

MEMOIR 3

Middle Pennsylvanian Brachiopods
From the Mud Springs Mountains and
Derry Hills, New Mexico

By JOHN LEONARD GEHRIG

1958

STATE BUREAU OF MINES AND MINERAL RESOURCES

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

CAMPUS STATION

SOCORRO, NEW MEXICO

NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

E. J. Workman, *President*

STATE BUREAU OF MINES AND MINERAL RESOURCES

Alvin J. Thompson, *Director*

THE REGENTS

MEMBERS EX OFFICIO

The Honorable Edwin L. Mechem *Governor of New Mexico*

Mrs. Georgia L. Lusk *Superintendent of Public Instruction*

APPOINTED MEMBERS

Robert W. Botts Albuquerque

Holm O. Bursum, Jr Socorro

Thomas M. Cramer Carlsbad

John N. Mathews, Jr Socorro

Richard A. Matuszeski Albuquerque

Contents

	<i>Page</i>
ABSTRACT	1
INTRODUCTION	1
Nature and purpose of report	1
Acknowledgments	1
STRATIGRAPHY	3
Derry series	3
Location	3
Derry Hills section	3
Des Moines series	3
Location	3
Whiskey Canyon section	4
Derry Hills section	6
Conclusions	6
DISTRIBUTION OF FOSSILS IN MEASURED SECTIONS	7
DISCUSSION OF FAUNA	9
SYSTEMATIC PALEONTOLOGY	10
Genus RHIPIDOMELLA Oehlert 1890	10
<i>Rhipidomella carbonaria</i> (Swallow)	10
Genus WELLERELLA Dunbar and Condra 1932	10
<i>Wellerella multiplicata</i> , n. sp.	10
Genus HUSTEDIA Hall and Clarke 1893	10
<i>Hustedia mormoni</i> (Marcou)	10
Genus PUNCTOSPIRIFER North 1920	11
<i>Punctospirifer kentuckiens</i> (Shumard)	11
Genus RETICULARIINA Fredericks 1916	11
<i>Reticulariina</i> cf. <i>R. spinosa</i> (Norwood and Pratten)	11
Genus COMPOSITA Brown 1849	12
<i>Composita argentea</i> (Shepard)	12
<i>Composita derryi</i> , n. sp.	12
<i>Composita malaya</i> , n. sp.	13
<i>Composita ovata</i> Mather	13
<i>Composita subtilita</i> (Hall)	13
<i>Composita</i> sp.	14
Genus NEOSPIRIFER Fredericks 1919	14
<i>Neospirifer triplicatus</i> (Hall)	14
<i>Neospirifer triplicatus</i> var. <i>gibbosus</i> Dunbar and Condra	14
<i>Neospirifer</i> cf. <i>N. latus</i> Dunbar and Condra	15

Genus SPIRIFER Sowerby 1814-18	15
<i>Spirifer occidentalis</i> Girty	15
<i>Spirifer rockymontanus</i> Marcou	16
Genus PHRICODOTHYRIS George 1932	16
<i>Phricodothyris perplexa</i> (McChesney).....	16
Genus BUXTONIA Thomas 1914	17
<i>Buxtonia?</i> sp.....	17
Genus CANCRINELLA Fredericks 1928	17
<i>Canocrinella boonensis</i> (Swallow)	17
Genus CHONETES	17
<i>Chonetes striatus</i> , n. sp.....	17
Genus DICTYOCLOSTUS Muir-Wood 1928.....	18
<i>Dictyoclostus hermosanus</i> (Girty)	18
<i>Dictyoclostus inflatus</i> var. <i>coloradoensis</i> (Girty)	18
<i>Dictyoclostus morrowensis</i> (Mather)	19
Genus ECHINOCONCHUS Dunbar and Condra (1932)	19
<i>Echinoconchus semipunctatus</i> var. <i>knighti</i> Dunbar and Condra	19
<i>Echinoconchus?</i> sp.....	20
Genus JURESANIA Fredericks 1920	20
<i>Juresania nebrascensis</i> (Owen)	20
Genus LINOPRODUCTUS Chao 1927	20
<i>Linoproductus</i> cf. <i>L. platyumbonus</i> Dunbar and Condra	20
Genus MARGINIFERA Waagen 1884	21
<i>Marginifera</i> cf. <i>M.haydenensis</i> Girty	21
Genus MESOLOBUS Dunbar and Condra 1932	21
<i>Mesolobus mesolobus</i> (Norwood and Pratten)	21
Genus DERBYA Waagen 1884 (emend Girty 1908)	21
Genus DIELASMA King 1859	22
<i>Dielasma angulata</i> , n. sp	22
REFERENCES	22
INDEX	23
<i>Table</i>	
1. Range of brachiopod species	8
<i>Figure</i>	
1. Location of the Whiskey Canyon and Derry Hills sections	2
<i>Plates</i>	
1-6. Middle Pennsylvanian brachiopods	Following 24

Abstract

A brachiopod fauna from carefully measured sections of the lower part (Derry and Des Moines series) of the Pennsylvanian in Sierra County, New Mexico, was studied to determine if the megafossils could be useful in designating and correlating the various units of the Pennsylvanian in this area.

It was found that strata belonging to the Derry and the Des Moines series could be distinguished on the basis of the contained brachiopod species. Several characteristic species

from the Derry, which is believed to be younger than the Morrow of the midcontinent region, are similar to upper Mississippian forms. Brachiopods of the Bolander group in the upper part of the Desmoinesian show close affinities with those of the Marmaton group of Kansas.

It thus appears that both megafossils and microfossils can be used successfully to distinguish groups and series in the Pennsylvanian of New Mexico.

Introduction

NATURE AND PURPOSE OF REPORT

Sedimentary rocks of Pennsylvanian age are widespread in New Mexico both on the surface and in the subsurface. They are particularly important as a source of petroleum and natural gas, and in the western part of the State they contain mineral deposits. They vary greatly from place to place in the proportions of sandstone and shale to carbonates; yet they are commonly more than 1,000 feet in total thickness, so that the distinction of units which can be recognized in outcrops or in drill holes is of economic importance.

Thompson (1942) measured a number of sections and divided the strata into series, groups, and formations. The age determinations and the correlations of these units with the standard section of the midcontinent region were based in large part upon the microfossil content. In many localities, megafossils, particularly brachiopods, are abundant. The purpose of this study was to determine whether or not the brachiopods could be used to distinguish units within the Pennsylvanian.

In the summer of 1953, Thompson's sections in the vicinity of Derry on the Rio Grande, 30 miles south of Truth or Consequences, and at Whiskey Canyon in the Mud Springs Mountains, 7 miles northwest of Truth or Consequences, were remeasured, and both megafaunas and microfaunas collected. These collections represent the Green Canyon and

Mud Springs groups of the Derry series and the Armendaris and Bolander groups of the Des Moines series. The brachiopods are described and illustrated in this report, and their stratigraphic relationship to the Fusulinidae is recorded. All figured specimens are in the collection of the New Mexico Bureau of Mines and Mineral Resources, at Socorro; the remainder were left at the University of Wisconsin, where the laboratory studies were completed.

ACKNOWLEDGMENTS

The writer is particularly grateful to Dr. M. L. Thompson, formerly of the University of Wisconsin, who not only made comparative material available but gave freely of his time, advice, and knowledge of the area studied. He is indebted also to Dr. L. M. Cline and to Dr. L. R. Laudon, who suggested the problem discussed in this study and assisted with the identification of the fossils.

Financial assistance was provided by the New Mexico Bureau of Mines and Mineral Resources under its Field Assistance Fellowship program. Dr. R. H. Flower, of the Bureau staff, was particularly helpful in providing assistance.

The report has profited from critical reading by Dr. Christina Lochman-Balk and Dr. F. E. Kottlowski, of the Bureau staff. The photography was done by Mr. C. S. Treseder, New Mexico Institute of Mining and Technology.

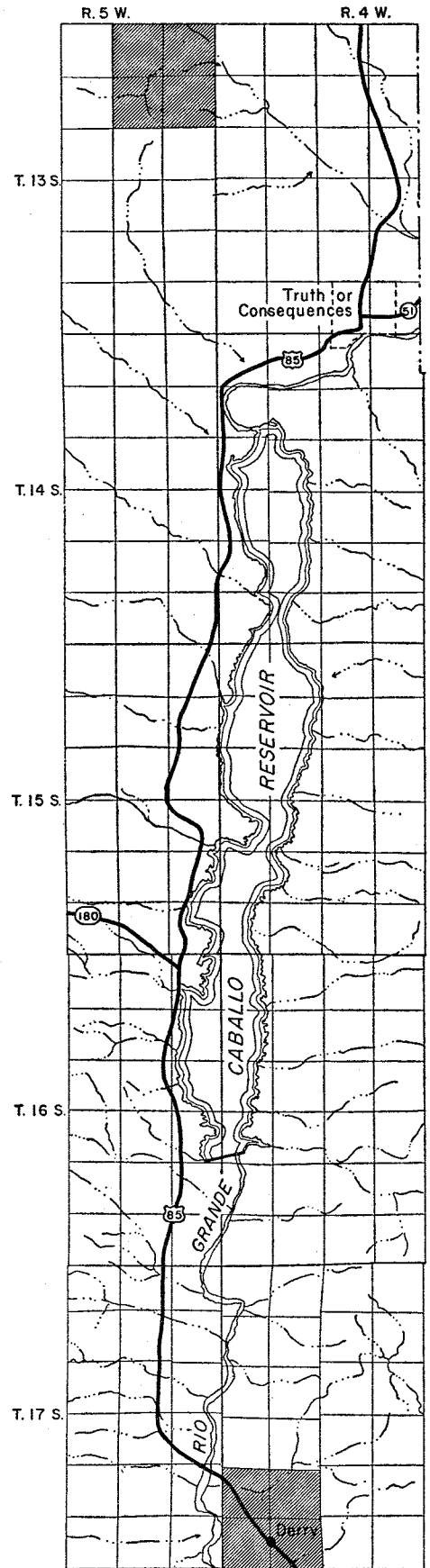
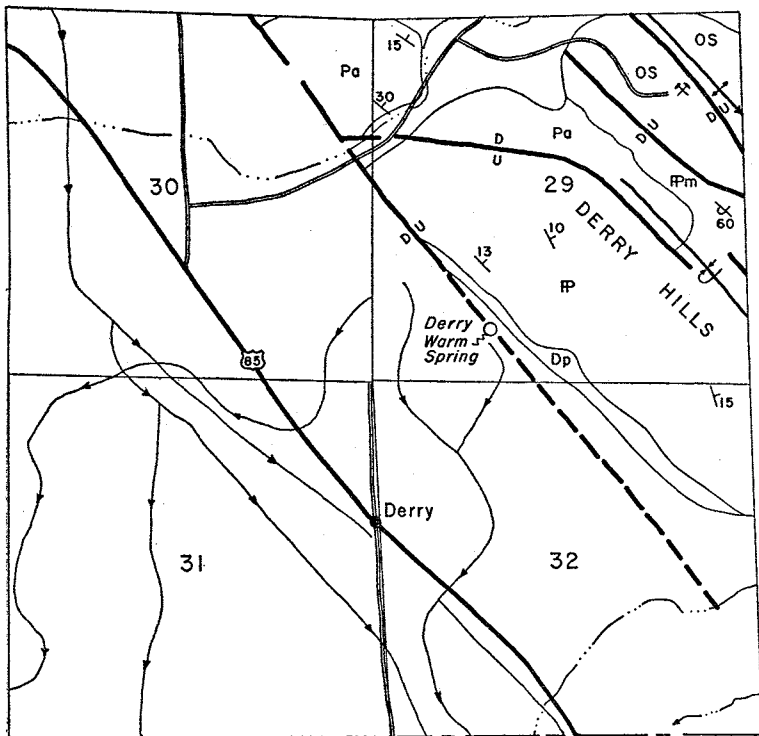
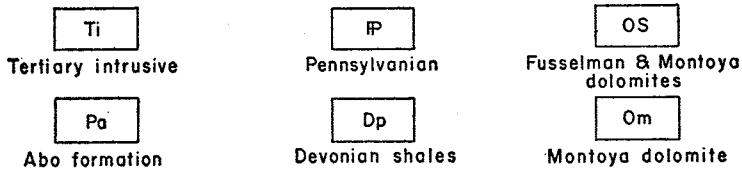
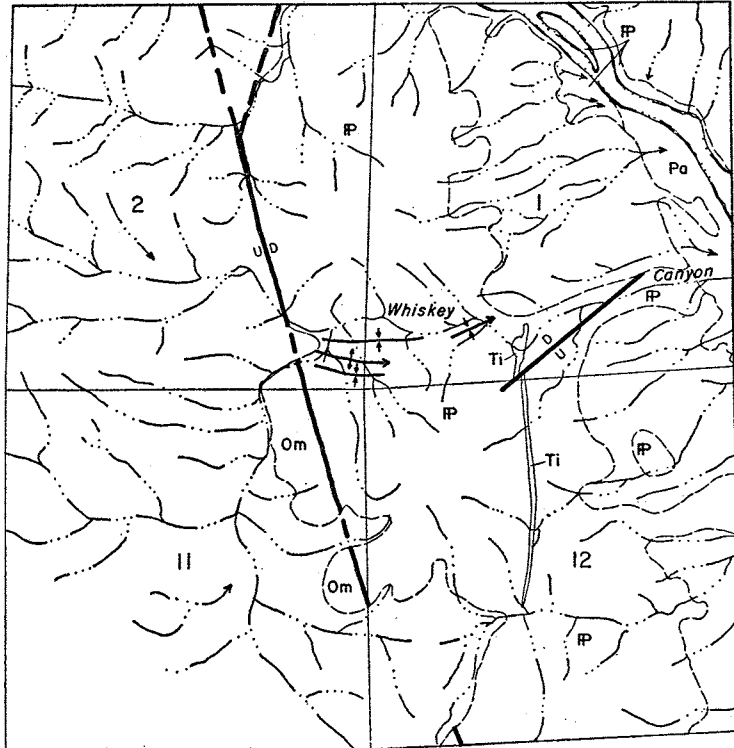


Figure 1.

LOCATION OF THE WHISKEY CANYON AND DERRY HILLS SECTIONS

Stratigraphy

DERRY SERIES

LOCATION

The type section of the Derry series, section 19 of Thompson (1942), 1s located on the steep west slope of the Derry Hills about three-fourths of a mile east of the small town of Derry, near the center of sec. 32, T. 17 S., R. 4 W., Sierra County, New Mexico. The town of Derry lies on U. S. Highway 85, on the flood plain of the Rio Grande, near the north end of the Hatch Basin, and just north of the line separating Sierra and Dona Ana Counties.

Thompson divided the Derry series into z groups and 4 formations. At the type locality, the Derryan consists of alternating limestones (80 percent) and shales (20 percent), approximately 127 feet thick, lying unconformably upon Devonian shale. The section, as remeasured by the author, is given below.

DERRY HILLS SECTION

Derry Series

west slope of Derry Hills, 0.8 mile east of Derry, Sierra County, New Mexico.

UNIT NO.	DESCRIPTION	THICKNESS (feet)
MUD SPRINGS GROUP		
<i>Cuchillo Negro formation</i>		
21d	Limestone, gray, hard; surface weathers very rough	4.0
21c	Limestone, gray, hard; weathers light gray; abundant large horn corals, poorly preserved; small stringers of chert	3.5
21b	Limestone, dark-gray, hard; weathers light gray or blue gray; coarse-grained; 3 beds; lower 1 foot hard, fine grained; middle foot weathers mottled	4.0
21a	Limestone, dark-gray, coarse-grained; weathers blue gray and tan; lower z feet cherty and nodular; upper 3 feet massive, weathering to a rough surface	5.0
20	Limestone, dark-gray; stringers of chert up to one-half foot wide; weathers gray green, with a slightly irregular surface, 2 beds	5.0
	Total Cuchillo Negro formation	21.5
<i>Fra Cristobal formation</i> (Thompson, 1948, p. 74)		
19,18	Limestone, dark-gray, coarse-grained; lower 2 feet weathers light blue green and contains abundant fusulinids; upper 5 feet has stringers and nodules of black chert with many fusulinids; massively bedded; basal 4 inches nodular and shaly; 2 feet below top, a nodular, shaly bed with brachiopods and corals	8.0
17	Covered; tan shale on slope	1.5
16	Limestone; lower 8 feet light a, coarse grained, crinoidal; upper 5 feet dark a, coarse rained; lower 10 feet breaks down to a slope; nodules and stringers of chert throughout; silicified corals in top bed	13.0
15	Shale, light-green, fissile; no fossils	1.5
	Total Fra Cristobal formation	24.0
GREEN CANYON GROUP		
<i>Apodaca formation</i>		
14,13	Limestone, gray or gray-green, hard, dense, fine-grained; weathers tan to brick orange; top nodular and cherty; basal 1 foot nodular, thin bedded; no fossils	3.5
12	Limestone, dark-gray, hard, dense, fine-grained; stringers	

	of chert up to 1 foot wide; weathers light gray; upper half massive, cliff forming	6.5
11c	Covered	14.5
11b	Limestone, red-brown, argillaceous, coarse-grained; weathers tan	1.0
11a	Shale, light-blue and tan, thin-bedded, fissile; no fossils	1.5
10b	Limestone, very silty, thin-bedded; weathers orange yellow; upper foot grades into fine-grained extremely hard light gray-green limestone; weathers light green; upper 2 feet contains stringers and nodules of dark-gray limestone which weathers light gray; brachiopods abundant in places; cliff-forming	14.0
10a	Limestone, dark-gray, fine-grained, thin-bedded; weathers blue green; poorly exposed	1.0
9, 8	Limestone, dark gray, hard, fine-grained; interbedded with thin shale lenses	1.0
7	Covered slope .	5.0
	Total Apodaca formation ,	48.0
<i>Arrey formation</i>		
6i	Limestone, dark-gray, crinoidal; green coloring on fresh surfaces	0.5
6h	Shale, highly calcareous; weathers light tan	0.2
6g	Limestone, dark-gray, crinoidal; weathers tan	0.5
6f	Shale, calcareous, weathers tan	0.2
6e	Limestone, dark-gray, crinoidal	0.3
6d	Shale, calcareous; weathers tan	0.3
6c	Limestone, gray, hard, crinoidal; calcite film on surface	1.5
6b	Shale, calcareous; weathers tan; very fossiliferous	1.0
6a	Limestone, gray, coarse-grained, crinoidal	1.0
5	Limestone, gray, massive; concentric nodules and irregular bands of chert common in upper half; no fossils	3.5
4	Shale, highly calcareous; weathers tan; interbedded with thin argillaceous limestones	1.7
3	Limestone, gray, nodular; weathers light blue	4.0
2b	Limestone, gray, coarse-grained, very thin-bedded; interbedded with white calcareous shale that weathers gray	2.0
2a	Limestone, gray, hard, fine-grained, extremely cherty; some yellow-banded chert; locally, crinoid stems in limestone and bryozoan impressions in chert; weathers rough; cliff-forming	8.7
1c	Limestone, gray, fine-grained, irregularly bedded, nodular	1.0
1b	Shale, light-gray; weathers black	0.3
1a	Limestone, dark-gray, hard, fine-grained; in upper 1 foot, irregular masses of brown chert; fossils in nodular bed just below	3.2
	Total Arrey formation	29.9
	Base of unit 1 rests unconformably on Devonian shale	

DES MOINES SERIES

LOCATION

Rocks of Desmoinesian age crop out along whiskey Canyon, at the north end of the Mud Springs Mountains, from the south-central to the southwest part of sec. 1, T. 13 S., R. 5 W. The type section of the Armendaris group (Thompson, 1942, p. 41-47) is near the west end of whiskey Canyon, in the westernmost box canyon. The type section of the Bolander group (Thompson, 1942, p. 51-55) is just west of the large box canyon in the central part of whiskey Canyon.

