle views.
 8—*Howellella pauciplicata* Waite (UCLA 35070) brachial view.
 10-12—*H. pauciplicata* Waite (UCLA 35069) pedicle, posterior, and lateral views.
 14—*Howellella* cf. *nucula* (Barrande) (UCLA 35072) pedicle view.
 15—*H. cf. nucula* (Barrande) (UCLA 35073) brachial view.
 16,17—*H. cf. nucula* (Barrande) (UCLA 35071) pedicle and brachial views.
 9—*Atrypella* cf. *carinata* Johnson n. sp. (UCLA 35065) pedicle view.
 13—*Atrypella* sp. B (UCLA 35066) pedicle view.
 18-20—*Atrypella carinata* Johnson n. sp., holotype (UCLA 35061) brachial, lateral and posterior views.
 21,22—*A. carinata* Johnson n. sp., paratype (UCLA 35063) anterior and posterior views of specimen; umbo removed to show disposition of the spiralia.
 23-26—*A. carinata* Johnson n. sp. paratype (UCLA 35064) anterior, lateral, pedicle, and brachial views.

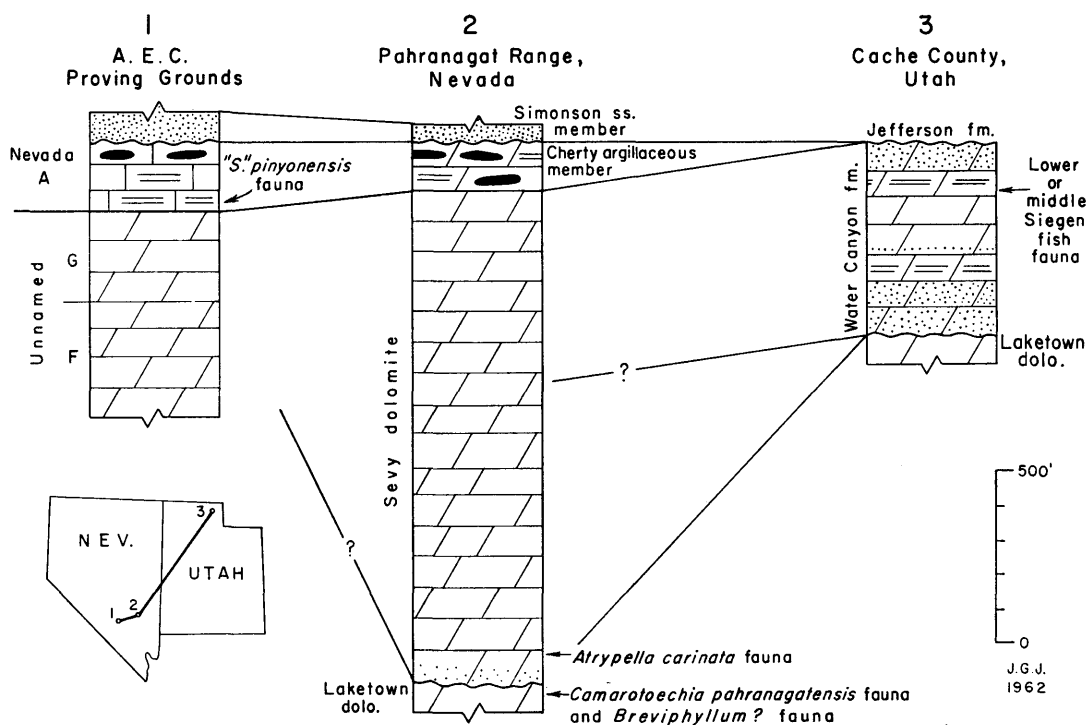
The Sevy fauna however has its affinities about equally divided between the "Striatus" and "Marginalis" horizons. The "Marginalis" beds of the eastern Urals probably are of Skala and Gedinne age and the "Striatus" beds presumably are of Ludlow age. The indicated correlation would be approximately upper Ludlow or lower Skala. *A. prunum* (Dalman) the type species of *Atrypella*, was reported in the Skala of Podolia (Kozłowski, 1929) and the genus is reported to be present above and below beds with *Monograptus ultimus* in the Arctic (Thorsteinson, 1958). Nikiforova (1954) shows that "*Lissatrypa prunum* (His.)" ranges through the Malinovetski and Skala beds of Podolia, but strong specific resemblance is found only with forms illustrated from the Malinovetski beds, thus correlation based on *Atrypella carinata* alone would indicate a pre-Skala age.