Whiskey Canyon enters the Cuchillo Arroyo, a normally dry wash, from the west. According to local residents, its name derives from illicit activity centered there during the era of national prohibition. The operators took advantage of the natural seclusion of the area and two rather deep pot-holes, which are kept filled, even during summer months,

by periodic runoffs. Whiskey Canyon is about 5 miles up-stream from the point where the Cuchillo Arroyo is crossed by U. S. Highway 85 and is accessible by truck or jeep, or on foot. A small abandoned stone hut stands on the west bank at the mouth of Whiskey Canyon. Power transmission lines cross the arroyo diagonally at this point.

WHISKEY CANYON SECTION

Des Moines Series

Type sections: Bolander group, center of S½ sec. 1, T. 13 S., R. 5 W.; Armendaris group, SW ¼ sec. 1, T. 13 S., R. 5 W.

UNIT NO.	DESCRIPTION	THICKNESS (feet)		
	BOLANDER GROUP			
120, 119	Limestone, light-gray to gray, hard, fine-grained, massive-bedded; beds 1 to 2 feet thick; forms back slope of hill into small canyon	13.0	105	Shale, weathered tan to reddish purple; locally, a 6-inch gray nodular limestone lens near middle of unit; poorly exposed
118	Limestone, gray, hard, fine-grained, nodular; weathers blue gray; interbedded with tan highly calcareous shale weathering nearly white	6.0	104	Limestone, light-gray, hard, irregularly bedded; irregular masses of brown chert at top; algae abundant
117	Limestone, light-gray, hard, dense, fine-grained; weathers light gray; 1 massive bed; calcite veins on surface	2.5	103	Limestone, light-gray to brown-gray, hard; weathers blue, yellow, and red in spheroidal masses
116, 115	Limestone, gray, highly nodular; weathers light gray; interbedded with light-gray shale weathering tan; no fossils	7.0	102	Limestone, gray, hard, dense, with calcite veins; weathers sandy; upper 2 inches purplish gray, coarse grained, crinoidal; no fossils except crinoid stems
114	Limestone, gray, hard, dense, fine-grained, with a slight brownish tinge, irregularly bedded; cherty throughout, especially top surface and upper 2 feet; lower third of unit consists of 0.5 foot of interbedded limestone and shale underlain by 1 foot of massive limestone, then 4 inches of interbedded limestone and shale underlain by a 1.5-foot limestone with a thin shale bed, then 0.5 foot of limestone interbedded with gray to greenish-gray very fossiliferous shale (brachiopods weather free), and a basal 0.5-foot nodular limestone	11.0	101	Limestone, gray, hard, dense, with calcite veins; top surface nodular, crinoidal
113a	Shale, grayish-pink, grayish-green, lavender and tan; abundant free brachiopods in talus on surface are probably from unit 114	30.0	100	Limestone, brownish-gray, hard, dense, fine-grained; weathers yellow, gray, or white, in spheroidal masses
113	Limestone, coarse-grained, hard, detrital; small chert pebbles throughout; gray to reddish-brown; weathers sandy; poorly exposed; some brachiopod fragments on surface	1.0	99	Shale, white, calcareous, nonfossiliferous; weathers tan
112	Conglomerate; chert pebbles 0.25 to 0.5 inch, a few up to 1 inch; limestone matrix; weathers soft, light tan, with dark-brown chert pebbles; detrital brachiopods on surface	6.0	98	Limestone, gray, hard, fine-grained, cherty; calcite veins throughout; weathers to very rough surface; in 3 beds; crinoidal on upper surfaces
111	Limestone, gray to light-gray, hard, dense, fine-grained; thin-bedded shaly layer 9 inches from base	4.3	97	Limestone, gray, argillaceous; interbedded with gray shale
110b	Limestone, gray, hard, dense, fine-grained; regularly interbedded with 1- to 2-inch lavender shale beds; limestone in 1-foot beds; upper 6 feet with abundant brachiopods; upper 2 feet weathers light gray, with top bed a pinkish highly fossiliferous ledge; brown chert covers faces of cliff where exposed	16.0	96	Limestone, gray to lavender-gray, hard, dense; weathers light gray; brachiopods abundant; upper 1 foot irregularly bedded, lower 3 feet massively bedded; bands of chert 1 foot wide in lower half
110a	Limestone, gray, with reddish tint on fresh surface; hard, dense, fine-grained; interbedded with 1- to 2-inch layers of light-pink highly calcareous shale	2.0	95e	Limestone, dark-gray, fine-grained, hard, dense; weathers yellow or blue gray
109	Shale, light-pink, highly calcareous; weathers pink, white, or very light green gray; 3-inch brown hard dense fine-grained nodular limestone bed just below top	1.2	95d	Covered
108	Limestone, light-gray, coarse-grained; weathers distinctively granular from abundance of tan fusulinids	3.0	95c	Limestone, light-gray, soft, very coarse-grained, crinoidal; shale stringers; breaks up easily; locally stained pink
107	Limestone, light-gray, with purple tint; hard, dense, cherty; upper ledge with many bryozoans and some brachiopods	11.0	95b	Limestone, dark-gray, hard, dense, fine-grained; weathers gray to dark gray, with large veins of calcite on surface
106	Limestone, light-gray, hard, very coarse-grained, crinoidal, cherty	3.5	95a	Shale, white, calcareous; weathers tan; usually talus-covered
			94	Limestone, gray to brownish-gray, hard, dense, fine-grained; many calcite veins; weathers sandy, with very rough surface
			93b	Limestone, light-gray, hard, dense, fine-grained; shaly and nodular at top; weathers light gray, locally stained lavender
			93a	Shale, pink; interbedded with pink coarse-grained limestone with large crystals of calcite; weathers tan
			92b	Chert; 1 solid bed stained with manganese; some silicified limestone, with traces of fusulinids on surface
			92a	Limestone, light-gray, hard, dense; fine-grained beds alternating with light-gray coarse-grained beds; white calcite veins common except near base; large nodules and irregular masses of chert throughout; lower 3 feet gray, red tinted, coarse grained, fossiliferous
			91	Limestone, gray, hard, dense, fine-grained, evenly bedded; layers of calcite; weathers blue gray; slope-forming
				Total Bolander group
				ARMENDARIS GROUP
				<i>Garcia formation</i>
			90	Limestone, light-gray, dense, fine-grained; 1 massive bed; weathers tan gray; some nodules and small chert stringers throughout
			89	Limestone, light-gray to lavender, hard, fine-grained; shaly and nodular bedding locally; 6-inch layer of white calcareous tan-weathering shale at top; unit weathers tan, orange, and white, with a dark mottling caused by abundant horn corals
			88	Limestone, light-gray to lavender, hard, fine-grained; weathers tan, light gray to lavender, and yellowish; mottled on top by abundant fusulinids; poorly exposed
			87	Limestone, light-gray to lavender, fine-grained, nodular; interbedded with shale; slope-forming
			86	Limestone, light-gray, coarse-grained, crinoidal; thin nodular interbeds; weathers mottled brown
			85	Limestone, gray, irregularly bedded to nodular; poorly exposed

84	Limestone, light-gray; upper 6 feet coarse grained, crinoidal, weathers gray and tan, brachiopods very abundant; underlying 8 feet fine-grained, dense, 1 massive bed, weathers gray; underlying 3 feet fine-grained, irregularly bedded, weathers blue gray, basal 6 feet fine-grained., massive bed, weathers gray and tan	61	weathers gray; underlying 6 inches gray and red, crinoidal, weathers tan; underlying 3.5 feet dark gray, hard, dense, fine grained, basal 3 feet gray brown, hard, fine grained, cherty, weathers blue gray and orange; forms slope	8.0
83	Limestone; top 2 feet gray, hard, fine-grained, very nodular, weathers light blue; interbedded with white shale; limestone and shale locally weather pink; basal 4 feet gray, coarse grained, crinoidal, weathers gray; poorly exposed	23.0	Limestone, gray, crinoidal; upper 2.5 feet soft, cherty, with brachiopod impressions; underlying 10 inches gray, hard, fine grained, noncrinoidal; basal 5.5 feet with chert nodules, stringers, and wide bands; foot from base, a shaly weathered layer with large	8.0
82	Shale; top foot tan; middle 3 feet rusty brown; basal 2 feet tan	6.0	productids	8.0
81	Limestone, gray to brownish-gray, hard, dense, fine-grained; top 1.5 feet brown and lavender; weathers blue gray and nodular to spheroidal, upper part interbedded with pale-yellow hard shale; no fossils	6.0	Limestone, gray, hard, fine-grained; prominent stringer of black chert and much irregular brown chert; upper 12 feet 1 massive bed; basal 2 feet crinoidal; cliff-forming	17.0
80	Limestone, light-brown stained with red, highly nodular; weathers light gray, interbedded with gray calcareous shale weathering tan; beds 6 inches to 2 feet thick; basal 6 feet very fossiliferous	29.0	Limestone, medium-gray, crystalline; interbedded with hard pink shale; brachiopod impressions; cliff-forming	3.0
79	Limestone; top 2 feet light gray, coarse grained, crinoidal, upper foot with brachiopods, basal 3 feet gray, hard, dense, fine grained, 2 thin zones of dark-gray chert, 6 inches thick, near base	22.0	Limestone, dark-gray, fine-grained, hard; many lenticular brown and dark-brown chert bands; weathers with sandy-appearing surface; cliff-forming	4.5
78	Shale, light-brown to brown; weathers tan; interbedded with brown limestone nodules	5.0	Limestone, gray to light-gray, hard, very cherty, nodular to massively bedded, crinoidal in middle; upper 6 inches interbedded with pink-weathering shale, 2 feet from top, many fusulinids on weathered surface of a gray limestone	11.0
77	Limestone, hard, dense, fine-grained; upper 1 foot gray, massive, weathers tan; lower foot light gray, nodular, weathers gray	2.0	Limestone, gray, coarse-grained, upper 6 feet is a massive bed with small chert nodules and stringers; weathers gray, with white calcite veins; a few fragmentary brachiopods and horn corals; underlying 2 feet is a massive bed with irregular thick bands and nodules of chert; fusulinids weathered on surface; then a massive 1-foot bed, fusulinids on surface; basal 7 feet is a massive bed with 2 zones of chert in lower part	16.0
76	Limestone, light-gray, dense, fine-grained, highly nodular; interbedded with shale; poorly exposed	6.0	Limestone, gray, coarse-grained; massive beds separated by nodular and shaly layers; nodular chert in upper half; weathers to a rough sandy surface; no fossils	9.0
75	Limestone, light-gray, tinted lavender, hard, fine-grained; locally, at top, a 14-inch light-gray coarse-grained crinoidal fossiliferous bed; upper 4 feet massive, with a 4-inch shaly fossiliferous layer near middle; top 2.5 feet cherty; lower 10 feet nodular and interbedded with hard calcareous shale; unit is cliff-forming	54	Limestone, light-gray to gray; upper 4 feet is one massive bed with 3 prominent chert bands; middle crinoidal, basal 1 foot very dark gray, hard, fine grained, nodular; poorly preserved horn corals	5.0
74	Limestone, gray to light-gray, tinted red brown, hard, fine-grained; upper 8.5 feet massive; lower 5.5 feet thick lenticular beds intercalated with some white hard calcareous shale; unit is cliff forming	14.0	Limestone, light-gray, stained purple, fine-grained; crinoidal near base; irregular dark-brown chert throughout; basal 5 feet very dark gray, hard, dense, fossiliferous; bryozoans, chert brachiopods, and crinoid stems; cliff-forming	6.0
73	Limestone, gray, loosely consolidated, nodular; weathers tan and blue; intercalated with some green-gray shale	14.0	Limestone, dark-gray, hard, coarse-grained; bands of dark-brown chert, 4 inches thick, in upper half; no fossils	6.5
72	Limestone, light-gray, hard, dense, fine-grained; 2 massive beds separated by a 6-inch nodular limestone inter-bedded with shale; upper 1.5 feet very cherty, stained lavender, and with white calcite veins; poorly exposed	2.5	Limestone, gray, brownish-purple, hard, fine-grained, algal; weathers gray; in z beds, surface of lower having many bryozoan impressions and brown chert	7.0
71	Shale, light-gray, thin-bedded, fissile; weathers tan	4.5	Limestone, light-gray, hard, fine-grained, irregularly to massively bedded; nodules and zones of chert in upper half; slightly fossiliferous, cliff-forming	8.0
70	Shale, light-gray, gray, black, and pink, thin-bedded, fissile; weathers light gray, green, blue green, black, and pink, interbedded with 10 thin zones of black hard fine-grained nodular limestone; no fossils	2.0	Limestone, light-gray, stained purple, nodular; re-entrant under cliff	1.5
69	Limestone, dark-gray, hard, dense, cherty, slightly fossiliferous; crinoidal on upper surface; forms a low cliff	17.0	Limestone, light-gray, hard, fine-grained; 1 massive bed; chert on upper surface; fragmentary brachiopod impressions, weathers sandy	48
68	Limestone, light-gray, fine-grained, very nodular, stained red; interbedded with light-gray and green-gray shales; no fossils	5.5	Limestone, gray to light-gray, hard, fine-grained, cherty; abundant algae; chert weathers dark brown and red; poorly preserved horn corals	27.5
67	Shale, light greenish-gray, silty	3.5	Limestone, gray to light-gray, dense, algal, nodular-bedded; no fossils; cliff-forming	13.0
66	Limestone, gray, coarse-grained, crinoidal, fossiliferous	1.0	Limestone, gray, grayish-brown and lavender, hard, dense; nodular beds of chert near top; abundant brachiopods at base; cliff-forming	4.0
65	Shale, greenish-gray to yellow; poorly exposed	7.5	Limestone, gray, hard, coarse-grained; interbedded with white calcareous shale which weathers pink; massive bed near top; no fossils; reentrant under cliff	7.5
64	Conglomerate; coarse sand to granules; quartz and small limestone granules, gray-brown, weathers dark brown from chert in upper part, top 2 feet almost quartzitic; slope-forming	4.0	Total Whiskey Canyon limestone	183.5
	Total Garcia formation	5.0		3.0
		210.5		
	<i>Whiskey Canyon limestone</i>		<i>Elephant Butte formation</i>	
63	Limestone, gray; upper 1 foot hard, dense, fine-grained, calcite veins and quartz crystals on surface; appears to grade into unit 64; lower 7 feet massive, soft, and slightly cherty; weathers tan to a very rough surface; brachiopods abundant	43	Limestone, light-gray, hard, dense, fine-grained, stained lavender, red, or gray, algal; surface covered	
62	Limestone; top 1 foot gray, hard, fine-grained, massive,	8.0		

	by dendritic chert; no fossils	6.0	D1	Limestone, dark-gray, hard, dense, fine-grained; weathers tan and silty; brachiopods abundant	2.5
42	Limestone, gray, dense, fine-grained; weathers red and yellow and somewhat sandy; massive beds alternate with thin beds which weather blocky; slightly fossiliferous			Total Elephant Butte formation	48.0
41	Limestone, light-gray, hard, dense, fine-grained, nodular- to massively bedded; cherty in upper part, fusulinids abundant	7.0		Base of unit D I rests conformably on the underlying Cuchillo Negro formation of the Derry series	
40	Shale, light-gray, tinted lavender; weathers dark brown	4.5			
39	Limestone, light-gray, hard, dense, thin- to nodular-bedded; algal in upper part; no fossils	8.0			
38	Shale, light-gray, silty	3.0			
37	Covered	6.0			
36	Limestone, gray, brown, and red, hard, fine-grained; weathers yellow, pink, and brown; abundant productids	2.0			
35	Limestone, gray, hard, dense; poorly exposed	2.0			
34	Limestone, light-gray and lavender, hard, coarse-grained; weathers light gray, yellow, and brown	2.0			
33	Shale, light-gray	2.0			
32, 31	Limestone, gray, hard, coarse-grained, slabby; weathers yellow to pale yellow; irregular thin masses of chert on upper surface; very fossiliferous	2.0			
30	Limestone, light-gray, tinted lavender, hard, dense, fine-grained; top crinoidal; middle 3 feet soft, gray, crinoidal	2.0			
29	Covered	8.0			
28	Conglomerate; pebbles to large granules; gray, hard, well-cemented; weathers dark red	4.0			
	<i>Warmington limestone member</i>	1.0			
27	Limestone, light-gray, hard, dense, fine-grained; upper 1.5 feet gray, coarse grained, crinoidal, <i>Chaetetes</i> abundant; quartz grains adhere to top surface, which weathers red brown; massive beds	10.0			
26d	Limestone, gray, soft, coarse-grained, crinoidal; weathers gray; chert abundant	1.0			
26c	Limestone, yellow to gray, hard, coarse-grained, crinoidal; weathers yellow and red	1.0			
26b	Limestone, dark-gray, hard, dense, fine-grained, very cherty; some large crinoid stems; weathers blue gray	3.0			
26a	Limestone, gray and lavender, slightly crinoidal	1.0			
25	Limestone, dark-gray, hard, dense, fine-grained; large chert nodules; <i>Chaetetes</i> abundant	6.0			
	Total Elephant Butte formation	81.5			

DERRY HILLS SECTION

Basal Part of Des Moines Series

West slope of Derry Hills, 0.8 mile east of Derry, Sierra County, New Mexico.

UNIT NO.	DESCRIPTION	THICKNESS (feet)
	<i>Elephant Butte formation</i>	
D9	Limestone, dark-gray to gray; stringer and nodules of chert; forms top surface of hill	7.0
D8	Limestone, gray, coarse-grained; abundant chert; no fossils; forms highest ledge	4.5
D7	Limestone, light-gray, hard, dense; stringers of chert; cliff-forming	12.5
D6	Limestone, very dark-gray, argillaceous, cherty; upper part very thin bedded; weathers tan and gray; no fossils; slope-forming	2.5
D5	Limestone, very ark-gray, fine-grained; no fossils	2.0
D4	Covered	5.0
D3	Limestone, gray, algal; weathers light blue; some bryozoans and fragmentary brachiopods	1.0
D2	Limestone, light-gray, hard, fine-grained; abundant chert; weathers light gray and black; 4.5 feet above base, a nodular 3-foot zone of abundant brachiopods and some corals	11.0

CONCLUSIONS

Prior to 1942, the rocks of presumed Pennsylvanian age in all of New Mexico usually were referred to as the Magdalena group or formation (proposed by Gordon, 1907). Strata of upper Mississippian and basal Permian age commonly were included with the Pennsylvanian.

Thompson (1942, p. 22), in an article based upon detailed lithologic and faunal studies, found that "almost all Pennsylvanian rocks recognized in other areas of North America have correlatives in the Pennsylvanian rocks of the Magdalena Mountains. The term Magdalena, therefore, seems to be essentially synonymous with the systemic term Pennsylvanian." Thompson described the New Mexico strata correlative with the Virgil, Missouri, and Des Moines series of the midcontinent region, and proposed the term Derry series for all the Pennsylvanian rocks in south-central New Mexico which crop out below the Desmoinesian beds and lie unconformably on pre-Pennsylvanian rocks. The faunas of the Derryan strata are younger than those in the type Morrow series. At this time, Thompson recognized and defined 15 formations of Pennsylvanian age in parts of New Mexico.

Kelley and Silver (1952, p. 88-91) used the term Magdalena group for all the Pennsylvanian rocks of the Caballo Mountains and stated (p. 91) that "owing to cartographic limitations the Magdalena group is mapped as a single unit. . . . However, the group is divided for stratigraphic purposes into three formations. . . ." These formations were defined primarily on the basis of their gross lithology and topographic expression: (1) The Red House formation, a slope-forming shaly unit with a few scattered limestone ledges; (2) the Nakaye formation, a precipitous cliff-forming limestone unit; and (3) the Bar B formation, a very weak shaly slope-forming unit. These formations apparently are not valid cartographic units since they were not utilized as mapping units, even though they should form wider outcrop bands than other formations that were mapped. As defined, they are lithic stratigraphic units which probably could not be recognized in isolated outcrops nor in the subsurface, if a complete section were not present.

The writer's examination of Thompson's type sections of the Derryan and the Desmoinesian formations has demonstrated to his satisfaction the validity and also the usefulness of Thompson's divisions in this region. The groups and formations were recognized in the surface outcrops examined; as valid lithic units, they have priority throughout this area of New Mexico. In addition, their distinctive fusulinid assemblages have been determined by Thompson (1948), and their brachiopod assemblages are described in this paper. The supplementary paleontologic information greatly increases the usefulness of the lithic units. Adequate knowledge of the relationships of the faunas of the varying lithologies now permits significant interpretations of the history of areal sedimentation and paleoecology, as well as correlations with contiguous regions.

Distribution of Fossils in Measured Sections

DERRY SERIES

MUD SPRINGS GROUP

Cuchillo Negro Formation

21. *Composita ovata*, *Spirifer occidentalis*, *Juresania* sp., *Marginifera* sp.; *Fusulinella*
20. *Composita ovata*, *Phricodothyris perplexa*, *Reticulariina* cf. *R. spinosa*, *Spirifer occidentalis*, *Dictyoclostus* sp., *Marginifera* sp., *Neospirifer* sp.; *Fusulinella*, *Eoschubertella*

Fra Cristobal Formation

- 19, 18. *Composita derrya*, *Linoproductus* cf. *L. platyumbonus*, *Marginifera* cf. *M. haydenensis*; *Fusulinella*, *Millerella*, *Pseudostaffella*, *Spirifer occidentalis*
16. *Composita subtilita*, *Spirifer occidentalis*

GREEN CANYON GROUP

Apodaca Formation

12. *Composita ovata*, *C. subtilita*, *Marginifera* cf. *M. haydenensis*, *Spirifer occidentalis*; *Profusulinella*, *Millerella*
10. *Chonetes striatus*, *Rhipidomella carbonaria*, *Spirifer occidentalis*
- 9, 8. *Linoproductus* cf. *L. platyumbonus*, *Rhipidomella carbonaria*, *Spirifer occidentalis*, *Neospirifer* sp.

Arrey Formation

6. *Dictyoclostus morrowensis*, *Hustedia mormoni*, *Punctospirifer kentuckyensis*, *Rhipidomella carbonaria*, *Composita* sp., *Marginifera* sp., *Neospirifer* sp.; *Millerella*, *Profusulinella*
5. *Dictyoclostus* sp.; *Millerella*, *Profusulinella*
4. *Chonetes striatus*, *Echinoconchus semipunctatus* var. *knighti*, *Rhipidomella carbonaria*, *Spirifer occidentalis*, *Marginifera* sp.; *Millerella*
3. *Millerella*, *Profusulinella*
- 2a. *Chonetes striatus*, *Marginifera* cf. *M. haydenensis*, *Rhipidomella carbonaria*, *Spirifer occidentalis*, *Neospirifer* sp.
2. *Dictyoclostus* sp.; *Millerella*
1. *Chonetes striatus*, *Composita subtilita*, *Dictyoclostus morrowensis*, *Spirifer occidentalis*; *Millerella*, *Ozawainella*

DES MOINES SERIES

OLANDER GROUP

114. *Buxtonia?* sp., *Cancrinella boonensis*, *Composita argentea*, *C. ovata*, *C. subtilita*, *Juresania nebrascensis*, *Neospirifer* cf. *N. latus*, *Marginifera* sp.
- 113a. *Buxtonia?* sp., *Cancrinella boonensis*, *Composita argentea*, *C. ovata*, *C. subtilita*, *Juresania nebrascensis*, *Neospirifer triplicatus*, *Punctospirifer kentuckyensis*, *Derbya* sp., *Marginifera* sp.
113. *Fusulina*
112. *Derbya* sp., *Neospirifer* sp.
111. *Fusulina*
110. *Composita* sp., *Derbya* sp.; *Eoschubertella*, *Fusulina*, *Millerella*

109. *Linoproductus* cf. *L. platyumbonus*, *Mesolobus mesolobus*, *Phricodothyris perplexa*

108. *Fusulina*, *Ozawainella*

107. *Juresania nebrascensis*, *Neospirifer* cf. *N. latus*, *Phricodothyris perplexa*

106. *Phricodothyris perplexa*

101-99. *Echinoconchus semipunctatus* var. *knighti*, *Linoproductus* cf. *L. platyumbonus*, *Phricodothyris perplexa*, *Derbya* sp., *Dictyoclostus* sp.; *Fusulina*, *Millerella*

96. *Composita ovata*, *Dictyoclostus inflatus* var. *coloradoensis*, *Spirifer occidentalis*, *Marginifera* sp.

95. *Composita subtilita*, *Dictyoclostus inflatus* var. *coloradoensis*, *Dictyoclostus morrowensis*, *Neospirifer* cf. *N. latus*, *Phricodothyris perplexa*, *Linoproductus* sp.

94. *Fusulina*

92. *Composita argentea*, *Juresania nebrascensis*, *Neospirifer triplicatus*, *Phricodothyris perplexa*, *Dictyoclostus* sp., *Spirifer* sp.

ARMENDARIS GROUP

Garcia Formation

90. *Dictyoclostus inflatus* var. *coloradoensis*

89. *Dictyoclostus inflatus* var. *coloradoensis*, *Echinoconchus semipunctatus* var. *knighti*

88. *Neospirifer* sp.; *Eoschubertella*, *Fusulina*, *Millerella*, *Pseudostaffella*

87. *Dictyoclostus inflatus* var. *coloradoensis*, *D. hermosanus*, *Neospirifer* cf. *N. latus*, *Phricodothyris perplexa*, *Spirifer* sp.

86. *Neospirifer triplicatus*, *Phricodothyris perplexa*

84. *Composita ovata*, *C. subtilita*, *Linoproductus* cf. *L. platyumbonus*, *Phricodothyris perplexa*, *Spirifer occidentalis*; *Eoschubertella*, *Fusulina*, *Wedekindellina*

83. *Cancrinella boonensis*, *Composita argentea*, *C. subtilita*, *Composita* sp., *Linoproductus* cf. *L. platyumbonus*, *Neospirifer* cf. *N. latus*, *Phricodothyris perplexa*, *Spirifer occidentalis*, *S. rockymontanus*, *Marginifera* sp.

80. *Composita argentea*, *C. ovata*, *C. subtilita*, *Dictyoclostus inflatus* var. *coloradoensis*, *Juresania nebrascensis*, *Neospirifer* cf. *N. latus*, *N. triplicatus*, *Phricodothyris perplexa*, *Spirifer occidentalis*, *S. rockymontanus*

79. *Composita ovata*, *C. subtilita*, *Linoproductus* cf. *L. platyumbonus*, *Spirifer occidentalis*, *Dictyoclostus* sp.

75. *Dielasma angulata*, *Spirifer occidentalis*, *Wellerella multiplicata*, *Marginifera* sp., *Neospirifer* sp.

74. *Phricodothyris perplexa*, *Marginifera* sp.; *Fusulina*, *Wedekindellina*

72. *Composita argentea*, *C. ovata*, *Spirifer occidentalis*, *Derbya* sp.

69. *Composita ovata*, *C. subtilita*, *Linoproductus* cf. *L. platyumbonus*, *Spirifer occidentalis*

66. *Composita subtilita*, *Phricodothyris perplexa*, *Spirifer occidentalis*

64. *Composita* sp.

Warmington limestone member

27. *Phricodothyris perplexa*, *Spirifer occidentalis*; *Fusulina*, *Fusulinella*

Basal DESMOINESIAN (Derry, New Mexico)

D7. *Neospirifer* sp.

D2. *Composita derrya*, *C. malaya*, *Dictyoclostus morrowensis*,
Linoproductus cf. *L. platyumbonus*, *Phricodothyris perplexa*, *Spirifer*
occidentalis, *Marginifera* sp.

D1. *Composita derrya*, *Dictyoclostus morrowensis*, *Spirifer occidentalis*, *S.*
rockymontanus, *Marginifera* sp.

Discussion of Fauna

The Middle Pennsylvanian megafaunas in the Mud Springs Mountains and Derry Hills are composed predominantly of brachiopods. The species represented in this study are, for the most part, those characteristic of the midcontinent region. This is especially true of the assemblages throughout the Derryan strata and in the Elephant Butte and whiskey Canyon formations of the Desmoinesian. In the Garcia formation, with a sudden expansion in the number of species, the brachiopod assemblages assume a slightly different aspect. *Dictyoclostus hermosanus* and *D. inflatus* var. *coloradoensis*, which are common in Colorado but rare or absent in the mid-continent, appear as new elements in the Garcia fauna. It is postulated that a seaway to the north formed at the beginning of Garcia time and persisted until the end of the Desmoinesian, permitting the mingling of faunal elements of the two regions.

The faunal list (table 1) indicates that the New Mexico brachiopod assemblages of the Derryan and the Desmoinesian are significantly dissimilar, and that strata of the two series can be distinguished on the basis of the brachiopods alone. At least 15 species, representing 11 genera, seem restricted to the Desmoinesian. *Juresania* and *Phricodothyris* first appear in the top beds of the Derryan but are more abundant in, and characteristic of, the higher fossiliferous units of the Desmoinesian. Four species, *Chonetes striatus*, *Marginifera* cf. *M. haydenensis*, *Reticulariina* cf. *R. spinosa*, and *Rhipido'mella carbonaria*, are restricted to the Derryan.

A fifth species, *Composita derrya*, continues into the basal beds of the Elephant Butte formation. It may be ecologically significant that the range of this brachiopod species is almost the same as that of *Fusulinella*, both extending just a little higher than the recognized boundary between the two series.

Several characteristic Derryan species (e.g., *Reticulariina* cf. *R. spinosa*, *Chonetes striatus*, and *Composita derrya*) show striking similarities to Upper Mississippian forms. These resemblances suggest a much closer relationship with their late-Mississippian progenitors that can be demonstrated for the other Pennsylvanian stocks.

The faunal list also shows that the Bolander group as defined by Thompson (1942) correlates almost exactly with the Marmaton group of Kansas. The faunal assemblages have much in common, and the two species of *Spirifer* show a similar peculiarity in their stratigraphic range. In the mid-continent region, *Spirifer rockymontanus* is believed (Dunbar and Condra, 1932) not to extend above the Cherokee shale, and *Spirifer occidentalis* ranges only a little higher. In the south-central New Mexico sections, the species show a similar stratigraphic range. The highest appearance of *S. rockymontanus* is recorded from unit 83 of the Garcia formation, and that of *S. occidentalis* from unit 84 or possibly unit 87. The lower boundary of the Bolander group, on this criterion, is no more than 27 feet higher than that of the Marmaton of Kansas and may be considered as at essentially the same position in both regions.

Systematic Paleontology

Order ORTHIDA

Suborder DALMANELLACEA

Genus **RHIPIDOMELLA** Oehlert 1890

Rhipidomella carbonaria (Swallow)

Pl. 6, fig. 39-41

- Orthis carbonaria* Swallow, 1858, St. Louis Acad. Sci. Trans., v. 1, p. 218.
---- Meek, 1872, U. S. Geol. Survey, Survey of Nebraska, Final Rept., p. 173, pl. 1, fig. 8a-c.
---- Meek and Worthen, 1873, Illinois Geol. Survey, v. 5, p. 571, pl. 25, fig. 4
---- Hall, 1883, New York State Geologist, Rept. for 1882, pl. 37, fig. 1-4
Orthis pecosi White (not Marcou), 1884, Indiana Geol. Survey, 13th Ann. Rept., p. 120 pl. 32, fig. 20-22.
---- Hall and Clarke, 1892, Pal. of New York, v. 8, pt. 1, pl. 7, fig. 1-4
---- Keyes, 1894, Missouri Geol. Survey, v. 5, p. 64.
---- Smith, 1897, Am. Phil. Soc. Proc., v. 35, p. 27.
Rhipidomella pecosi Beede, 1900, Kansas Univ. Geol. Survey, v. 6, p. 96.
---- Girty, 1915, Missouri Bur. Geology and Mines, 2d ser., v. 13, p. 286, 293, 299, 303.
Rhipidomella carbonaria (Swallow) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 52-54, pl. 2, fig. 1-4.
---- Shimer and Shrock, 1944, Index Fossils of North America, p. 355, pl. 139, fig. 24-26.

Shell, small, subcircular to subovate, slightly biconvex, a little wider than long. Greatest width just anterior to midlength; greatest thickness just posterior. A typical specimen is 9.5 mm long, 10.5 mm wide, and 4 mm thick. Hinge line short. Anterior more broadly rounded than the posterior.

Dorsal valve gently convex, thicker than the ventral. Beak very small, low, inconspicuous, barely incurved over the hinge line. A faint, rather broad sinus can be discerned on the anterior, apparently originating about three-fourths of the way from the anterior to the beak.

Ventral valve thin, very gently convex from umbo to anterior margin. Beak small, moderately low, with a small cardinal area curving longitudinally beneath it.

Surface marked by fine radial lirae, which increase by intercalation, and by occasional varices of growth on the anterior half.

Discussion. Comparison of specimens from limestone and shale matrices indicates that those taken from the latter have suffered compression. In undistorted shells, the ventral beak is higher, the cardinal area much larger, and the valve very gently convex all the way to the anterior instead of being almost resupinate. Typical measurements cited by Dunbar and Condra indicate that the specimen whose dimensions were given above should probably have a thickness of 6.5 to 7 mm. Previously reported only from the Cherokee and Henrietta groups of Kansas (Beede, 1908, p. 366) and widely distributed throughout the Missouri series (Dunbar and Condra, 1932, p. 54), the range of *Rhipidomella carbonaria* is here extended downward into the Derryan, to which it is confined in the Derry Hills section.

Occurrence. Units 2a, 4, 6 (middle), 8, 9 (top), 10.

Figured specimen. No. 442¹, from unit 4, Arrey formation, Derry, New Mexico.

Order RHYNCHONELLTDA

Suborder RHYNCHONELLACEA

Genus **WELLERELLA** Dunbar and Condra 1932

Wellerella multiplicata, n. sp.

Pl. 6, fig. 14-17

Shell small, rhynchonelliform, subtriangular in outline, as long as wide. Greatest thickness at midlength, greatest width anterior to middle. A single well-preserved specimen measures 7.5 mm long, 7.5 mm wide, and 3.5 mm thick. Posterolateral margins diverge from the beak at an angle of approximately 95 degrees.

Dorsal valve much thicker than the ventral; moderately convex from beak to beyond midlength, curving abruptly downward to a truncated anterior margin; transversely, strongly and regularly convex. limbo smooth. The fold begins faintly about 3 mm in front of the beak, widens rather abruptly anteriorly, but remains low. Three coarse, sharply angular plications in the fold on each lateral slope; 6 smaller distinct plications, a 7th short and almost obsolete, and a faint suggestion of an 8th.

Ventral valve gently convex. Beak prominent and pointed, only slightly curved; terminated by a small oval foramen. Umbo smooth but bears a faint median elevation. A broad shallow fold originates about 4 mm in front of the beak and is occupied by 2 plications, with 7 plications on each lateral slope, the outer one very short. The sinus is bent sharply upward to meet the fold of the dorsal valve, the sulcus between two plications extending upward to make an inverted V-shaped notch in the opposing plication. The fold and sulcus meet in a plane at, or nearly at, a right angle to the rest of the shell.

Discussion. The single specimen is so unique, on the basis of number of plications alone, as to be set off immediately from any heretofore described species. No described species has more than four plications on the lateral slopes, whereas this form has almost double that number.

Occurrence. Unit 75.

Holotype. No. 443, from unit 75, Garcia formation, Whiskey Canyon, New Mexico.

Order SPIRIFERIDA

Suborder PLINCTOSPIRACEA

Genus **HUSTEDIA** Hall and Clarke 1893

Hustedia mormoni (Marcou)

Pl. 6, fig. 1-8

- Terebratula Mormoni* Marcou, 1858, Geology of North America, p. 51, pl. 6, fig. 11-11c.
Hustedia mormoni (Marcou) Weller, 1898, U. S. Geol. Survey Bull. 153, p. 308 (synonymy to date).
---- Beede, 1900, Kansas Univ. Geol. Survey, v. 6, p. 103, pl. 11, fig. 10-10d; pl. 12, fig. 3.
---- Girty, 1915, U. S. Geol. Survey Bull. 544, p. 103, pl. 12, fig. 5-6a.
---- Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 356, pl. 42, fig. 9-11.
---- Shimer and Shrock, 1944, Index Fossils of North America, p. 363, pl. 141, fig. 43-45.

1. Specimen members refer to the collection of the New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico.

Shell small, gibbous, ovate, longer than wide. Greatest width anterior to middle; greatest thickness slightly posterior. Two typical specimens measure: Length 9 mm, 8 mm; width 7 mm, 6 mm; thickness 6 mm, 5 mm.

Dorsal valve thicker than the ventral. Convexity greatest transversely; longitudinally it is moderate from beak to umbo and gentler thereafter. Beak small and inconspicuous. Marked by 13 coarse, simple radial plications.

Ventral valve moderately convex longitudinally; flattened medially, with the lateral slopes dropping off steeply. Beak narrow, elevated, rather prominent, overarched a small triangular symphytium, and terminated by a small round foramen. An extremely faint, broad sinus usually can be distinguished on the anterior half. Line of commissure jagged. There are 14 plications (similar to those on the dorsal valve) on 2 complete specimens, but 1 broken specimen bears 16.

Discussion. This species is rare in the whiskey Canyon and Derry Hills sections, only 4 having been found. Of these, 3 came from a single bed of shale near the base of unit 6; the other weathered out of the limestone of unit 60.

Dunbar and Condra state that "the length of the hinge line slightly exceeds one-third the greatest width," but neither their specimens nor the New Mexico specimens show this proportion.

In all the shells, the hinge line is extremely short and considerably obscured. The range of this species, according to Dunbar and Condra (1932), is throughout the Pennsylvanian system in the Mississippi Valley, but it is rarely abundant.

Occurrence. Units 6 (base), 60.

Figured specimens. Nos. 444a-c; from unit 6, Arrey formation, Green Canyon group, Derry series, Derry, New Mexico.

Genus **PUNCTOSPIRIFER** North 1920

Punctospirifer kentuckiensis (Shumard)

Pl. 6, fig. 18-20

Spirifer octoplicata? Hall (not Sowerby), 1852, Stansbury's Expedition to Great Salt Lake, p. 409, pl. 4, fig. 4a-b.

Spirifer kentuckiensis Shumard, 1855, Missouri Geol. Survey Ann. Rept. 2, p. 203.

Spiriferina kentuckensis (Shumard) Meek, 1872, U. S. Geol. Survey, Survey of Nebraska, Final Rept., p. 185, pl. 6, fig. 3a-d; pl. 8, fig. 11a-b.

Spiriferina kentuckiensis (Shumard) Weller, 1898, U. S. Geol. Survey Bull. 153, p. 594 (synonymy to date).

Punctospirifer kentuckyensis (Shumard) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 351-355, pl. 38, fig. 1-5.

Punctospirifer kentuckiensis (Shumard) Shimer and Shrock, 1944, Index Fossils of North America, p. 361, pl. 141, fig. 6-7.

Shell small, transverse, rather gibbous, with acutely pointed or bluntly angular cardinal extremities at greatest width. Straight hinge line; greatest thickness at midlength. Both valves moderately and subequally convex. Two specimens (one mature) measure: Length 9.5 mm, 7 mm; width 18.5 mm, 9.5 mm; thickness 7 mm, 5 mm.

Dorsal valve bears a narrow, flat-topped fold about twice the size of its bounding plications. In the last 2 mm of the mature individual, a faintly distinguishable, narrow, de-pressed area appears on the top of the fold. Six coarse, simple plications (becoming smaller laterally) lie to each side of the fold and are separated by sulci at least as large; the outermost 3 do not reach the beak.

Ventral valve with a narrow, deep sinus originating in the beak and 6 lateral plications on each side. On the juvenile

specimen, the outer plication is very short and faint, as is the case on the dorsal valve. Only the innermost 3 reach the beak, which is small, narrow, elevated, not closely incurved above a relatively high, triangular interarea. Delthyrium not observed.