It appears that there is not yet conclusive evidence based on brachiopods leading to a choice between a late Ludlow (Silurian) or early Skala (Devonian of pre-Gedinnian age according to Boucot, 1960) age assignment, but since the base of the Sevy appears regionally to be below *Halysites*, the fauna is tentatively assigned to the Silurian.

Age of the Sevy Dolomite.—At the time the Sevy Dolomite was defined by Nolan (1935) it was assigned a tentative Middle Devonian age because it is overlain by the Simonson Dolomite containing Middle Devonian fossils. However, at that time, no diagnostic fossils had been recovered from the Sevy. In 1953 little more evidence had been brought to light and the Eastern Nevada Geological Association Stratigraphic Committee (Easton *et al.*) regarded the Sevy as the oldest of three Devonian formations in west Utah.

Osmond (1954) in his lithostratigraphic studies, recognized the Sevy throughout a broad area in eastern Nevada. Osmond gave the first report of fossils pertinent to an age determination when he recorded "*Halysites* sp. cf. *H. catenularia* Linné" from the lower part of the Sevy in the Egan Range (1954, p. 1928). He concluded that "a late Silurian age seems probable for the lower part of the Sevy; the upper part may be early Devonian" (1954, p. 1929).

In the same paper Osmond transferred the basal Simonson sandstone (Nolan, 1935) to the Sevy by which the age of the upper Sevy was affected, although there was then no evidence to date these beds.



TEXT-FIG. 2—Correlation of the Sevy Dolomite with important fossil-bearing sections in Nevada and Utah. Column 2 is a composite section.

Carlisle and others (1957) discussed the age of the Sevy in light of their investigation of fossiliferous limestones that interfinger with Sevy-like rocks in the Sulphur Spring Range. They showed that Osmond had been incorrect in assuming that the lower part of the Nevada Formation was younger than the Sevy and that the Sevy was instead the dolomite facies of the Lower Devonian McColley Canyon Formation (then the lower member of the Nevada Formation).

The weight of the evidence from the Sulphur Spring Range led Osmond (1957) to abandon his Silurian age assignment and an Early Devonian age has been accepted by a number of recent workers. Indeed Langenheim and others (1960 p. 66) believed that the Egan Range *Halysites* reported by Osmond must have come from the Laketown Dolomite.

Rush (1956) in studying the pre-Simonson beds of Millard County, Utah, established new names for two stratigraphic units just below the Simonson. The lower of these, the Decathon Dolomite, yields *Halysites* sp. (Rush, 1956, p. 25) and the unit probably may be regarded as a lower member of the Sevy. Rush (1956, p. 26) believes that the Decathon is lithologically related to the Kings Canyon Dolomite (Sevy) above and Osmond (1962) also believes that the Decathon resembles Sevy rocks.

The Lower and Middle Devonian zones of central Nevada were revised by Johnson (1962a) and the data pertinent to dating the upper part of the Sevy were discussed (Johnson, 1962b). These studies showed that the youngest beds below quartz sandstones at the contact with the overlying Simonson Dolomite are Lower Devonian and that the quartz sandstones are Middle Devonian.

The Water Canyon Formation of northern Utah (Williams, 1948) has come to be regarded as a facies of the Sevy (Williams, 1948; Rigby, 1958, p. 35; Osmond, 1962). The fish fauna of the Water Canyon therefore bears on the age assignment of the Sevy. Denison has described the Water Canyon fauna and in his latest summary (Denison, 1958) he assigns it an early or middle Siegenian (late Early Devonian) age.

This short summary together with the evidence from the Pahranaagat Range collections shows that the Sevy Dolomite ranges in age from Late Silurian to Early Devonian at the thicker sections. Where the Sevy is thin, probably only the Early Devonian is represented. The Sevy is unconformably overlain by Middle Devonian beds which are characterized at many localities by quartz sand. Text-figure 2 shows correlations of several important fossil-bearing sections.

SYSTEMATIC PALEONTOLOGY

Phylum BRACHIOPODA

Class ARTICULATA

PENTAMERACEA Schuchert, 1896

Family PENTAMERIDAE

Subfamily GYPIDULINAE

GYPIDULA Hall, 1867

Type species: Pentamerus occidentalis Hall, 1858, p. 514, pl. 6, fig. 2.

Diagnosis.—Gypidulinae with ventral fold and with cruralium lacking septal support. Shells with or without simple plications.