Surface ornamented by closely spaced growth lamellae.

Discussion. Dunbar and Condra (p. 352) state:

There is a surprising variation in the degree to which the cardinal extremities are extended, but it seems to be an individual variation only, since the greatest extremes are found in a single lot of specimens and are joined by completely intergrading forms.

The extreme shortness of the sixth plication on the juvenile shell, in which the length is only slightly less than that of the mature individual, is believed caused by disproportionate growth along the posterior margin as the individual matured.

Punctospirifer kentuckiensis ranges throughout the Pennsylvanian of Kansas, Nebraska, and Missouri. The species has been found in the Mud Springs and Derry Hills sections only twice.

Occurrence. Units 6 (near base), 113a.

Figured specimen. No. 445; from unit 6 (near base), Arrey formation, Derry, New Mexico.

Genus **RETICULARIINA** Fredericks 1916

Reticulariina cf. R. spinosa (Norwood and Pratten)

Pl. 6, fig. 29-32

Spirifer spinosa Norwood and Pratten, 1855, Acad. Nat. Sci. Philadelphia Jour., v. 3, p. 71, pl. 9, fig. 1a-d.

Spiriferina spinosa (Norwood and Pratten) Weller, 1898, U. S. Geol. Survey Bull. 153, p. 596 (synonymy to date).

Reticulariina spinosa (Norwood and Pratten) Shimer and Shrock, 1944, Index Fossils of North America, p. 361, pl. 141, fig. 9-13.

Shell small, transverse, rather gibbous, coarsely punctate. Hinge line a little less than the greatest width; greatest thickness and greatest width posterior to midlength. Sides slant upward and back from the dorsal beak when the shell is viewed from the front, ventral valve up. A single, beautifully preserved specimen is 10.5 mm long, 15 mm wide, 7 mm thick. The cardinal extremities are bluntly rounded.

Dorsal valve thin and, except for the beak, plane longitudinally; gently convex transversely. Beak very small, barely projecting beyond the hinge line. Cardinal area flat and triangular, dying out just before reaching the end of the hinge line. A narrow, sharply elevated, bluntly rounded fold originates on the beak. It is somewhat flattened near the anterior margin, and an incipient sinus on its top can be detected near the edge; at least twice the size of the bounding plications. Four plications of the same type on each lateral slope; these are not perfectly straight but curve gently toward the sides. They diminish rapidly in size, each being about half the size of the next inner one; the outermost is very low, almost paralleling the hinge line but not reaching the beak. The sulci are inverted equivalents of the plications.

Ventral valve much deeper than the dorsal. A small, pointed, elevated beak gently overarches a high triangular cardinal area longitudinally curved beneath it. The cardinal area does not extend to the end of the hinge line and is distinguished from the lateral slopes only by a pair of faint, narrow lines or ridges diverging from the beak. A large, open delthyrium, shaped like an equilateral triangle, is present. The growth lamellae bend across the line separating the

lateral slopes from the cardinal area and continue straight across the latter, giving it a longitudinally striated appearance. The sinus is the ventral equivalent of the dorsal fold, except that it bears a low and narrow, but distinct, median fold for about 5 mm behind the margin. The sinus is rather abruptly produced into the dorsal fold. Five plications similar to those on the dorsal valve are present, the outermost being very faint and not traceable to the beak.

Surface of both valves crossed by about 6 growth lamellae, progressively coarser and more closely spaced toward the front. Each plication bears from 2 to 4 very small spines along the anterior margin, and 1 is discernible on each umbonal slope.

Discussion. *Punctospirifer* is the only shell occurring in the Mud Springs and Derry Hills sections with which this species might be confused upon casual inspection. Four characteristics distinguish *Reticulariina* from *Punctospirifer*: (1) Spines along the anterior margin, (2) the ventral cardinal area is regularly curved instead of being nearly flat, except under the beak, (3) the growth lamellae are fewer and more widely spaced, and (4) fewer plications at a comparable growth stage.

Reticulariina spinosa also rather closely resembles *Spiriferina salemensis* of the Chester, in that its cardinal area is concave, the plications are the same number and size, the growth lines are crowded toward the front, and the general form is the same. The delthyrium of the latter species, however, is narrow, instead of broad; the cardinal area is higher and broader, extends all the way to the end of the hinge line, and is very distinctly set off from the lateral slopes; the shell bears no spines; and the punctae are minute instead of coarse.

It is unlikely that this shell is conspecific with *Reticulariina spinosa*, inasmuch as that species usually has 1 or 2 more plications and probably attains a greater size. It seems closely allied to *R. spinosa*, however, and probably descended directly from it. *Reticulariina spinosa* has been noted in the Chester series (Mississippian) of Kentucky, Tennessee, Alabama, and Illinois.

Occurrence. Unit 20.

Figured specimen. No. 446; from unit 20, Cuchillo Negro formation, west slope of Derry Hills, 0.8 mile east of Derry, New Mexico.

Suborder ROSTROSPIRACEA

Genus **COMPOSITA** Brown 1849

Composita argentea (Shepard)

Pl. 5, fig. 1-4

Terebratula argentea Shepard, 1838, Am. Jour. Sci., v. 34, p. 152, fig. 8.
Seminula argentea (Shepard) Weller, 1898, U. S. Geol. Survey Bull. 153, p. 561 (synonymy to date).

Composita argentea (Shepard) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 367, pl. 43, fig. 1-6.

Shell small, subcircular in outline; valves subequal in convexity; greatest width and thickness at, or near, midlength. A typical specimen is 14 mm long, 15 mm wide, and 7 mm thick.

Dorsal valve gently convex. Beak small, tightly incurved; fold ill defined.

Ventral valve gently convex longitudinally, a little more strongly curved transversely. Posterolateral slopes converge to form a rather short, blunt beak which terminates in a

small oval foramen. The sinus first appears as a faint, narrow indentation on the umbo, continuing to the front with only slight increase in depth and width; very lightly, or not at all, produced.

Surface marked by concentric growth lines crossed by faint radial striae.

Discussion. Dunbar and Condra probably were correct in recognizing this species as distinct from *Composita subtilita*. At comparable growth stages, it is subcircular instead of sub-ovate; the sinus is much less prominent and only slightly, if at all, produced; and the ventral beak is more blunt.

The species was described originally by Shepard from the LaSalle limestone, on the eastern edge of the city of LaSalle, Illinois. It ranges from the Desmoinesian through the Missourian.

Occurrence. Units 72, 80, 83, 92, 1134, 114.

Figured specimens. Nos. 447, 454, from unit 113a, Bolander group, Des Moines series, whiskey Canyon, New Mexico.

Composita derrya, n. sp.

Pl. 4, fig. 9-27

Shell large, gibbous, subovate in outline, normally a little wider than long; greatest width usually at midlength; greatest thickness slightly posterior. Measurements of 4 typical specimens: Length 30 mm, 32 mm, 32 mm, 32.5 mm; width 26 mm, 33 mm, 37 mm, 33 mm., thickness 19 mm, 18 mm, 23.5 mm, 17.5 mm.

Dorsal valve moderately convex. Greatest convexity lies in the umbonal region, the curvature becoming more gentle longitudinally; laterally, sides slope rather steeply to the margin. Beak small, inconspicuous, barely incurved over the delthyrium. A low fold begins near the umbo, expands, and is slightly produced anteriorly. A shallow sinus appears along each side on the anterior.

Ventral valve deeper, more convex. Posterolateral margins converge to form a blunt, rounded beak which is tightly incurved above that of the dorsal valve. Beak not sufficiently preserved to show the foramen. Convexity greatest from beak to umbo, then curving gently and regularly to the anterior margin; lateral slopes fall away steeply from the medial flattening. The sinus begins as a narrow, shallow indentation on the umbo, expanding and deepening gradually until it reaches the anterior margin.

Surface ornamented by concentric, sublamellose lines of growth. When half grown, the shell is much wider than long. Further growth takes place almost wholly along the anterior margin, resulting in a final subovate shape.

Discussion. This large gibbous species is one of the most easily recognizable of all the Middle Pennsylvanian fossils collected, and can be distinguished from other *Composita* species even though it displays a certain amount of variability.

It is closely allied to *Composita ozarkana*, with which it agrees in most features, but is at least a third larger in every dimension. Its recognition as a new species is believed justified because it is limited stratigraphically, and because *C. ozarkana* has not been recorded above the Morrow.

C. derrya differs from mature forms of *Composita ovata*, which attain the size of our smaller specimens, in that it is typically wider than long, the sinus differs in form and is distinctly produced, and the fold bears a lateral sinus on each side anteriorly.

This species and *Composita malaya*, n. sp., occur only in

a part of the section, which is either missing entirely in the midcontinent region or is represented there by sands and continental deposits.

Occurrence. Units 18 (base), 19 (base), D1, D2.

Types. Holotype. No. 448; from unit 18, Des Moines series, Derry, New Mexico.

Paratypes. No. 449, from unit D2, Elephant Butte formation, west slope of Derry Hills, 0.8 mile east of Derry, New Mexico. No. 450; from unit D1, Elephant Butte formation, Derry, New Mexico. Nos. 452, 453, from unit D2, Elephant Butte formation, Derry, New Mexico.

Composita malaya, n. sp.

Pl. 4, fig. 32-36

Shell of medium size, elongate, subcylindrical, greatest width at, or just anterior to, middle; greatest thickness at middle; valves subequal in convexity. The single specimen is 27 mm long, 20 mm wide, and 16 mm thick.

Dorsal valve evenly and gently convex from beak to anterior margin; lateral slopes curve somewhat more strongly to the sides; beak small, tightly incurved; fold rounded, ill defined.

Ventral valve strongly curved from beak to umbo, then regularly convex to anterior margin; a little more convex transversely. Posterolateral slopes converge to form a narrow, prominent beak closely incurved over the dorsal beak and concealing the delthyrium. Shallow, ill-defined sinus is present on the anterior, extending only about one-fourth of the way to the beak and very slightly produced.

The surface of the partially exfoliated specimen is ornamented by very fine growth lines with occasional coarser ones; in early stages, they are transversely elliptical; along the lateral margins, they appear sublamellose. No radial or con-centric striae observed.

Discussion. The single specimen is so distinctive that the writer has established a new species, although such procedure generally is regarded as undesirable. *Composita malaya* resembles *C. elongata* but differs in several respects. It is half again as large; the dorsal valve is regularly curved from the umbo to the anterior, instead of being nearly straight; the fold is almost obsolete, and the sinus ill defined; the anterior margin is only slightly produced. *C. malaya* is associated with *C. derrya*.

Occurrence. Unit D2.

Holotype. No. 451; from unit D2, Elephant Butte formation, Derry, New Mexico.

Composita ovata Mather

Pl. 5, fig. 5-13, 24-27, 38-40

Composita ovata Mather, 1915, Denison Univ., Sci. Lab., Bull., v. 18, p. 202, pl. 14, fig. 6a-c.

Composita wasatchensis Mather (not white), 1915, Denison Univ., Sci. Lab., Bull., v. 18, p. zoo, pl. 14, fig. 7-10b.

Composita ovata Mather Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 370-371, pl. 43, fig. 14-19.

Shell of medium to large size, subovate to subcircular in outline. Measurements of typical specimens: Length 32 mm, 25 mm, 22 mm, 19 mm; width 28.5 mm, 24 mm, 20.5 mm, 18 mm; thickness 18.5 mm, 11 mm, 11 mm, 10 mm. Valves

subequal in convexity; greatest thickness at midlength; greatest width usually just anterior to middle.

Dorsal valve moderately convex. Beak small, inconspicuous, not interrupting the subcircular outline of the valve. Fold almost obsolete.

Ventral valve most convex from beak to umbo, moderately convex on anterior slope. Posterolateral slopes converge to form a short, blunt beak which is incurved over the delthyrium and terminated by a large circular foramen. Beak usually is broken off when separated from a limy matrix. A median sinus originates near the umbonal region as a definite narrow groove, which continues to the anterior margin with little increase in width or depth and is only slightly produced. Surface ornamented by fine lines of growth and fine radiating striae. Occasional growth lines are sublamellose.

Discussion. This is one of the most common *Composita* species in the whiskey Canyon and Derry Hills sections. At maturity, it is characterized by its narrow sinus and broadly oval outline. Youthful stages can be distinguished from *C. argentea* by the incipient sinus and from *C. subtilita* by the circular outline and thin lens shape.

The species was described originally from the Morrowan of Arkansas and Oklahoma and ranges up into the Wabaunsee group (Missourian) of Kansas and Nebraska.

Occurrence. Units 12, 20, 21, 36, 69, 72, 79, 80, 84, 96, 113a, 114.

Figured specimens. Nos. 455-458; from (respectively) units 96, 96, 113a, and 114, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Composita subtilita (Hall)

Pl. 5, fig. 14-23, 28-37

Terebratula subtilita Hall, 1852, Stansbury's Exped. to Great Salt Lake, p. 409, pl. 4, fig. 1a-2c.

Composita subtilita (Hall) Dunbar and Condra, 1932, Nebraska Geol. Survey, 24 ser., Bull. 5, p. 363, pl. 43, fig. 7-13.

Shell variable in size, subovate in outline. Greatest width normally about two-thirds the distance from beak to anterior margin; greatest thickness at midlength. Valves subequally convex. Measurements of several perfect specimens: Length 24 mm, 23 mm, 19 mm, 17 mm; width 22 mm, 21 mm, 16 mm, 15 mm; thickness 15 mm, 13 mm, 12 mm, 11 mm.

Dorsal valve most convex from beak to umbo, then curving gently to the anterior and sharply to the lateral margins. Beak small, inconspicuous, barely incurved over the hinge. A low, broad fold is present on the anterior half of the shell.

Ventral valve slightly deeper than the dorsal. Posterolateral slopes converge gradually to form a prominent, tightly incurved beak which conceals the delthyrium and terminates in a small, round foramen. Convexity greatest from beak to umbo, then curving moderately and regularly to the anterior and lateral margins. In mature specimens, the sinus appears as a narrow, shallow depression about 8 mm from the beak. This depression remains distinct to the front of the shell and continues along the bottom of the broad, shallow sinus developed on the anterior half of the valve. This sinus is produced into the fold of the dorsal valve.

Surface ornamented by fine radial striations (on exfoliated shells) and growth lines. The latter are occasionally sublamellose and divide the surface into rather prominent, unequally spaced bands; in mature, well-preserved shells, they make their appearance about 16 mm anterior to the ventral beak and 12 mm anterior to the dorsal beak.

Discussion. In numbers and variability, *C. subtilita* is the most outstanding species of the Whiskey Canyon and Derry Hills sections. The specimens collected show intergradations with many other *Composita* species. In these sections, *C. ovata*, *C. argentea*, and *C. subtilita* are found in nearly every fossiliferous limestone and shale, and are associated with most of the other common brachiopod species. Such faunule assemblages suggest that *Composita* species adapted readily to a variety of environments.

The species was described by Hall from the "Missouri River, near Weston," Missouri. The latan limestone, Weston shale, and Stanton limestone, all of Missourian age, are exposed at this locality.

C. subtilita (Hall) ranges throughout the Pennsylvanian and into the early Permian.

Occurrence. Units 1, 12, 16, 66, 69, 79, 80, 83, 84, 95, 113a, 114.

Figured specimens. No. 459; from unit 114, Bolander group, Des Moines series, Whiskey Canyon, New Mexico. Nos. 460, 461; from unit 113a, Bolander group, Des Moines series, Whiskey Canyon, New Mexico. No. 462; from unit 83, Armendaris group, Des Moines series, Whiskey Canyon, New Mexico.

Composita sp.

Pl. 4, fig. 28-31

Shell small, gibbous, subpentagonal in outline; greatest width and thickness at midlength. Measurements of the single specimen: Length 16 mm, width 13 mm, thickness 10.5 mm.

Dorsal valve much thicker than the ventral; apparently, regularly convex from beak to midlength, then curved sharply (almost at a right angle) to the anterior margin. An obscure, shallow sinus occupies the middle of the tongue, which is received by an upright fold along the line of commissure; not produced beyond the regular margin of the shell.

Ventral valve strongly convex from beak to umbo but almost plane anteriorly; gently convex toward the lateral slopes; broad, ill-defined fold; beak, narrow, not prominent; delthyrium concealed. Surface peculiarly rugose, owing to 2 prominent varices of growth which divide the shell roughly into 3 parts.

Surface of both valves ornamented by fine growth lines and faint radial striae.

Discussion. This unique specimen is most interesting; unfortunately, the posterior half of the dorsal valve is damaged, it differs markedly from all other *Composita* specimens in the collection and apparently represents a rare new species. It is not named at this time, as the single broken specimen is not considered a suitable holotype.

Occurrence. Unit 83.

Figured specimen. No. 463; from unit 83, Armendaris group, Des Moines series, Whiskey Canyon, New Mexico.

Order SPIRIFERIDA

Suborder SPIRIFERACEA

Genus **NEOSPIRIFER** Fredericks 1919

Neospirifer triplicatus (Hall)

Pl. 3, fig. 26-30

Spirifer triplicatus Hall, 1852, Stansbury's Exped. to Great Salt Lake, p. 410, pl. 4, fig. 5a-e.

---- Girty, 1920, U. S. Geol. Survey Prof. Paper 111, p. 645, pl. 54, fig. 22.

Spirifer cameratus of authors in part.

Neospirifer triplicatus (Hall) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 328-332, pl. 39, fig. 5; pl. 41, fig. 1-6.

Shell medium sized, thin, transverse, subtriangular in outline; widest at the hinge line; greatest thickness slightly posterior to middle. Measurements of well-preserved specimen: Length 27 mm, width 50 mm, thickness 17 mm. Hinge line straight, cardinal area linear, cardinal extremities acute.

Dorsal valve most convex from beak to umbo, then moderately convex; the lateral slopes descend from the fold to the extended cardinal extremities, giving a gently concave appearance to each side. Beak small, barely overarched the hinge line; cardinal area linear. Fold starts as a single plication and divides about 5 mm from the beak; then the 2 plications almost immediately subdivide. Fold is low and narrow posteriorly but rises and expands anteriorly, where it is occupied by 6 plications. A total of 9 fascicles start from the beak, each splitting into 3. About 7 small, simple plications lie on each side and do not reach the beak.

Ventral valve a little deeper than the dorsal. Beak prominent, strongly overarched the hinge line. A deep, sub-rounded sinus originates on the beak between 2 fascicles and expands gradually to the anterior margin, where it is produced into a subangular tongue fitting into the fold of the dorsal valve. A single, simple plication runs down the center; 2 more split off on each side from the bounding fascicles. Ten of these fascicles spring from the beak, each splitting into 3 about 5 mm therefrom. About 8 small, simple (with the exception of the innermost one, which splits once) plications lie on each side. Cardinal area high and prominent, decreasing but little in height toward the extremities.

Discussion. The New Mexico specimens are somewhat more transverse than is typical, but not so much as in *Neospirifer triplicatus* var. *alatus*. It seems preferable to recognize the species proper in the New Mexico material, since the var. *alatus* is considered to be confined to the Kansas City and Lansing groups of Kansas.

The species was described originally from the Douglas group on the Missouri River above Weston, Missouri. Dunbar and Condra give as its range the base of the Marmaton up into the Wabaunsee group. This range supports the conclusion (p. 9) that the Bolander group is very nearly the equivalent of the Marmaton of Kansas.

Occurrence. Units 80, 86, 92, 113a.

Figured specimen. No. 464; from unit 113a, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Neospirifer triplicatus var. *gibbosus* Dunbar and Condra

Pl. 3, fig. 31-33

Neospirifer triplicatus var. *gibbosus* Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 333, pl. 38, fig. 14-15.

Shell large, very gibbous, wider than long; hinge line straight, a little less than the greatest width at the midlength. Cardinal extremities meet the slightly curved lateral margins at a low obtuse angle. Cardinal areas not observed. The single specimen measures 35 mm in width, 18 mm in thickness, and about 26 mm in length.