Discussion.—One specimen exhibits a spondylium but it has not been possible to examine the brachial plates. Tentative assignment is made to *Gypidula* rather than *Sieberella* because comparable species belong to the former genus. However, the recently defined gypidulinid genus *Levigatella* Andronov, 1961 (p. 38, pl. 1) may be congeneric with the Sevy shells, but their assignment should await elucidation of their inner structures.

GYPIDULA? BILOBA Johnson, n. sp.

Pl. 19 figs. 1-4

Diagnosis.—Transverse gypidulinids with a medially grooved fold and a single plication within the sulcus. No plications on the flanks.

Description.—Pedicle valve highly convex. Beak strongly incurved and with pedicle valve curving regularly toward the anterior. Greatest width anterior to mid-length. Brachial beak less strongly incurved, pointing just beneath the pedicle beak. Curvature not so strong anterior to the umbo. Fold and sulcus originate anterior to the beak. There appears to be some variation in the point of origin of the median groove in the fold and the median plication in the sulcus. On most small specimens these latter features are not developed, but on the holotype the median groove appears to originate posterior to the fold.

Comparison.—*Gypidula? biloba* most resembles "*Sieberella*" *biplicata* Poulsen (1943, p. 27, pl. 2, figs. 21-24). The latter appears slightly less inflated ventrally and has a more widely flaring sulcus. Also similar to *G? biloba* is a specimen from the "Marginalis" beds of the east slope of the Urals described by Khodalevich (1939) as *Gypidula problematica* var. *crassa* (p. 92, pl. 16, fig. 1). *Gypidula? biloba* may be distinguished from *G. crassa* by the narrower fold and more sharply incised furrow on the former.

"*Pentamerus*" *nucleus* Hall and Whitfield, 1875 (Hall & Clarke, 1893, pl. 72, figs. 1-3) and "*Pentamerus*" *problematicus* Barrande, 1879 (pl. 20, figs. 3-5) both resemble *Gypidula? biloba*, but these species are characterized by

plication of the flanks in addition to the medial portions.

Measured specimens.—Of the thirteen specimens of *Gypidula? biloba* in the Sevy collection, four are well enough preserved for measurement. Their dimensions in mm are as follows: UCLA 35048 (holotype) length 11.4, width 13.9, thickness 10.1. Paratype 2: length 12.1, width 13.6, thickness 9.9. Paratype 3: length 9.8, width 12.8, thickness 7.7. Paratype 4: length 9.4, width 10.8, thickness 7.0.

CAMAROTOECHIACEA Havlíček, 1960

Family RHYNCHOTREMATIDAE

Subfamily RHYNCHOTREMATINAE

FERGANELLA Nikiforova, 1937

Type species.—*F. turkestanica* Nikiforova, 1937, pl. 7, fig. 10.

Diagnosis.—Plicate rhynchonellids with dental lamellae, brachial median septum and septalium which bears a median blade-like cardinal process.

Discussion.—The Sevy specimens are allied with *Ferganella* or with *Stegerhynchus* according to their external configuration. Impressions of the dental lamellae and the brachial septum can be seen on several specimens, but the septalium has been obliterated by silicification of the matrix core. In the absence of critical internal structures, assignment is made to *Ferganella* because of specific resemblance to illustrated forms of the *Ferganella borealis* group occurring in the Ural Mountains (Khodalevich, 1939) and in Central Asia (Nikiforova, 1937).

FERGANELLA? LINCOLNENSIS Johnson n. sp.
Pl. 19, figs. 5-12

Diagnosis.—Transverse ferganellids with three, four, or five angular plicae on the fold and three, four, or five angular plicae on each flank of the brachial valve.

Description.—The holotype bears four plicae on the fold and three in the sulcus. There are five plicae on each flank of the brachial valve and six on each flank of the pedicle valve. The brachial valve is the more convex. The pedicle beak is moderately incurved. Shells with four plicae on the fold are the most common and those with five are relatively rare. One shell with three plicae on the fold has anomalously coarse and rounded plicae (pl. 19, fig. 12).

Material.—Forty-five silicified specimens.

Figured specimens.—Four specimens have the following dimensions in mm: UCLA 35050 (holotype) length 8.3, width 9.7, thickness 6.5; UCLA 35051 length 8.9, width 9.8, thickness 5.4; UCLA 35052 length 8.1, width 8.7, thickness 5.0; UCLA 35053 length 7.9, width 8.3, thickness 5.2.