Dorsal valve gibbous, with a very small, inconspicuous beak. A broad, elevated, prominent fold begins at the beak

and widens rapidly anteriorly. Lateral slopes at an angle of about 45 degrees. Fasciculation is low and inconspicuous (possibly from weathering), and is confined largely to the region around the beak. There are 8 broad, rounded costae on the fold and about 13 on each lateral slope along the mar-gins; the outermost 4 or 5 are simple and do not reach the beak.

Ventral valve very gibbous, so that even the lateral slopes appear inflated. Surface features weathered, beak and cardinal area broken off. A deep, broad sinus appears to be produced into the dorsal fold. The costae are similar to those on the dorsal valve.

Discussion. The single specimen agrees fairly well with Dunbar and Condra's illustrations. There is no other species of *Neospirifer* which compares with it in convexity. One hesitates to make a definite identification because the shape of the cardinal area and beak cannot be determined, and because the fasciculation is not so marked as on the specimen figured by Dunbar and Condra. Dunbar and Condra found this variety only in the Douglas group of the Missouri series. The New Mexico specimen occurs near the base of the Des Moines series.

Occurrence. Unit 45.

Figured specimen. No. 465; from unit 45, Whiskey Canyon limestone, Armendaris group, Whiskey Canyon, New Mexico.

Neospirifer cf. *N. latus* Dunbar and Condra

Pl. 3, fig. 34; pl. 4, fig. 1-2

Neospirifer latus Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 335-337, pl. 40, fig. 1-5.

Shell large, transverse, varying in width at the hinge line from 70 to 90 mm, and in length from 40 to 50 mm; thickness 17 mm or more. Hinge line straight, forming the greatest width. Cardinal area linear, about 4 mm high; cardinal extremities acute to bluntly rounded; cardinal margins finely crenulate; valves subequally convex.

Dorsal valve moderately convex, slightly concave on each side of the fold. Beak low, small, overarched the hinge line. A low, broadly rounded fold originates on the beak and gradually expands anteriorly; 6 or 7 plications on fold at midlength, and 12 to 16 at anterior margin. Plications on the lateral slopes are markedly fasciculate on the posterior half of the valve. Some 20 to 24 *subequal* plications on each side anteriorly.

Ventral valve moderately convex; beak strongly curved over the hinge line. A broad, shallow sinus about 20 mm wide at anterior margin, where it is occupied by 12 coarse plications. Twenty low, rounded, closely spaced plications to each side, becoming smaller toward the lateral margins and obsolete on the extreme posterolateral region; not markedly fasciculate.

Discussion. The specimens are poorly preserved isolated valves in limestone matrix and are weathered or exfoliated. Identification is difficult and is based largely on gross surface features. *Neospirifer latus* is confined to the Kansas City and Lansing groups in Nebraska, Kansas, and Missouri. It has been reported previously from the Derry of New Mexico by Wood et al. (1946).

Occurrence, Units 80, 83, 87, 95, 107, 114.

Figured specimens. No. 466; from unit 80, Garcia formation, Whiskey Canyon, New Mexico. No. 467; from unit

114, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Genus **SPIRIFER** Sowerby 1814-18

Spirifer occidentalis Girty

Pl. 3, fig. 7-18

?*Spirifer boonensis* Swallow, 1860, Acad. Sci. St. Louis Trans., v. 1, . 646.

Spirifer boonensis? Girty, 1903, U. S. Geol. Survey Prof. Paper 16, p. 381, pl. 6, fig. 1-3.

---- Morningstar, 1922, Ohio Geol. Survey Bull. 25, p. 186, pl. 9, fig. 21-25.

Spirifer opinius Hall var. *occidentalis* Girty, 1927, U. S. Geol. Survey Prof. Paper 152, p. 433, pl. 27, fig. 28-31.

Spirifer occidentalis Girty Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 322-326, pl. 41, fig. 12-16.

Shell of medium size, transverse, about two-thirds as long as wide. Hinge line straight, equals the greatest width. Cardinal extremities usually extended slightly and pointed, meeting the lateral margins at an acute angle. Greatest thickness just posterior to the middle. Measurements of typical specimens: Length 23.5 mm, 23 mm, 20.5 mm., width 35 mm, 32 mm, 26 mm; thickness 16.5 mm, 16 mm, 11.5 mm. Several dissociated valves indicate a width slightly in excess of 50 mm, and a length of 35 mm may be attained.

Dorsal valve transverse, somewhat gibbous. Beak small but conspicuous; incurved over a narrow, linear cardinal area which meets that of the ventral valve at right angles; fold begins as a simple plication near the beak and rises to prominence anteriorly. This plication splits almost at once, each of the halves subdividing again immediately. The 2 outer-most halves branch again about 5 mm from the beak (making a total of 6 plications), although these 2 outer branches usually remain indistinct until beyond the middle. The lateral slopes bear 10 or 11 coarse, rounded plications separated by narrow, shallow sulci. All plications on both valves apparently radiate from the beak.

Ventral valve moderately and regularly convex, deeper than the dorsal. Cardinal area large, triangular; straight except in uppermost portion, where it curves beneath the small, slightly overarched beak; cleft by a large, open delthyrium in the form of an isosceles triangle; in well-preserved specimens, distinctly crenulate. A broad, shallow sinus originates on the tip of the beak between two bounding plications. At 2 mm, a plication arises in the center, which continues simple to the anterior margin; the bounding plications split on their inner side and then subdivide once more a short distance farther from the beak. The median plication is the largest on the shell. mature specimens, the sinus is sharply deflected downward and produced into the fold. Eleven or 13 plications occupy each lateral slope. On this valve, the outer plications do not reach the beak. No other surface ornamentation observed.

Discussion. *S. occidentalis* is the most abundant *Spirifer* in the Whiskey Canyon and Derry Hills sections. It ranges from the lowermost beds of the Derryan to well up in the Desmoinesian. The species is confined to the lower part of the Pennsylvanian system and has been recorded from Oklahoma, Colorado, New Mexico, Missouri, and Ohio. Dunbar and Condra did not find it above the Fort Scott limestone, which is the basal member of the Marmaton group in New Mexico. The writer did not find it above unit 84, which is 29 feet below the top of the Armendaris group.

Occurrence. Units 1, 2a, 4, 8, 9, 10, 12, 16, 18, 19, 20, 21, DI, D2, 27, 31, 32, 34, 36, 45, 53, 58, 61, 62, 66, 69, 72, 75, 79, 80, 83, 84, 96.

Figured specimens. No. 468; from unit 12 (base), Apodaca formation, Derry, New Mexico. No. 469; from units 8 and 9 (top), Apodaca formation, Derry, New Mexico. No. 470; from unit 84, Garcia formation, Whiskey- Canyon, New Mexico.

Spirifer rockymontanus Marcou

Pl. 3, fig. 19-25

Spirifer rocky-montani Marcou, 1858, *Geology of North America*, p. 50, pl. 7, fig. 4c-e.

Spirifer rockymontanus Marcou Weller, 1898, U. S. Geol. Survey Bull. 153, p. 589 (synonymy to date).

---- Girty, 1899, U. S. Geol. Survey 19th Ann. Rept., pt. 3, p. 578.

---- Girty, 1903, U. S. Geol. Survey Prof. Paper 16, p. 383, pl. 6, fig. 5-7c.

---- Raymond, 1910, Carnegie Mus. Annals, v. 7, p. 156, pl. 24, fig. 5.

---- Raymond, 1911, Pennsylvania Topog. and Geol. Survey Comm., Rept. for 1908-10, pl. 3, fig. 5.

---- Mark, 1911, Denison Univ., Sci. Lab., Bull., v. 16, p. 308, pl. 8, fig. 10.

---- Mather, 1915, Denison Univ., Sci. Lab., Bull., v. 18, p. 181, pl. 12, fig. 1-6.

---- Plummer and Moore, 1921, Texas Univ. Bull. 2132, p. 45, pl. 6, fig. 8.

---- Morgan, 1924, Bur. of Geol. (Oklahoma) Bull. 2, p. 220, pl. 45, fig. 6-6b.

---- Croneis, 1930, Arkansas Geol. Survey Bull. 3, p. 86, pl. 22, fig. 10-13.

---- Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 318-319, pl. 41, fig. 7-9.

---- Shimer and Shrock, 1944, Index Fossils of North America, p. 325, pl. 124, fig. 20-24.

Shell medium sized, gibbous, subovate in outline; length about equals width. Two well-preserved specimens measure: Length 24.5 mm, 25 mm., width 26.5 mm, 23.5 mm, thickness 14 mm, 16 mm. Hinge line a little less than the greatest width, which lies at the midlength of the dorsal valve; greatest thickness at the middle; valves subequally convex.

Dorsal valve moderately convex, more so transversely than longitudinally; lateral margins evenly curved, broader anteriorly, meeting the straight hinge line at an obtuse angle. Beak small, overarched a distinct flat interarea which meets that of the ventral valve at right angles. A strong, elevated, narrow fold bears 6 coarse, subangular plications; each lateral slope has 9 or 10 plications. Fold starts as a single median plication on the beak, dividing almost immediately; each half then subdivides twice close to the beak.

Ventral valve most complex from beak to umbo, curving more gently to anterior margin; lateral slopes steep. Beak large, elevated, and arched over a prominent triangular inter-area which curves longitudinally beneath it. This area may be vertically striated. A broad, shallow sinus, produced into a prominent, pointed tongue, originates on the beak between two lateral plications; then a median plication arises which continues simple to the anterior and is the largest plication on the shell. Each of the lateral bounding plications sub-divides twice, making a total of 5 coarse, subangular plications in the sinus. There are 11 on each lateral slope; the first pair join near the beak, the outer plications not reaching it.

Discussion. The shells were all collected from limestone and are partially exfoliated. The fine radial and concentric lirae cannot be distinguished. No specimens were found in

the Derryan units, although they were obtained in the lowest Desmoinesian beds and sporadically higher. *Spirifer occidentalis* occurs abundantly throughout both series. The two species are easily distinguished, as *S. occidentalis* is much more transverse and its plications all radiate from the beak.

According to Dunbar and Condra (1932, p. 319):

Spirifer rockymontanus [originally] was described from the Magdalena limestone near Ti[j]eras in San Antonio Canyon[,] east of Albuquerque, New Mexico. It is widely distributed in the early Pennsylvanian of Colorado (*vide* Girty) and appears in typical expression in the Pumpkin Creek limestone member of the Dornick Hills formation in Sec. 30, T. 3 S., R. 2 E., near Berwyn, Oklahoma. It occurs also in the upper Pottsville of Ohio. Like *S. opimus*, it is confined to the lower part of the [Pennsylvanian], where it occurs with *Mesolobus mesolobus* and *Marginifera muricatina*. It probably does not occur above the horizon of the Cherokee shale.

Occurrence. Units D1, 45, 63, 80, 83.

Figured specimens. No. 471, from unit 45, Whiskey Canyon limestone, Whiskey Canyon, New Mexico. No. 472, from unit D 1, Elephant Butte formation, Derry, New Mexico.

Genus **PHRICODOTHYRIS** George 1932

Phricodothyris perplexa (McChesney)

Pl. 6, fig. 9-13, 33-38

Spirifer perplexa McChesney, 1860, Description of New Species of Fossils From the Paleozoic Rocks of the Western States, p. 43.

Reticularia perplexa (McChesney) Weller, 1898, U. S. Geol. Survey Bull. 153, p. 520 (synonymy to date).

Squamularia perplexa Girty, 1903, U. S. Geol. Survey Prof. Paper 16, p. 392, pl. 6, fig. 8-1 oa.

---- Girty, 1915, U. S. Geol. Survey Bull. 544, p. 92, pl. 11, fig. 1-3a.

Squamularia? perplexa (McChesney) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 313-317, pl. 42, fig. 5-8.

Phricodothyris perplexa (McChesney) Shimer and Shrock, 1944, Index Fossils of North America, p. 327-328, pl. 126, fig. 9-10.

Shell moderately small, gibbous, subcircular in outline, usually a little wider than long. Greatest width and thickness at midlength. Exact proportions difficult to determine, as a free, well-preserved shell is rare, the valves usually being found dissociated. Measurements of 3 small specimens: Length 8 mm, 10 mm, 12 mm., width 8 mm, 12 mm, 14 mm; thickness 6.5 mm, 6 mm, 8.5 mm. Two valves measured 26 mm and 28 mm across; others are no larger than 4 mm. Hinge line about one-half the greatest width; exact determination difficult because of the gradual gradation into the posterolateral margins. Line of commissure straight.

Dorsal valve moderately convex; beak small, barely rising above the hinge line; anterior more rounded than the posterior. In most specimens, a faint, but distinct, hairlike furrow extends down the center.

Ventral valve much more convex; beak prominent, elevated, strongly arched over a triangular cardinal area which curves beneath it. The area is not very sharply delimited from the posterior slopes which curve into it, and is occupied for the greater part by a large, open delthyrium having the form of an isosceles triangle. On the larger shells, a furrow also extends down the center of this valve.

Surface ornamented by concentric bands more sharply set off anteriorly than posteriorly. The exfoliated shells show only the great number of closely spaced rows of spine bases, which give the shell a faintly striate appearance. No spines were preserved on these specimens. Dunbar and Condra

(1932, p. 315) have observed that "usually there is a very faint dorsal fold and ventral sinus near the front of large specimens but in all cases these are almost obsolete." None of the New Mexico specimens can be construed to have either a fold or sinus.

Discussion. The type specimens were probably from the Desmoinesian of Illinois, although McChesney described the shell as occurring "in the Coal Measures in almost every part of the country where rocks of that age exist." Dunbar and Condra record the species range from the Desmoinesian to the Iowa Point shale, high up in the Missourian. It appears in the Whiskey Canyon and Derry Hills sections in the uppermost beds of the Derryan, unit 20, and thereafter is abundant throughout the Des Moines series.

Occurrence. Units 20, D2, 27, 30, 31, 32, 34, 36, 45, 53, 60, 63, 66, 74, 80, 83, 84, 86, 87, 92, 95, 99-101, 106, 107, 109.

Figured specimens. No. 473, from unit 53, Whiskey Canyon limestone, Whiskey Canyon, New Mexico. No. 474, from unit 63, Whiskey Canyon limestone, Whiskey Canyon, New Mexico. No. 475; from unit 106, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Order STROPHOMENIDA

Suborder PRODUCTACEA

Genus **BUXTONIA** Thomas 1914

Buxtonia? sp.

Pl. 4, fig. 3-8

Shell medium sized, subquadrangular in outline, slightly wider than long. Hinge line not observed. Approximate measurements of a slightly crushed specimen: Length 22.5 mm, width 25 mm, thickness 11 mm; a second specimen, width 27 mm, length 23 mm. The lateral margins are nearly straight, meeting the hinge line at an obtuse angle; the anterior is broadly rounded. The beak appears to be strongly curved over the hinge line.

Dorsal valve nearly flat, curved abruptly upward along the anterior margin. It bears coarse, low, rounded, unequally spaced costae, with a few additional ones intercalated near the upturned edge. Small spine bases arise from the top of the costae, slightly thickening them.

Ventral valve strongly convex longitudinally; almost flat transversely, with lateral slopes at right angles. A shallow sinus originates about cm from beak and remains constant in width (about 5 mm in the larger specimen, 3 mm in the smaller) and depth to the anterior margin. Ears small, bearing (as far as can be determined) two spines along the cardinal margin. Rugae, from which arise spine bases, cross the lateral slopes and continue very faintly across the umbo. Coarse, elevated, rounded, subequal costae radiate from the beak and increase by intercalation on the anterior half of the shell. Irregularly spaced spine bases arise at a low angle from the costae, slightly thickening them.

Discussion. This form is questionably referred to the genus *Buxtonia*, although it agrees well in size, shape, and general appearance with the specimen of *B. scabricula* (Martin) illustrated by Dunbar and Condra (1932, pl. 21, fig. 6). The costae on specimens 476 and 477 are uninterrupted and bear pustulose spine bases on their top; the rugae are only weakly developed. These are characteristics of the genus *Buxtonia*. *B. semicircularis* Sutton and Wagner, from the Chester, and

B. peruviana (d'Arbigny), from the Permian, are the only described American species.

It would appear that these two specimens actually represent a distinct new species of *Buxtonia* in the Pennsylvanian of the Southwest. The characteristic features of this species suggest that it represents a line of development independent of the two previously known American species. The stratigraphic position refutes the possibility that this species may be a link between *Pustula* and *Juresania*, since *Juresania* already is present in typical development much lower in the Whiskey Canyon section. The marked similarity to the European *B. scabricula* suggests relationship to that species.

Occurrence. Units 113a, 114.

Figured specimens. No. 476; from unit 113a, Bolander group, Des Moines series, Whiskey Canyon, New Mexico. No. 477, from unit 114, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Genus **CANCRINELLA** Fredericks 1928

Cancrinella boonensis (Swallow)

Pl. 6, fig. 21-22

Productus Boonensis Swallow, 1858, Acad. Sci. St. Louis Trans., v. 1, p. 217.

--- Weller, 1898, U. S. Geol. Survey Bull. 153, p. 496.

Productus Boonensis var. *elevata* Swallow, 1858, Acad. Sci. St. Louis Trans., v. 1, p. 217.

Productus pertenuis Meek, 1872, U. S. Geol. Survey, Survey of Nebraska, Final Rept., p. 164, pl. fig. 14a-c (not pl. 8, fig. 9a-d).

Cancrinella Boonensis (Swallow) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 258-260, pl. 32, fig. 1-5.

Shell small, subcircular in outline, length and width almost equal; hinge line straight, shorter than the greatest width. Specimens measure about 11.5 mm long, 11 mm wide, and 4 mm thick.

Dorsal valve not observed.

Ventral valve gibbous, strongly and regularly convex. Beak small and pointed, barely projecting past hinge line; lateral slopes only moderately steep, except from the small, inflated umbo, where they are abrupt. Ears small, not much flattened. Surface covered by fine, regular, rounded, radial costae and concentric rugae. Rugae are faint over the umbonal region and relatively broad and irregular over the anterior slopes. Coarse spines arise tangentially from the radial costae; they are especially numerous near the anterior and lateral margins.

Discussion. There is no other fossil in this fauna which resembles *Cancrinella*. The rugae completely crossing the shell, and the numerous spines, preclude mistaking this form for a small *Linoproductus*. The species was described originally by Swallow "from numerous localities in the Coal Measures, particularly the upper division near the mouth of the Platte, in [Nebraska] Territory." It ranges throughout the Pennsylvanian in Kansas and Nebraska.

Occurrence. Units 83, 113a, 114.

Figured specimen. No. 478; from unit 113a, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Genus **CHONETES**

Chonetes striatus, n. sp.

Pl. 6, fig. 23-28

Shell small, subsemielliptical, two-thirds as long as wide; hinge line straight, equal to greatest width. A typical shell is 6 mm long, 8.5 mm wide, 2.5 mm thick. Lateral margins al-

most straight for 2 to 3 mm, then curved broadly to the anterior; cardinal extremities slightly extended in some specimens.

Dorsal valve concave, dropping abruptly from the beak, then curving regularly to anterior margin, but only slightly laterally and posteriorly, so that the portion of the valve beneath the ventral ears is flattened. Beak small and inconspicuous, barely notching the hinge line.

Ventral valve strongly convex. Beak small, barely projecting beyond the hinge line; umbo broad, inflated; small, flattened ears set off distinctly from the otherwise even convexity of the valve. Three spine bases distinguishable along each side of the ventral cardinal margin. Ventral cardinal area low and triangular, decreasing in height gradually to the cardinal extremities and lying within the plane of the valves.

Surface of the ventral valve covered by fine, rounded, uneven, bifurcating lirae separated by striae of nearly equal width; concentric ornamentation lacking. Lirae are equally prominent on all parts of the valve; 5 to 6 in a width of mm at midlength. The dorsal valve bears lirae of about the same size; since they do not seem to bifurcate, they give the impression of being coarser.