Family CAMAROTOECHIIDAE

Subfamily CAMAROTOECHIIINAE

CAMAROTOECHIA Hall & Clarke, 1893

Type species.—*Atrypa congregata* Conrad, 1841, p. 55

Diagnosis.—Plicate rhynchonellids with dental lamellae, brachial median septum and a septalium which is more or less covered by the inner hinge plates. Dental sockets crenulated.

CAMAROTOECHIA? REESIDEI Kirk & Amsden,
1952

Pl. 19, figs. 13-19

Camarotoechia reesei Kirk & Amsden, 1952, p. 57, pl. 8, figs. 1-7.

Description.—There are three small specimens in the Sevy collection with one plica in the sulcus and two on the fold. Seven specimens of slightly larger average size bear two plicae in the sulcus and three on the fold. The larger specimens are often smooth or nearly so on the umbones. The brachial valve is the most convex and the pedicle beak is only slightly incurved. Characteristically, the plicae on the fold are closely set together and distinctly set off from those on the flanks by the height of the fold and the slope of its flanks. Internal structures were not observed in the Sevy specimens and since the presence of crenulate dental sockets has not yet been demonstrated for *C? reesei* the generic assignment must be regarded as tentative.

Comparison.—*Camarotoechia? reesei* specimens of Kirk and Amsden were borrowed from the U. S. National Museum. UCLA 35055 was found to closely resemble USNM 116571 which has a better preserved plica on the sulcus than the holotype.

Figured specimens.—Four specimens from the Sevy collection have the following dimensions in mm: UCLA 35055 length 9.2, thickness 6.5; UCLA 35056 length 10.3, width 10.7, thickness 7.9; UCLA 35057 length 10.1, width 11.1, thickness 6.2; UCLA 35058 length 11.0, width 12.7, thickness 7.1.

ATRYPACEA Schuchert & LeVene, 1929

Family ATRYPIDAE

Subfamily ATRYPINAE

ATRYPA Dalman, 1828

Type species.—*Anomia reticularis* Linnaeus, 1758 (in part) p. 702, no. 195 excl. Mus. Tess. pl. 5, fig. 5.

Diagnosis.—Atrypaceans bearing anteriorly bifurcating costae and growth lines of variable strength. Dental lamellae lacking. Pedicle muscle field broad, flabellate. Inner hinge plates and brachial median septum lacking. Dental sockets crenulate. Striate area for diductor attachment present in brachial valve.

ATRYPA sp.
Pl. 19, figs. 20, 21

Description.—Outline subcircular; transverse, or with length approximately equal to the width. Subequally biconvex, lenticular in profile. Preservation of the pedicle beak is insufficient in all of the Sevy specimens to ascertain its curvature. It appears to have been small and only slightly projecting beyond the beak of the brachial valve. Fold and sulcus are absent, but at the anterior the commissure is gently deflected toward the brachial valve in a broad smoothly-rounded arc. The costae are of slightly greater strength than the growth lamellae.

Material.—Nineteen silicified specimens.

Figured specimen.—UCLA 35060 has the following dimensions in mm: length 10.4, width 10.7, thickness 6.2.

Subfamily LISSATRYPINAE
ATRYPELLA Kozłowski, 1929

Type species.—*Atrypa prunum* Dalman, 1828, pl. 5, fig. 2.

Diagnosis (based on Sevy specimens).—Subequally biconvex, smooth atrypaceans with sulcate pedicle valve and folded brachial valve. Spiralia dorso-medially directed. Dental lamellae lacking. Pentagonal delthyrial cavity set off by a yoke-like transverse ridge which is bisected by a medial groove connecting the delthyrial cavity with the anterior regions (see pl. 20, fig. 25). Long, narrow, pedicle diductor muscle tracks slightly impressed and divergent anteriorly. Brachial valve lacks a myophragm, but may bear a short medial groove in the posterior region, a feature possibly dependent on the mode of preservation. Hinge plates discrete, with their inner edges diverging at about 60 degrees from one another.

Discussion.—The Sevy specimens appear to be congeneric with *A. prunum* because of size-shape and structural relations. However, the musculature of the type species is relatively poorly known. *AtryPELLA tenuis* of Kirk and Amsden may be generically distinct because of the presence of a prominent brachial myophragm, its unyoked delthyrial cavity, and its more lenticular form. Inspection of serial sections of *AtryPELLA borealis* Kirk and Amsden (1952, fig. 6) reveals that that species has massive hinge plates as in *Lissatrypa* and *Glassia* and is probably most closely related to the latter genus rather than to *AtryPELLA*.

The possible synonymy of *AtryPELLA* and *AtryPOIDEA* Mitchell & Dun, 1920, is still to be investigated, the internal structures of *AtryPOIDEA* being largely unknown.

Material.—There are more than fifty-six

specimens of *AtryPELLA* in the Sevy collection, but not all are so well preserved as to be specifically identifiable.

ATRYPELLA CARINATA Johnson n. sp.
Pl. 20, figs. 9, 18–26

Diagnosis.—*AtryPELLA* specimens that are longer than wide and attain greatest width posterior to mid-length. Pedicle valve flattened medially.

Description.—In small shells, as in the posterior portion of larger ones, the entire width of the brachial valve is involved in the fold so that lateral slopes are smoothly convex. Toward the anterior of larger specimens the fold may become accentuated and distinct from the flanks as can be seen on the holotype (pl. 20, fig. 18). The pedicle valve is noticeably flattened medially (pl. 20, fig. 21). The pedicle beak is strongly incurved. Pedicle adductor tracks not impressed. *AtryPELLA carinata* is variable in relative thickness with respect to width. Increased thickness due to increased convexity of the brachial valve is usually accompanied by relative decrease of the width and by an increase in the strength of the deflection of the anterior commissure.

Comparison.—*AtryPELLA carinata* Johnson n. sp. closely resembles a specimen designated by Khodalevich as *Lissatrypa*(?) *penitus elongata* (1939, p. 105, pl. 20, figs. 3, 5) from the "Striatum" beds. Also similar is a specimen illustrated by Barrande as *Atrypa linguata columbella* (1879, pl. 14, case 2, figs. 10b, 10d). *AtryPELLA carinata* somewhat resembles *A. prunum* Dalman but differs in the nature of the anterior commissure deflection. The latter species has, in addition, a more highly inflated pedicle valve (Dalman, 1828, pl. 5, fig. 2c). Larger specimens of *AtryPELLA scheii* Holtedahl? (Kirk & Amsden, 1952) resemble *A. carinata*, but the Alaskan specimens are somewhat drawn out along the lateral margins. A specimen from the Malinovetski beds of Podolia illustrated as "*Lissatrypa prunum* (His.)" by Nikiforova (1954, pl. 14, fig. 7) is nearly identical with the holotype of *A. carinata*, but other specimens illustrated from the overlying Skala beds are more lenticular and elongate than Sevy specimens of *A. carinata*. Several specimens attain maximum width anterior to mid-length (see pl. 20, fig. 9) and resemble forms designated by Khodalevich as *Lissatrypa penitus* (1939, p. 105, pl. 24, figs. 2, 5).

Figured specimens.—Four specimens have the following dimensions in mm: UCLA 35061 (holotype) length 26.5, width 20.0, thickness 18.7. UCLA 35063 width 20.3, thickness 16.4. UCLA 35064 length 28.7, width 24.6, thickness 19.4. UCLA 35065 width 26.8, thickness 24.4.

ATRYPELLA sp. B.

Pl. 20, fig. 13

Discussion.—Three specimens that are not specifically determinable are distinct by the presence of short, strongly impressed adductor muscle tracks in the pedicle valve. There seems to be no intergradation between forms with and without impressed pedicle adductor tracks, suggesting the presence of a second *Atrypella* species in the Sevy collection.

Comparison.—The musculature of "*Lissatrypa*" *camelina* (Buch) as illustrated by Niki-forova (1937, pl. 13, fig. 16) is very close to that on one of the Sevy specimens in the presence of arcuate diductor tracks as well as the impressed linear adductors.

Figured specimen.—UCLA 35066.

SPIRIFERACEA Waagen, 1883

Subfamily EOSPIRIFERINAE

MACROPLEURA Boucot, 1963

Type species.—*Delthyris macropleura* Conrad, 1840, p. 207.

Diagnosis.—Eospiriferids with a non-plicate fold and with simple rounded plicae on the lateral slopes, separated by U-shaped interspaces.

Discussion.—Two specimens in the collection appear to be unrelated to the Sevy spiriferoids assigned to *Howellella* and to be more closely related to described eospiriferids. The assignment cannot be affirmed with the material at hand because interior structures are not exposed and because the external ornament is not preserved.