Discussion. This species shows the closest affinities to several Mississippian species. It differs from *Chonetes tonensis* in being smaller and proportionately more convex, in having the ears distinctly set off from the umbo, in having simple lirae on the dorsal valve, and in having the striae as wide as the lirae. It differs from *C. logani* by having the umbonal surface striated; by its proportionately larger, more distinct ears; by its simple costae on the dorsal valve; by the lack of concentric ornamentation which gives *C. logani* a finely crenulate appearance; and by having lirae no wider than the intervening striae. It can be distinguished from *C. ornatus* in being smaller and proportionately more convex, in having costae on the ears, and in having simple lirae on the dorsal valve and no concentric markings.

The specimen on which the measurements were taken was collected from shale and is probably somewhat compressed. A second specimen suggests that the normal convexity of the shell may be 3 to 3.5 mm and that the anterolateral margins are more rounded. A weathered ventral valve shows small, closely spaced papillae running the entire length of the striae. The papillae are not visible on well-preserved specimens. *Chonetes striatus* appears to be confined to the basal Derryan.

Occurrence. Units 1 (middle), 2a, 4, 10.

Types. Holotype. No. 479, from unit 1 (middle), Arrey formation, Derry, New Mexico.

Paratypes. Nos. 480, 481; from unit 4, Arrey formation, Derry, New Mexico.

Genus **DICTYOCLOSTUS** Muir-Wood 1928

Dictyoclostus hermosanus (Girty)

P1.1, fig. 16-20

Productus semireticulatus var. *hermosanus* Girty, 1903, U. S. Geol. Survey Prof. Paper 16, p. 358-359, pl. 2, fig. 1-4.

Shell very large, wider than long, suboval in outline; hinge line equals the greatest width; greatest thickness at midlength. Measurements (in part restored): Length 50 mm, width 62 mm, thickness 30 mm.

Dorsal valve not observed.

Ventral valve, strongly and regularly convex from beak to anterior margin; transversely broad, with steep lateral slopes. A deep, narrow sinus originates on the umbo and remains almost constant in width and depth to the anterior margin. Limbo broad, inflated, and extending beyond hinge line; ears and beak not observed. Surface covered by large, rounded, regular, rarely bifurcating costae, which increase in width toward the anterior. At midlength, the costae number 8 or 9 to 10 mm; along anterior margin, 7 or 8. They are crossed on posterior third of shell by fine, regular, closely spaced, concentric rugae, which form small nodes where they cross the costae. The rugae gradually die out anteriorly, becoming lower and less distinct, but they can still be detected at midlength. A few small, erect spines arise from the top of the costae, which are thickened at that point and for a short distance anteriorly.

Discussion. These specimens clearly represent the same species described by Girty as *Productus semireticulatus* var. *hermosanus*. Girty illustrated several specimens. One "very characteristic specimen" has about the same number and size of spines as the New Mexico specimen; another, described by Girty as "a finely striated type more or less intermediate between this species and *Productus inflatus*, to which, on the whole, I am disposed to regard it as nearer related," shows the large spines mentioned by Girty in the description. His quoted comments indicate that the smaller spined shell is the type he had in mind for *D. hermosanus*. Muir-Wood (1928, p. 101) has shown that the British species *D. semireticulatus* (Martin) is quite distinct from the American Pennsylvanian species. In 1932, Dunbar and Condra named the common midcontinent species *D. americanus* and noted the differences between it and *D. hermosanus*.

Occurrence. Unit 87.

Figured specimen. No. 487; from unit '87, Garcia formation, Whiskey Canyon, New Mexico.

Dictyoclostus inflatus var. *coloradoensis* (Girty)

P1.1, fig. I-10

Productus inflatus McChesney, 1860, Descriptions of New Species of Fossils From the Paleozoic Rocks of the Western States, p. 40.

-----Weller, 1898, U. S. Geol. Survey Bull. 153, p. 491 (synonymy to date).

-----Girty, 1903, U. S. Geol. Survey Prof. Paper 16, p. 359-361, pl. 3, fig. 2-2a, 3.

Productus inflatus var. *coloradoensis*, Girty, 1910, New York Acad. Sci.

Annals, v. 20, n. 3, pt. 2, p. 215.

-----Girty, 1915, U. S. Geol. Survey Bull. 593, p. 47, pl. 3, fig. 7-8a (synonymy to date).

-----Croneis, 1930, Arkansas Geol. Survey Bull. 3, p. 64, pl. 15, fig. 1-2.

Shell of medium size, a little longer than wide, subquadrate in outline, with the greatest width at the hinge line. Measurements of two specimens (in part restored): Length 43.5 mm, 43 mm, width 40 mm, 39 mm., thickness 19 mm, 20 mm.

Dorsal valve almost plane and markedly reticulate posteriorly, strongly geniculated at midlength. A very small beak impinges upon the hinge line; in front of the beak, there rises a very low, broad, triangular elevation which runs to the anterior margin. Ears relatively large and flat. The same coarse plications are present as on the ventral valve. An exfoliated surface shows several spine bases emerging tangentially from the costae; scattered on the ears and anterior slope

are rather numerous, large, rounded nodes, perhaps the bases of spines, which impart a peculiarly rough appearance to the shell.

Ventral valve geniculate. Beak large and rounded, projecting over the hinge line with such convexity that much of the broad, inflated umbo is posterior to the hinge. Ears relatively small, curved, sharply separated from the umbonal slopes, and bearing at least 2 large spines along the cardinal margin and 4 in an oblique row on the base of the umbonal slopes. A sinus, varying somewhat in prominence between specimens but always narrow and distinct, extends from the umbo to the anterior margin.

Surface ornamented with strong, rounded, subequal, rarely bifurcating costae separated by narrow sulci. The costae increase in thickness toward the anterior; about 11 occupy a space of 10 mm at midlength. Posterior marked by concentric rugae a little broader than the costae and forming rounded nodes where they cross, giving the shell the customary reticulated appearance. Some half dozen large, irregularly scattered, erect spines spring from the radial costae; these costae continue thickened for a distance, then split into 2 or 3 costae of normal size.

Discussion. Girty was not sure that his specimens from Colorado were conspecific with McChesney's types of *D. inflatus* from the Chester. Subsequently, the Pennsylvanian forms from Colorado were recognized as a distinct variety, *coloradoensis*, by Girty, but the marked similarity between the two forms validates their conspecific recognition. This variety was recorded by Girty from the Lower Pennsylvanian of Colorado, Nebraska, Kansas, and Tennessee. Dunbar and Condra (1932, p. 217) mention the general similarity between this variety and *D. portlockianus* (Norwood and Pratten), but the known specimens of the latter species are consistently somewhat smaller in size and have much coarser costae.

Occurrence. Units 39, 80, 87, 89, 90, 95, 96.

Figured specimens. No. 482, from unit 80, Garcia formation, Whiskey Canyon, New Mexico. No. 483; from unit 96, Bolander group, Des Moines series, whiskey Canyon, New Mexico. No. 484; from unit 89, Garcia formation, Whiskey Canyon, New Mexico.

Dictyoclostus morrowensis (Mather)

Pl. 1, fig. 11-15

Productus morrowensis Mather, 1915, Denison Univ., Sci. Lab., Bull., V. 17, p. 152, pl. 10, fig. I-4a.

Croneis, 1930, Arkansas Geol. Survey Bull. 3, p. 86, pl. 22, fig. 1-3.

Shell of medium size, much wider than long, subquadrate in outline; hinge line equals the greatest width. Measurements of a typical specimen (in part restored): Length 21 mm, width 32 mm, thickness 15 mm.

Dorsal valve plane posteriorly, sharply geniculated at the middle. The small beak extends from a small, subcircular elevation which is a little past the hinge line. A broad, shallow sinus originates at the rear of the elevation and extends to the anterior margin. Ears not distinctly set off from the rest of the valve. Fine, regular costae, about 8 in 5 mm at the line of geniculation, are crossed posteriorly by closely spaced, fine, concentric rugae, producing a finely reticulate appearance.

Ventral valve strongly and evenly convex. Ears relatively small, bearing two large spines along the cardinal margin. A broken large spine near the lateral margin is seen to be hol-

low. A narrow, shallow sinus extends from the broad, rounded umbo to the anterior margin.

Surface ornamented (except the ears) by numerous fine, rounded, subequal, regular, bifurcating costae crossed posteriorly by regular, rounded rugae. A few slender spines arise from the costae.

Discussion. The transverseness of the shell, the fine regular costae, and shallow median sinus distinguish this species. It is very similar to *Dictyoclostus fernglenensis* of the Chester series, the only noticeable difference being the relatively greater evenness (and perhaps a greater fineness) of the costae on *D. morrowensis*. The species is a very common and characteristic Morrowan fossil. It has been reported from the Hale sandstone and the Wapanucka, Marble Falls, and Brentwood limestones.

Occurrence. Units (base), 6, Dr, D2, 45, 58, 95.

Figured specimens. Nos. 485, 486; from unit 1 (base), Arrey formation, Derry, New Mexico.

Genus **ECHINOCONCHUS** Dunbar and Condra (1932)

Echinoconchus semipunctatus var. *knighti* Dunbar and Condra

Pl. 2, fig. 10-12, 20, 23

Productus symmetricus white (not McChesney), 1883, Indiana Geol. Survey, 13th Rept., p. 123, pl. 25, fig. 1-20.

Productus punctatus of American authors in part.

Echinoconchus semipunctatus var. *knighti* Dunbar and Condra, 1932, Nebraska Geol. Survey, 24 ser., Bull. 5, p. 208-209, pl. 26, fig. 1-3.

Shell rather large, suboval in outline, width almost equal to length; greatest width anterior to the middle; hinge line straight, a little shorter than the greatest width. Measurements (in part restored): Length 62 mm, width 56.5 mm, thickness 17 mm.

Dorsal valve subquadrangular in outline; concave, owing to the rather abrupt upturning of the lateral margins. A small, shallow, subcircular depression beneath the beak. A low, median elevation originates in front of the depression and continues to the anterior margin, expanding very gradually. Surface ornamented by regular, closely spaced concentric bands bearing the spines typical of the genus.

Ventral valve strongly convex from beak to umbo, gently and regularly convex to anterior margin. Beak small, pointed, closely incurved against the dorsal valve. A small portion of the umbo overhangs the hinge line. The posterolateral margins steep, commonly forming a right angle, but the angle decreases slightly toward the anterior. Ears small and flat, seldom preserved. A broad, shallow sinus originates on the umbo, gradually expanding anteriorly. Surface ornamented by numerous concentric bands similar to those on the dorsal valve, but 2 to 3 times as wide. On each low back slope, a single or double row of small, slender spines emerges tangential to the surface; farther forward, 2 or 3 rows of finer, more numerous spines are arranged in the same manner.

Discussion. The specimens are all crushed to some extent and weathered, but the size, form, and surface ornamentation are unmistakable. Dunbar and Condra recognized and described this species and recorded its range as from the Fort Scott limestone (Desmoinesian) into the Altamont limestone of the midcontinent region. According to White's description, this shell is widely spread in the lower Coal Measures of Illinois and Indiana. It is present also in the Lower Pennsylvanian of the Ardmore Basin, Oklahoma. It occurs in New Mexico in the Derryan and the Desmoinesian.

Occurrence. Units 4, 36, 89, 99-101.

Figured specimens. No. 488; from unit 4, Arrey formation, Derry, New Mexico. Nos. 489, 490; from units 99-101, Bolander group, Des Moines series, whiskey Canyon, New Mexico.

Echinoconchus? sp.

Pl. 2, fig. 17-19

Two broken ventral valves are fully assigned to the *Echinoconchus*. The shell is small, measuring (restored) about 12 mm long, 13 mm wide, and 5 mm thick. Greatest thickness and width at midlength.

Dorsal valve not observed.

Ventral valve strongly and regularly convex; middle broad, relatively flat, with steep lateral slopes; beak narrow, strongly overarched the hinge line. Surface divided into low, concentric, terracelike bands, with a broad back slope and a steep front slope and bearing spine bases of two sizes. The posterior half has, at least on the largest anterior band, three rows of larger spines arranged in quincunx. The anterior half apparently also bears three rows of the smaller spines, rather irregularly arranged. All spines appear to leave the surface at a low angle. There is no trace of a sinus.

Discussion. The surface ornamentation suggests a species of *Echinoconchus*, but the small size and incomplete preservation prevent accurate assignment to previously described species, all of which are much larger at maturity.

Occurrence. Units 53, 61 (base).

Figured specimen. No. 491; from unit 61, Whiskey Canyon limestone, whiskey Canyon, New Mexico.

Genus **JURESANIA** Fredericks 1920

Juresania nebrascensis (Owen)

Pl. 2, fig. 13-16; pl. 3, fig. 1-3

Productus nebrascensis Owen, 1852, Geol. Rept. Wisconsin, Iowa, and Minnesota, p. 584, pl. 5, fig. 3.

---- Meek, 1872, U. S. Geol. Survey, Survey of Nebraska, Final Rept., p. 165, pl. 2, fig. 21; pl. 4, fig. 6; 0,5, fig. 11a-c.

---- Hall and Clarke, 1892, Pal. of New York, v. 8, pt. 1, pl. 19, fig. 5-7

---- Weller, 1898, U. S. Geol. Survey Bull. 153, p. 495 (synonymy to date).

Pustula nebrascensis (Owen) Girty, 1915, U. S. Geol. Survey Bull. 544, p. 65-68, pl. xo, fig. 7 (not 6, 6a).

Juresania nebrascensis (Owen) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5₂ p. 195-198, pl. 22, fig. 1-9₂ 13.

Shell of small to medium size, rather subquadrangular in outline, a little wider than long. Measurements of a large, fairly well-preserved specimen: Length 34 mm, width 36.5 mm, thickness 16 mm; of a more representative specimen, length 21 mm, width 26 mm, and thickness 11 mm. Hinge line about three-fourths of the greatest width; greatest thickness at midlength; greatest width slightly anterior; hinge line depressed on each side of the middle. Cardinal area not visible.

Dorsal valve wider than long, almost flat in the middle, its concavity caused by an abrupt upturning of the lateral and anterior margins. Beak very small, rising out of a shallow, subcircular depression; has the appearance of a node on the hinge line. Surface ornamented by low, closely spaced, concentric rugae radiating from the posterior margin. No costae present; the rugae thicken and thin irregularly, with the development of rows of pits in the interspaces. A thin median ridge extends down the middle of weathered specimens,

dividing the valve in half. Anterior margin straight, regularly curving laterally to the hinge line, which it meets at an obtuse angle.

Ventral valve deep, geniculate; visceral cavity spacious; sinus very faint, the shell appearing more or less fiat transversely; lateral slopes steep, ears small. A row of thick spines runs along the cardinal margin, with other spines irregularly scattered over the umbonal slopes and ears. The beak is small, but the umbo inflated. The curvature is such that the beak and a considerable portion of the umbo lie posterior to the hinge line, but the beak is not incurved against it. Surface ornamented by irregular, concentric bands or rugae. Bases of numerous, small spines, nearly erect, are scattered irregularly over the surface, being most numerous on the anterolateral slopes. Bases of smaller, very numerous tangential spines emerge at a low angle to the surface and impart a brokenly striate appearance to the shell.

Discussion. On one of the specimens, the dorsal valve appears to be drawn slightly away from the ventral. This may indicate the portion of the true cardinal area which is sometimes observed. All the specimens are badly weathered and appear in the upper Des Moines beds. The species was originally described from the Kansas City(?) group at Bellevue, Nebraska. It ranges from the Desmoinesian up into the Council Grove stage of the Permian.

Occurrence. Units 60, 80, 92, 107, 113a, 114.

Figured specimens. Nos. 492, 493, from unit 113a, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Genus **LINOPRODUCTUS** Chao 1927

Linoproductus cf. *L. platyumbonus* Dunbar and Condra

Pl. 2, fig. 1-9, 21-22

Linoproductus platyumbonus Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 254-255, pl. 31, fig. 1-5.

Shell of medium size, length and width subequal; greatest width anterior to midlength; hinge line straight, equal to, or a little greater than, the greatest width. Approximate measurements of two typical specimens: Length 31 mm, 39 mm; width 29 mm, 38 mm; thickness 15 mm, 17 mm.

Dorsal valve moderately convex transversely; gently convex longitudinally but sharply geniculated anteriorly, the trail of a smaller shell being about 20 mm long. Ears small and flat, with strong rugae. Beak small, barely projecting beyond the hinge line. No spines on this valve.

Ventral valve strongly convex, greatest convexity from beak to umbo, regularly and slightly less convex anteriorly. Beak rather small and pointed; strongly incurved against the hinge line, so that a considerable portion of the broad, rounded umbo is posterior to the hinge line. Transversely, except for a faint sinus or flattening on the umbo, the valve is broad and flat, with lateral margins at a 90-degree angle. The umbonal slopes descend at a steeper angle, merging into the moderately small, flat ears. No spines are visible on the ears or umbonal slopes; fewer than a half dozen small, slender, erect spines are scattered irregularly over the anterior half.

Surface of both valves ornamented by fine, sharply rounded, subequal, slightly sinuous costae; 9 to 13 in 5 mm at midlength. The costae increase by intercalation, especially on the posterior half and close to the lateral margins; they are separated by striae varying in width but usually wide. Strong

rugae present on the posterolateral slopes, tending to extend directly backward and to die out abruptly, so that none of them reach more than halfway up the slopes.

Discussion. The large number of specimens collected comprise a closely related, intergrading series which cannot be separated. From the basal Derryan to the uppermost Desmoinesian, the valves show a definite tendency toward increased overall size; the spines and costae also enlarge slightly. However, the essential specific characters—the weak, flattened median sinus, the convexity of the shell, the broad umbo and small beak, the number of spines, the width of the hinge line—all remain unchanged. The species was described by Dunbar and Condra as confined to the Kansas City and Lansing groups of Nebraska, Kansas, Iowa, and Missouri. In 1946, Wood et al. reported it from the Desmoinesian of New Mexico.

Occurrence. Units 8 and 9 (top), 18, 19, D2, 36, 45, 62, 69, 79, 83, 84, 99-101, 109.

Figured specimens. No. 494, from unit D2, Elephant Butte formation, whiskey Canyon, New Mexico. No. 495, from unit 83, Garcia formation, Whiskey Canyon, New Mexico. No. 496; from units 99-101, Bolander group, Des Moines series, Whiskey Canyon, New Mexico. No. 497, from unit 84, Garcia formation, whiskey Canyon, New Mexico. No. 498; from unit 45, Whiskey Canyon limestone, Whiskey Canyon, New Mexico.

Genus **MARGINIFERA** Waagen 1884

Marginifera cf. *M. haydenensis* Girty

Pl. 3, fig. 4-6

Marginifera haydenensis Girty, 1903, U. S. Geol. Survey Prof. Paper

16, p. 380, pl. 5, fig. 9-11a.

-----Girty Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., Bull. 5, p. 232-234, pl. 36, fig. 12-17.

Shell small, subquadratic in outline; hinge line straight, equals the greatest width. Most specimens average about 16 mm long and 12 mm wide. One large shell attains a length of 22.5 mm and a width of 25 mm.

Dorsal valve not observed.

Ventral valve geniculated; umbo relatively flat and obtuse; beak small, incurved against the hinge line which it overhangs so greatly that the hinge line is almost at the midlength of the shell. Ears large, strongly curved, set off from the body of the shell by lateral slopes dipping at right angles from the broad, gently convex upper surface. The ear appears to bear a single small spine on the cardinal margin and an oblique row of three larger spines extending from near the outer tip to the base of the umbonal slope almost immediately in back of the hinge line. A broad, shallow sinus begins on the umbo and continues to the anterior margin; very shallow on the anterior slope. Posterior to the line of geniculation, the valve is marked by low, narrow rugae. Rounded, relatively strong, regular costae over most of the valve; obsolete on the ears and weak on the umbo; 7 or 8 to 5 mm on the anterior slope. Rarely, one will bifurcate before the anterior third of the shell is reached; at that point the costae begin to bifurcate freely and become extremely irregular.