MACROPLEURA? sp.

Pl. 20, figs. 1-7

Diagnosis.—Pauciplicate spiriferids with transverse pedicle valve bearing a wide, flat and shallow sulcus. Brachial valve with a prominent flat, flaring fold forming a distinct projection anteriorly.

Description.—The pedicle interarea is low, sharply incurved at the beak, and narrower than the maximum width of the valve. Cardinal angles acute or rounded. On the pedicle valve the most distinct plication borders the sulcus. The lateral slopes, in addition, each bear a single indistinct, low, rounded plica. On the brachial valve there are two indistinct, low, rounded plicae on each flank; or in the case of small specimens there is only one.

Comparison.—*Macropleura?* sp. closely resembles "*Eospirifer*" *juno* Khodalevich (1939, pl. 28, figs. 1-3) from the "Marginalis beds," but the Uralian species has more prominent plicae adjacent to the fold. The specimens from Nevada very closely resemble "*Spirifer*" *spurius*

Barrande (1879, pl. 1, figs. 4a-f) from Ludlovian-age beds of Bohemia and Barrande's illustrations show an eospiriferid-type ornament. However, Havlíček (1959, p. 91) has assigned Barrande's species to *Howellella*. More adequate material must be found before the specimens from the Sevy can be assigned with certainty.

Figured specimens.—Two specimens have the following dimensions in mm: UCLA 35067 length 13.7, width 15.0, thickness 9.2; UCLA 35068 length 8.5, width 9.1, thickness 5.9.

Subfamily DELTHYRINAE

HOWELLELLA Kozłowski, 1946

Type species.—*Delthyris elegans* Muir-Wood, 1925 (= *Terebratula crista* Hisinger, 1826, K. Vet. Akad. Handl., pl. 7, fig. 4, not Linnaeus, 1758).

Diagnosis.—Smooth or pauciplicate Delthyrinae with crural plates and dental lamellae, but lacking a median septum. Exterior with concentric rows of spines aligned radially on the growth lamellae. Preservation of specimens from the Sevy collection is too poor to reveal brachial structures nor fine ornament. A number of specimens do exhibit dental lamellae and lack a median septum.

HOWELLELLA PAUCIPLICATA Waite, 1956

Pl. 20, figs. 8, 10-12

Howellella pauciplicata Waite, 1956, p. 17, pl. 4, figs. 6-10.

Diagnosis.—*Howellella* specimens lacking lateral plications. Shells wider than long and with fold and sulcus distinctly set off by adjacent grooves or ridges.

Material.—Twenty-four silicified specimens.

Comparison.—Paratype specimens from Waite's collection at Kings Canyon, Utah (B-1408) were borrowed from the Museum of Paleontology, University of California, Berkeley. Comparison with the Sevy specimens shows the latter to be larger and more transverse on the average, but otherwise not differing at all from the Utah specimens.

Howellella specimens reported by Kirk and Amsden (1952) were borrowed from the U. S. National Museum and compared with *H. pauciplicata* from Utah and from Nevada. USNM 116601 and USNM 116602 are larger forms than any of *H. pauciplicata* at hand, lack ridges bordering the sulcus, and have a wider and less sharply defined fold. The Alaskan specimens appear, therefore, to represent a related but distinct species from *H. pauciplicata*.

Figured specimens.—Two hypotypes have the following dimensions in mm: UCLA 35069 length 10.7, width 12.5, thickness 8.1. UCLA 35070 length 10.1, width 13.5, thickness 7.7.

HOWELLELLA cf. NUCULA (Barrande, 1879)
Pl. 20, figs. 14-17

Spirifer nucula Barrande 1879, pl. 2, figs. 1,2.
Howellella nucula Havlíček 1959, pl. 18, fig. 8.

Diagnosis.—Small transverse pauciplicate *Howellella* specimens with strongly convex pedicle valve bearing a sulcus bounded by two distinct rounded plicae.

Description.—Pedicle interarea high, triangular, and moderately incurved in most specimens, but more transverse forms bear a lower interarea. Pedicle valve with six plicae or the outer lateral pair may be obsolescent. The brachial valve has two plicae on either side of the fold. The fold is low and slightly flattened.

Material.—Twelve specimens from the Sevy Dolomite and four specimens from the Lake-town Dolomite.

Figured specimens.—Three specimens have the following dimensions in mm: UCLA 35071 width 12.4, thickness 9.5. UCLA 35072 length 7.9, thickness 6.1. UCLA 35073 length 7.7, width 10.1, thickness 6.1.

HOWELLELLA? cf. ARCTICA (Poulsen, 1943)

Crispella arctica Poulsen 1943, p. 54, pl. 6, figs. 9-12.

Description.—A single, incomplete, small, transverse specimen in the Sevy collection has the appearance of *Howellella arctica*. The sulcus is angular and is accompanied by three angular plicae on each flank. On the brachial valve the fold bears a distinct median groove. There apparently were three angular plicae on each flank of the brachial valve.

ATHYRACEA Williams, 1956
Family MERISTELLIDAE
Subfamily HINDELLINAE
HYATTIDINA Schuchert, 1913

Type species: *Atrypa congesta*, Conrad, 1842, p. 265.

Diagnosis.—Smooth biconvex athyraceans with simple stemless jugum. Short dental lamellae present. Pedicle diductor muscle tracks linear, narrow, impressed, slightly diverging. Hinge plates divided by a narrow fissure, or they may be anteriorly conjunct. No brachial median septum.

Discussion.—The Nevada specimens were originally assigned to *Protathyris*, but the pedicle musculature of *Protathyris* is only faintly impressed and resembles that of *Athyris*. The musculature of "*Protathyris*" *hesperalis* as described by Waite (1956, p. 18) and shown in figure 15 of his plate 4 is characteristic of *Hyattidina* rather than *Protathyris*.

HYATTIDINA HESPERALIS (Waite, 1956)
Pl. 19, figs. 22,23,25-28

Protathyris hesperalis Waite, 1956, p. 18, pl. 4, figs. 11-15.

Description.—Externally, the Sevy specimens of *Hyattidina hesperalis* vary from inflated-elongate to lenticular and transverse. On well preserved specimens a pedicle sulcus is usually developed, originating immediately anterior to the beak. A corresponding fold on the brachial valve is not discernible. Short dental lamellae occupy the apex of the pedicle valve. The pedicle muscle scars are impressed, linear, and diverge slightly. A short myophragm and conjunct hinge plates are present in the brachial valve (pl. 19, fig. 26).

Comparison.—Topotype specimens of *Hyattidina hesperalis* from loc. 3 (text fig. 1) were available for comparison. Seventeen specimens from a single collection at location 3 yielded the following data expressed in mm.:

	L.	W.	T.
Max	11.9	12.3	8.0
Min	3.6	3.4	1.7
\bar{x}	6.8	6.8	3.8

Fifty-six specimens from the Sevy collection were measured and yielded the following data expressed in mm.:

	L.	W.	T.
Max	9.6	9.8	6.7
Min	4.7	4.9	2.8
\bar{x}	7.3	7.2	4.7

Figured specimens.—Three hypotypes yielded the following measurements in mm.: UCLA 35075 length 8.0, width 7.3, thickness 4.8; UCLA 35076 length 8.4, width 9.9, thickness 5.0; UCLA 35077 length 8.8, width 8.6, thickness 4.9.

Family NUCLEOSPIRIDAE
NUCLEOSPIRA Hall, 1859

Type species.—*Spirifer ventricosa* Hall, 1857, p. 57.

Diagnosis.—Smooth biconvex athyraceans with non-bifurcate jugum, free imperforate cardinal plate, brachial and pedicle myophragms. Dental lamellae lacking.

NUCLEOSPIRA HECETENSIS Kirk & Amsden,
1952?

Pl. 19, figs. 24,29

Nucleospira hecetensis Kirk & Amsden, 1952, p. 61, pl. 7, figs. 24-29,31,32.

Description.—A single shell in the Sevy collection is preserved as an internal mold revealing the pedicle myophragm and adjoining linear adductor scars. In the brachial valve the myophragm is impressed in the posterior portion

of the shell. The Sevy specimen is lenticular in lateral profile, slightly wider than long, and attains greatest width posterior to mid-length. The anterior commissure is distinctly deflected.

Comparison.—The holotype (USNM 116586) closely resembles the Sevy specimen although the different mode of preservation does not allow comparison of the pedicle beaks. *Nucleospira raritas* Amsden, 1958 from the Henryhouse Formation of Oklahoma is more nearly circular in outline than *N. hecetensis*.

Figured specimens.—UCLA 35074 has the following dimensions in mm: length 8.8, width 9.4, thickness 5.0.

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