Discussion. *Marginifera* occurs abundantly in the Whiskey Canyon and Derry Hills sections, but preservation is usually too poor for specific identification.

The most distinctive features of the shells of this species are the extreme overhang of the posterior, the strong costae

and their lamellosity over the anterior third of the ventral valve, and the median sinus.

Girty's original description, in part, reads:

Surface marked by longitudinal striae, which vary from strong to almost obsolete, and are very irregular. They are wavy, some-times bifurcate or fasciculate, often nearly obsolete over the anterior half of the shell.

Only the fact that the writer's specimens uniformly are striated strongly and regularly over most of the shell has prevented his referring them with certainty to this species.

M. haydenensis was described originally from two localities on Grand River, Colorado. At one of these localities, it was associated with *Mesolobus mesolobus* and *Marginifera muricatina*. According to Dunbar and Condra, the species is confined to the lowest part of the Pennsylvanian in the Mississippi Basin.

Occurrence. Units 2a, 12, 18, 19.

Figured specimen. No. 499, from units 18 and 19, Fra Cristobal formation, Derry, New Mexico.

Genus **MESOLOBUS** Dunbar and Condra 1932

Mesolobus mesolobus (Norwood and Pratten)

Pl. 6, fig. 47

Chonetes mesolobus Norwood and Pratten, 1855, Acad. Nat. Sci. Philadelphia Jour., v. 3, p. 27, pl. 11, fig. 7a-c.

----Weller, 1898, U. S. Geol. Survey Bull. 153, p. 178 (synonymy to date) includes references to the varieties of this species.

Mesolobus mesolobus (Norwood and Pratten) Dunbar and Condra, 1932, Nebraska Geol. Survey, 2d ser., v. 5; p. 161-164, pl. 20, fig. 1-2a.

Shell small, subquadratic, wider than long; hinge line straight, equals greatest width; greatest thickness at mid-length. Approximate measurements of specimen in limestone matrix: Length 5 mm, width 7.5 mm. Cardinal extremities rectangular; lateral and anterior margins nearly straight, sharply rounded at corners.

Dorsal valve not observed.

Ventral valve convex, with a prominent fold and steep lateral slopes extending from beak to anterior corners. The "fold" bears a broad, shallow sinus from which a median fold rises almost equal in height to the sides; ears and beak small.

Surface marked by many extremely fine but distinct radial lirae, which grow fainter toward the ears. Rows of coarse pits, prominent when the shell is partially exfoliated, extend down between the lirae.

Discussion. Two general types of the *Mesolobus* stock are recognized: those which have distinct radial lirae and those which are smooth or show only obscure traces of lirae. The New Mexico specimen belongs to the first group, which constitutes *Mesolobus mesolobus*, sensu stricto. The form is restricted to rocks of Desmoinesian age and is reported from almost every place where such rocks crop out. It is very rare in central New Mexico, however; and so is useless there as a guide fossil.

Occurrence. Unit 109.

Figured specimen. No. 500, from unit 109, Bolander group, Des Moines series, Whiskey Canyon, New Mexico.

Suborder STROPHOMENACEA

Genus **DERBYA** Waagen 1884 (emend Girty 1908)

The genus *Derbya* is poorly represented in this collection. Fragmentary specimens appear infrequently throughout the

Desmoinesian beds. They can be recognized with certainty as to genus, but specific determination is impossible.

Order TEREBRATULIDA

Genus **DIELASMA** King 1859

Dielasma angulata, n. sp.

Pl. 6, fig. 42-46

Shell terebratuliform, of medium size, elongate, subpentagonal in outline. Greatest thickness and width at midlength; width decreases only slightly to the front. Measurements of the single specimen: Length 16.5 mm, width 10 mm, thickness 6 mm.

Dorsal valve almost plane longitudinally, strongly convex transversely; beak small, inconspicuous. A low, broad fold almost indistinguishable from the even convexity (transverse) of the valve occupies the entire width of the shell on the anterior margin. Its boundaries defined by an abrupt bending of the sublamellose growth lines where they meet the fold; anterior slightly emarginate.

Ventral valve deeper than the dorsal, moderately and regularly convex longitudinally; concave upward across the

sinus, the lateral slopes dipping steeply away from its well-defined edges. Posterolateral margins converge gradually from the middle to a pointed beak. The sinus, originating on the umbo, is broad and shallow on the posterior but deepens abruptly on the anterior half until it occupies the entire width of the shell along the anterior margin, to which it gives a broadly spatulate appearance. It is divided by a narrow, distinct furrow, originating near the beak, which imparts a distinct median angulation to the sinus. About two-thirds of the way from the beak to the front, the furrow expands slightly and thereafter is only faintly distinguishable. Surface crossed by growth lines which bend abruptly at the sides of the sinus and become fainter across it. Anterior margin straight, making an abrupt curve into the lateral region.

Discussion. This form can be distinguished readily from the typical *Dielasma bovidens* (Morton) of the Pennsylvanian by its overall angularity; the subpentagonal outline; the distinct median angulation to the sinus, with the consequent quadripartite appearance of the ventral valve; and the extremely obscure dorsal fold.

Occurrence. Unit 75.

Holotype. No. 501; from unit 75, Garcia formation, Whiskey Canyon, New Mexico.

References

- Beede, J. W. (1900) *Carboniferous invertebrates*, Kansas State Geol. Survey, v. 6, pt. 2, 1-187.
- Condra, G. E., (1927) *The stratigraphy of the Pennsylvanian system in Nebraska*, Nebraska Geol. Survey, 2d ser., Bull. 291 p., 38 fig., 7 pl.
- Dunbar, C. O., and Condra, G. E. (1932) *Brachiopods of the Pennsylvanian system in Nebraska*, Nebraska Geol. Survey, 2d ser., Bull. 5, 377 p., 44 pl.
- Girty, G. H. (1903) *The Carboniferous formations and faunas of Colorado*, U. S. Geol. Survey Prof. Paper 16, 533 p., 10 pl.
- (1915) *The stratigraphy of the Pennsylvanian series in Missouri with a chapter on invertebrate paleontology*, Missouri Bur. Geol. and Mines, 2d ser., v. 13, 263-376, pl. 27-32.
- Gordon, C. H. (1907) *Notes on the Pennsylvanian formations in the Rio Grande Valley, New Mexico*, Jour. Geology, v. 15, 805-816.
- Kelley, V. C., and Silver, Caswell (1952) *Geology of the Caballo Mountains*, New Mex. Univ. Pub., geol. ser., n. 4, 277 p., 19 pl., 26 fig.
- Mather, K. F. (1915) *The fauna of the Morrow group of Arkansas and Oklahoma*, Denison Univ., Sci. Lab., Bull., v. 18, 59-284, 16 pl.
- McChesney, J. H. (1859) *Descriptions of new species of fossils from the Paleozoic rocks of the Western States*, Extract from Chicago Acad. Sci. Trans., v. 1, 76 p.
- Moore, R. C., Lalicker, C. G., and Fischer, A. G. (1953) *Invertebrate fossils*, 1st ed., New York, McGraw-Hill Book Co., 739
- Morningstar, Helen (1922) *Pottsville fauna of Ohio*, Ohio Geol. Survey, 4th ser., Bull. 25, 312 p., 1 fig., 16 pl.
- Muir-Wood, Helen M. (1928) *The British Carboniferous Producti, II, Productus (sensu stricto): sernireticulatus and longispinus groups*, Great Britain Geol. Survey Mem., v. 3, pt. I, 217 p., 12 pl.
- Shimer, H. W., and Shrock, R. R. (1949) *Index fossils of North America*, New York, John Wiley & Sons, Inc., 345-351.
- Thompson, M. L. (1942) *Pennsylvanian system in New Mexico*, N. Mex. School of Mines, State Bur. Mines and Mineral Res. Bull. 17, 90 p., 2 pl., 8 fig.
- (1948) *Protozoa; studies of American fusulinids*, Kansas Univ. Paleont. Contr., n. 4, art. 1, 184 p., 38 pl.
- Tomlinson, C. W. (1929) *The Pennsylvanian system in the Ardmore Basin*, Oklahoma Geol. Survey Bull. 46, 79 p., 20 pl., 3 fig.
- Wood, G. H., Jr., Northrup, S. A., and Cowan, M. J. (1946) *Geology of Nacimiento Mountains, San Pedro Mountains, and adjacent plateaus in parts of Sandoval and Rio Arriba Counties, New Mexico*, U. S. Geol. Survey Oil and Gas Inv. Prelim. Map n. 57.

Index

Numbers in *italics* indicate references to figures and plates; boldface indicates main references.

- Abo formation, 2
Alabama, 12
Albuquerque, New Mexico, 16
Altamont limestone (midcontinent region), 19
Apodaca formation, 3, 7, 8, 16
Ardmore Basin (Oklahoma), 19
Arkansas, 13
Armendaris group, 1, 3, 4, 14, 15
 Elephant Butte formation, **5-6**, 8, 9, 13, 16, 21
 fossil distribution, 7-8
 Garcia formation, **4-5**, 7, 8, 9, 10, 15, 16, 18,
 19, 21, 22
 stratigraphy, 4-6
 type section, 4
 Whiskey Canyon limestone, **5**, **8**, 9, 15, 16, 17,
 20, 21
Arrey formation, **3**, **7**, 8, 10, 11, 18, 19, 20
Bar B formation, 6
Bellevue, Nebraska, 20
Bolander group, 1, **4**, **7**, 8, 9, 12, 13, 14, 15, 17, 19,
 20, 21
 fossil distribution, 7
 stratigraphy, 4 type section, 4
Brachiopod species, range, 8
Brentwood limestone (northwestern Arkansas), 19
Buxtonia, 17
B. peruviana, 17
B. scabricula, 17
B. semicircularis, 17
Buxtonia? sp., 7, 8, **17**; pl. 4, fig. 3-8
Caballo Mountains, 6
Caballo Reservoir, 2
Cancrinella, 17
Cancrinella boonensis, 7, 8, 17; pl. 6, fig. 21-22
Chaetes, 6
Cherokee group (Kansas), 10
Cherokee shale (midcontinent region), 9, 16
Chester series, 12, 17, 19
Chonetes burlingtonensis, 18
C. logani, 18
C. mesolobus, 21
C. ornatus, 18
C. striatus, n. sp., 7, 8, 9, **17**, 18; pl. 6, fig. 23-28
Coal Measures (*see also* Pennsylvanian), 17, 19
Colorado, 9, 15, 19
Coloradoensis, 19
Composita, 12, 14
Composite argentea, 7, 8, **12**, 13, 14; pl. 5, fig. 1-4
C. derrya, n. sp., 7, 8, 9, 12, **13**; pl. 4, fig. 9-27
C. elongata, 13
C. malaya, n. sp., 8, 9, 12, **13**; pl. 4, fig. 32-36
C. ovata, 7, 8, 12, **13**, 14; pl. 5, fig. 5-13, 24-27,
 38-40
C. ozarkana, 12
C. subtilita, 7, 8, 12, **13**, 14; pl. 5, fig. 14-23, 28-37
C. wasatchensis, 13
C. sp., 7, 8, **14**; pl. 4, fig. 28-31
Condra, G. E., 10, 11, 12, 14, 15, 16, 17, 18, 19,
 21
Council Grove stage, 20
Cowan, J. J., *see* Wood, G. H., Jr.
Cuchillo Arroyo (Mud Springs Mountains), 3, 4
Cuchillo Negro formation, **3**, 6, 7, 8, 12
Dalmanellacea, 10
Derbya, 21
D. sp., 7, 8,
Derry, New Mexico, 1, 2, 3, 6, 9, 12, 13,
 15, 16, 18, 19, 20, 21
Derryan (*see also* Derry series), 3, 6, 10, 15,
 16, 17, 18, 19, 21
 strata, 9
Derry Hills, 2, 3, 6, 9, 12, 13
 section, 2, 3, 6, 10, 11, 12, 13, 14, 15, 17, 21
Derry series (*see also* Green Canyon group; Mud
 Springs group), 1, **3**, 6, 7, 8, 11, 21
 fossil distribution, 7, 8
 stratigraphy, 3
 type section, 3
Dery Warm Spring, 2
Des Moines beds, 20
Desmoinesian (*see also* Des Moines series),
 3, 6, 9, 12, 15, 16, 17, 19, 20, 21, 22
Des Moines series (*see also* Bolander group;
 Armendaris group), 1, **3**, 4, 6, 7, 8, 12,
 13, 14, 15, 17, 19, 20, 21
 basal part, 6
 Derry Hills section, 6
 fossil distribution, 7-9
 stratigraphy, 3-6
 Whiskey Canyon section, 4-6
Devonian shale, 2, 3
Dictyoclostus americanus, 18
D. fernglenensis, 19
D. hermosanus, 7, 8, 9, **18**; pl. 1, fig. 12-20
D. inflatus, 19
D. in flatus var. *coloradoensis*, 7, 8, 9, **18**; pl. 1,
 fig. 1-10
D. morrowensis, 7, 8, 9, **19**; pl. 1, fig. 11-15
D. portlockianus, 19
D. semireticulatus, 18
D. sp., 7, 8
Dierasma angulata, n. sp., 7, 8, **22**; pl. 6, fig. 42-
 46
D. bovidens, 22
Dona Ana County, 3
Douglas group (Missouri), 14, 15
Dunbar, C. O., 10, 11, 12, 14, 15, 16, 17, 18, 19,
 21
Echinoconchus, 20
E. semipunctatus var. *knighti*, 7, 8, **19**; pl. 2, fig.
 10-12, 20-23
E.? sp., 8, **20**; pl. 2, fig. 17-19
Elephant Butte formation, **5**, 6, 8, 9, 13, 16, 21
 Warrington limestone member, 6, 9
Eoschubertella, 7, 8
Fort Scott limestone, 15, 19
Fra Cristobal formation, **3**, **7**, 8, 21
Fusselman dolomite, 2
Fusulina, 7, 8, 9
Fusulinella, 7, 9
Garcia:
 fauna, 9
 formation, **4**, 5, 7, 8, 9, 10, 15, 16, 18, 19, 21,
 22
 time, 9
Girty, G. H., 18, 19
Gordon, C. H., 6
Grand River, Colorado, 21
Green Canyon group, 1, **3**, **7**, 8, 11
 Apodaca formation, 3, 7
 Arrey formation, 3, 7
 fossil distribution, 7
Hale sandstone (Oklahoma), 19
Hall, 14
Hatch Basin, 3
Henrietta group (Kansas), 10
Hustedia mormoni, 7, 8, 10; pl. 6, fig. 1-8
Iatan limestone (Missouri), 14
Illinois, 12, 17, 19
Indiana, 19
Iowa, 21
Iowa Point shale (Missouri), 17
Juresania, 9, 17
J. nebrascensis, 7, 8, **20**; pl. 2, fig. 13-16; pl. 3, fig.
 1-3
J. sp., 7, 8
Kansas, 9, 10, 11, 13, 14, 15, 17, 19, 21
Kansas City group (Kansas), 14
Kansas City(?) group (Nebraska), 20
Kansas City, Kansas, 14, 15, 21
Kelley, V. C., and Silver, Caswell, 6
Kentucky, 12
Lansing group (Kansas), 14, 15, 21
La Salle, Illinois, 12
La Salle limestone (Illinois), 12
Linoproductus, 17
L. platyumbonus, 20
L. cf. L. platyumbonus, 7, 8, 9, **20**; pl. 2, fig. 1-9,
 21-22
L. sp., 7
Magdalena formation, 6
Magdalena limestone, 16
Magdalena Mountains, 6
Marble Falls limestone (Texas), 19
Marginifera haydenensis, 21
M. cf. M. haydenensis, 7, 8, 9, **21**; pl. 3, fig. 4-6
M. muricata, 16, 21
M. sp., 7, 8, 9, 21
Marmaton group (Kansas), 9, 14, 15
McChesney, J. H., 17, 19
Mesolobus mesolobus, 7, 8, 16, **21**; pl. 6, fig. 47
Midcontinent region, 9, 19
Millerella, 7, 8
Mississippian, 6, 12, 18
 Upper, 9
Mississippi Basin, 21

- Mississippi Valley, 11
 Missouri, 11, 15, 21
 Missourian (*see also* Missouri series), 12, 13, 14, 17
 Missouri River, 14
 Missouri series, 6, 10, 12, 13, 14, 15, 17
 Montoya dolomite, 2
 Morrowan (*see also* Morrow series), 13, 19
 Morrow series, 6, 12, 13, 19
 Mud Springs group, 1, 3, 7, 8
 Cuchillo Negro formation, 3, 6, 7, 8, 12
 fossil distribution, 7
 Fra Cristobal formation, 3, 7, 8, 21
 Mud Springs Mountains, 1, 3, 9
 Mud Springs section, 11, 12
 Muir-Wood, H. M., 18
- Nakaye formation, 6
 Nebraska, 11, 13, 15, 17, 19, 21
 Neospirifer, 15
N. latus, 15
N. cf. N. latus, 7, 8, 15; *pl. 3, fig. 34; pl. 4, fig. 1-2*
N. triplicatus, 7, 8, 14; *pl. 3, fig. 26-30*
N. triplicatus var. *alatus*, 14
N. triplicatus var. *gibbosus*, 8, 14; *pl. 3, fig. 31-33*
N. sp., 7, 8, 9
 New Mexico, 14, 15, 16, 17, 18, 19, 21, 22
 central, 21
 south-central, 6, 9
 Northrop, S. A., *see* Wood, G. H., Jr.
- Ohio, 15
 Oklahoma, 13, 15, 19
Orthis carbonaria, 10
O. pecosi, 10
Ozawainella, 7
- Pennsylvanian, 2, 6, 11, 14, 15, 18, 21, 22
 in Southwest, 17
 Middle, 9, 12
 Lower, 19
 Permian, 6, 14, 17, 20
Phricodothyris, 9
- P. perplexa*, 7, 8, 9, 16; *pl. 6, fig. 9-13, 33-38*
 Platte River, 17
 Productacea, 17
Productus Boonensis, 17
P. Boonensis var. *elevata*, 17
P. inflatus, 18
P. inflatus var. *colomdoensis*, 18
P. morrowensis, 19
P. nebrascensis, 20
P. pertenuis, 17
P. punctatus, 19
P. semireticulatus var. *hermosanus*, 18
P. symmetricus, 19
Profusulinella, 7
Pseudostaffella, 7, 8
 Punctospiracea, 10
Punctospirifer, 12
P. kentuckyensis, 7, 8, 11; *pl. 6, fig. 18-20*
Pustula, 17
P. nebrascensis, 20
- Red House formation, 6
Reticularia perplexa, 16
Reticulariina, 12
R. spinosa, 12
R. cf. R. spinosa, 7, 8, 9, 11; *pl. 6, fig. 29-32*
Rhipidomella carbonaria, 7, 8, 9, 10; *pl. 6, fig. 39-41*
R. pecosi, 10
 Rhynchonellacea, 10
 Rio Grande, 1, 2, 3
 Rostrospiracea, 12
- San Antonio Canyon, 16
Seminula argentea, 12
 Shepard, 12
 Sieira County, 3
 Silver, Caswell, *see* Kelley, V. C.
Spirifer, 15
 ?*S. boonensis*, 15
S. cameratus, 14
S. kentuckyensis, 11
S. occidentalis, 7, 8, 9, 15, 16; *pl. 3, fig. 7-18*
- S. octoplicata?*, 11
S. opimus var. *occidentalis*, 15
S. perplexa, 16
S. rocky-montani, 16
S. rockymontanus, 7, 8, 9, 16; *pl. 3, fig. 19-25*
S. spinosa, 11
S. triplicata, 14
S. sp., 7, 8
 Spiriferacea, 14
Spiriferina kentuckyensis, 11
S. salemensis, 12
S. spinosa, 11
Squamularia perplexa, 16
 Stanton limestone (Missouri), 14
 Strophomenacea, 21
 Swallow, 17
- Tennessee, 12, 19
Terebratula argentea, 12
T. Mormoni, 10
T. subtilita, 13
 Tertiary intrusive rocks, 2
 Thompson, M. L., 6, 9
 Truth or Consequences, New Mexico, 1, 2
- Virgil series, 6
- Wabaunsee group (Kansas), 13, 14
 Wapanucka limestone (Oklahoma), 19
 Warmington limestone member (Elephant Butte formation), 6, 9
Wedekindellina, 7, 8
Wellerella multiplicata, 7, 8, 10; *pl. 6, fig. 14-17*
 Weston shale (Missouri), 14
 Weston, Missouri, 14
 Whiskey Canyon, 1, 2, 3, 4, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22
 limestone, 5, 8, 9, 15, 16, 17, 20, 21
 section, 2, 4, 21
 White, 19
 Wood, G. H., Jr., Northrop, S. A., and Cowan, J. J., 15, 21

PLATES 1-6

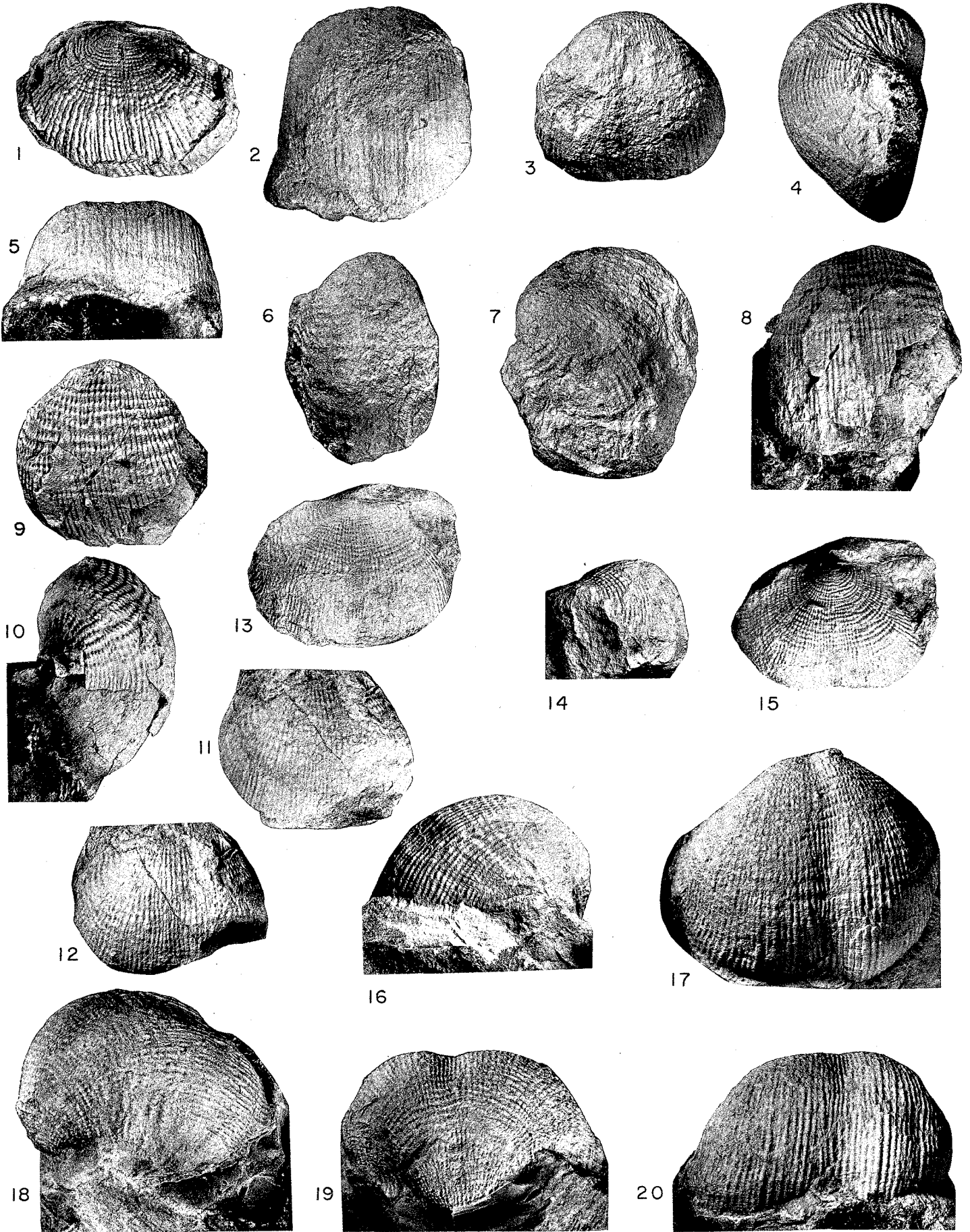
WITH EXPLANATIONS

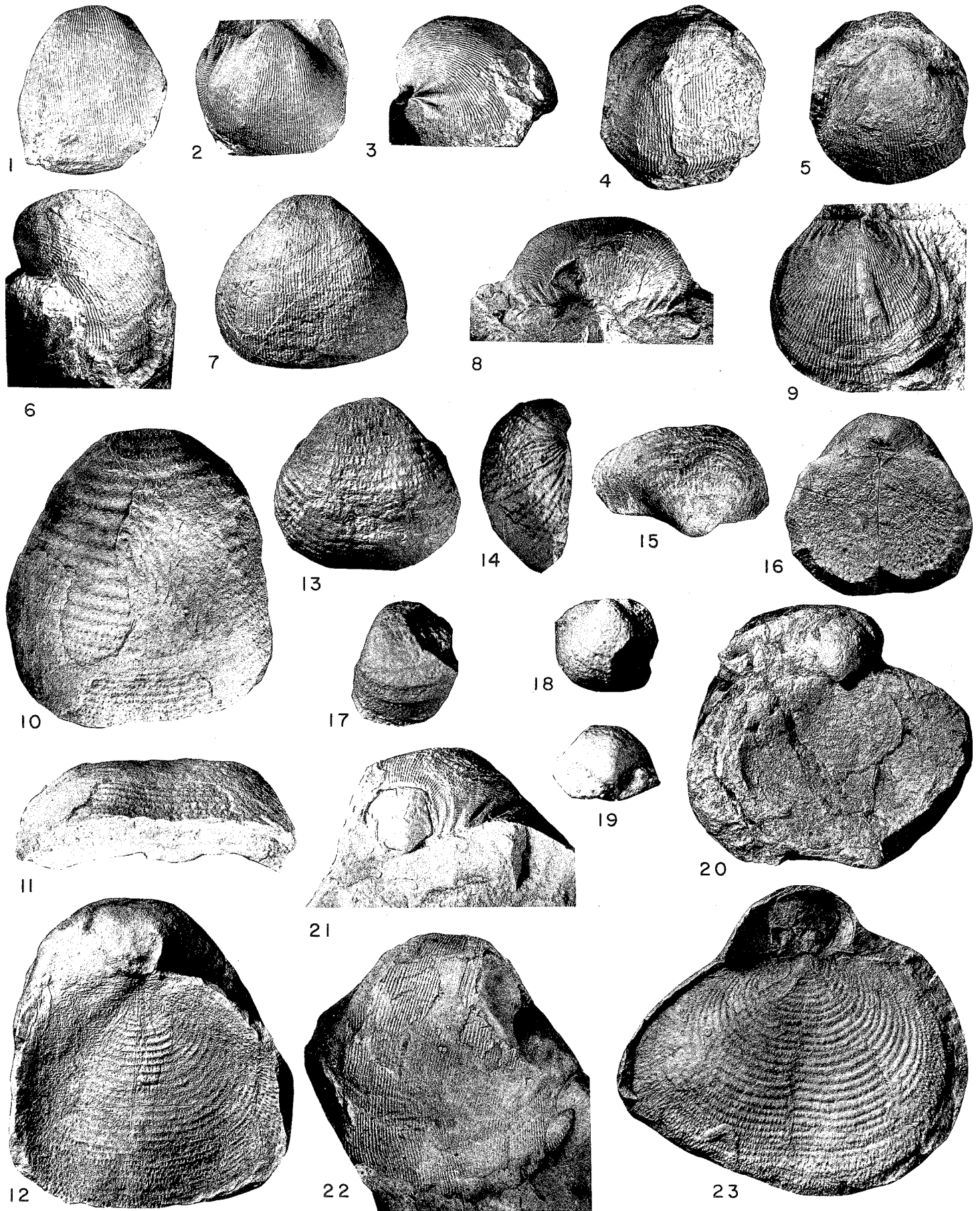
(Specimen numbers refer to the collection of the New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico.)

NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES

PLATE 1

Figures	Page
1-10. <i>Dictyoclostus inflatus</i> var. <i>coloradoensis</i> (Girty)	18
1. Exterior of complete dorsal valve. No. 484. 2-5. Ventral, umbonal, profile, and anterior views of complete ventral valve. No. 482. 6-7. Ventral and profile views, showing surface of broken ventral valve. No. 502. 8-10. Ventral, umbonal, and profile views of another ventral valve. No. 483. All x 1.	
11-15. <i>Dictyoclostus morrowensis</i> (Mather)	9
11-12. Two views of a ventral valve. No. 485. 13-15. Dorsal, profile, and umbonal views of a dorsal valve. No. 486. Both x 1.	
16-20. <i>Dictyoclostus hermosanus</i> (Girty)	18
Profile, ventral, oblique, posterior, and anterior views of a large ventral valve. No. 487. X I.	





MIDDLE PENNSYLVANIAN BRACHIOPODS

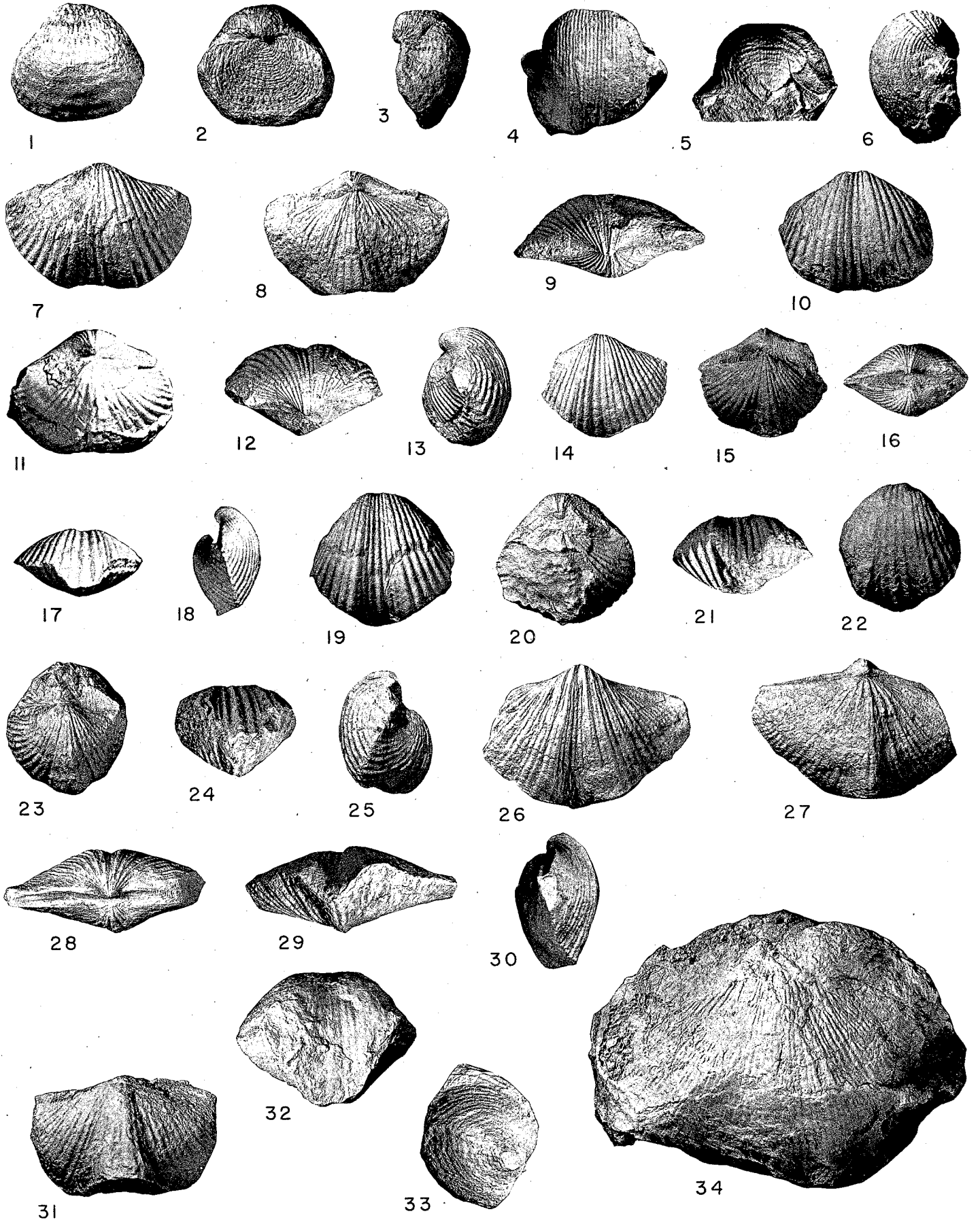
PLATE 2

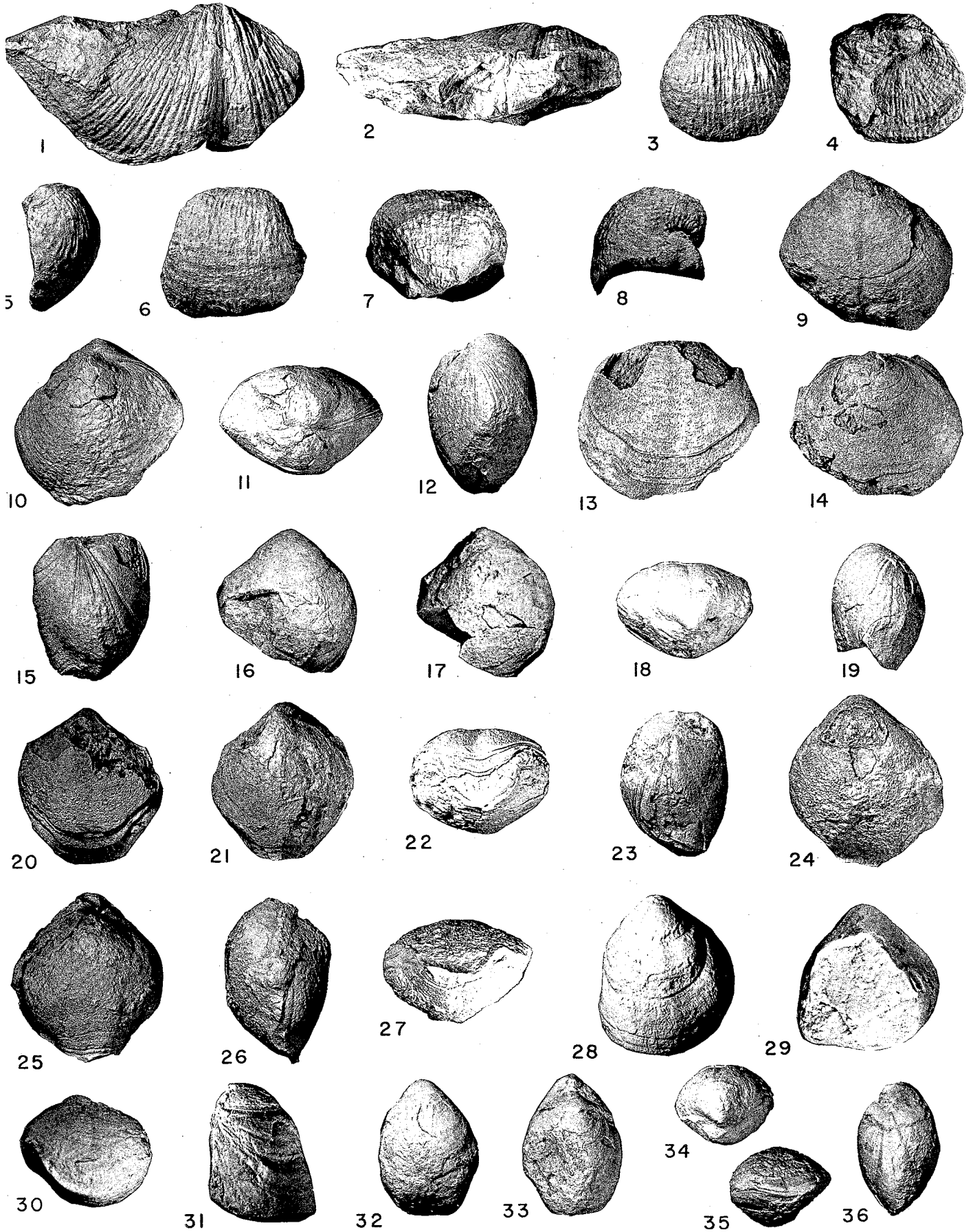
Figures	Page
1-9. <i>Linoproductus</i> cf. <i>L. platyurnbonus</i> Dunbar and Condra	20
21-22. 1-3. Ventral, posterior, and profile views of an exceptionally well preserved ventral valve. Its small size is characteristic of the basal Desmoinesian of this area. No. 494. 4-6. Ventral, umbonal, and profile views of another ventral valve. No. 495. 7-8. Ventral and posterior views of an incomplete ventral valve. No. 498. 9. Dorsal valve with a bryozoan adhering. No. 497. 21-22. Posterior and ventral views of a large distorted ventral valve from the uppermost Desmoinesian. No. 496. All x 1.	
10-12, <i>Echinoconchus semipunctatus</i> var. <i>knighti</i> Dunbar and Condra	19
20, 23. 10-12. Ventral and anterior views of large ventral valve and impression of the dorsal valve. No. 488. 20. Badly weathered specimen, illustrating the typical curvature of beak of ventral valve. No. 490. 23. Interior surface of dorsal valve. No. 489. All x 1.	
13-16. <i>Juresania nebrascensis</i> (Owen)	20
Ventral, profile, and umbonal views of ventral valve and imprint of the dorsal valve of a medium-sized specimen. No. 492. X 1.	
17-19. <i>Echinoconchus?</i> sp:	20
Ventral, umbonal, and posterior views of a small ventral valve. No. 491. x 2.	

NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES

PLATE 3

Figures		Page
I-3.	<i>Jurescraia nebrascensis</i> (Owen) Ventral valve, dorsal valve, and profile of a small specimen. No. 493. X 1.	20
4-6.	<i>Marginifera</i> cf. <i>M. haydenensis</i> Girty Ventral, posterior, and profile views of large ventral valve. No. 499. X 1.	21
7-18.	<i>Spirifer occidentalis</i> Girty 7-9. Ventral valve, dorsal valve, and posterior views of a typical specimen. No. 468. 10-13. Ventral valve, dorsal valve, and posterior and profile views of a second specimen. No. 469. 14-18. Ventral valve, dorsal valve, and posterior, anterior, and profile views of a third typical specimen. No. 470. All X 1.	15
19-25.	<i>Spirifer rockymontanus</i> Marcou 19-21. Ventral valve, dorsal valve, and anterior views of a broken specimen. No. 471. 22-25. Ventral valve, dorsal valve, and anterior and profile views of a second specimen. No. 472. All X 1.	16
26-30.	<i>Neospirifer triplicatus</i> (Hall) Ventral valve, dorsal valve, and posterior, anterior, and profile views of typical specimen. No. 464. X 1.	14
31-33.	<i>Neospirifer triplicatus</i> var. <i>gibbosus</i> Dunbar and Condra Dorsal valve, anterior and profile views; ventral beak is broken. No. 465. X 1.	14
340	<i>Neospirifer</i> cf. <i>N. latus</i> Dunbar and Condra Ventral valve of a distorted specimen, showing the large size attained by the species. No. 466. X 1.	15





MIDDLE PENNSYLVANIAN BRACHIOPODS

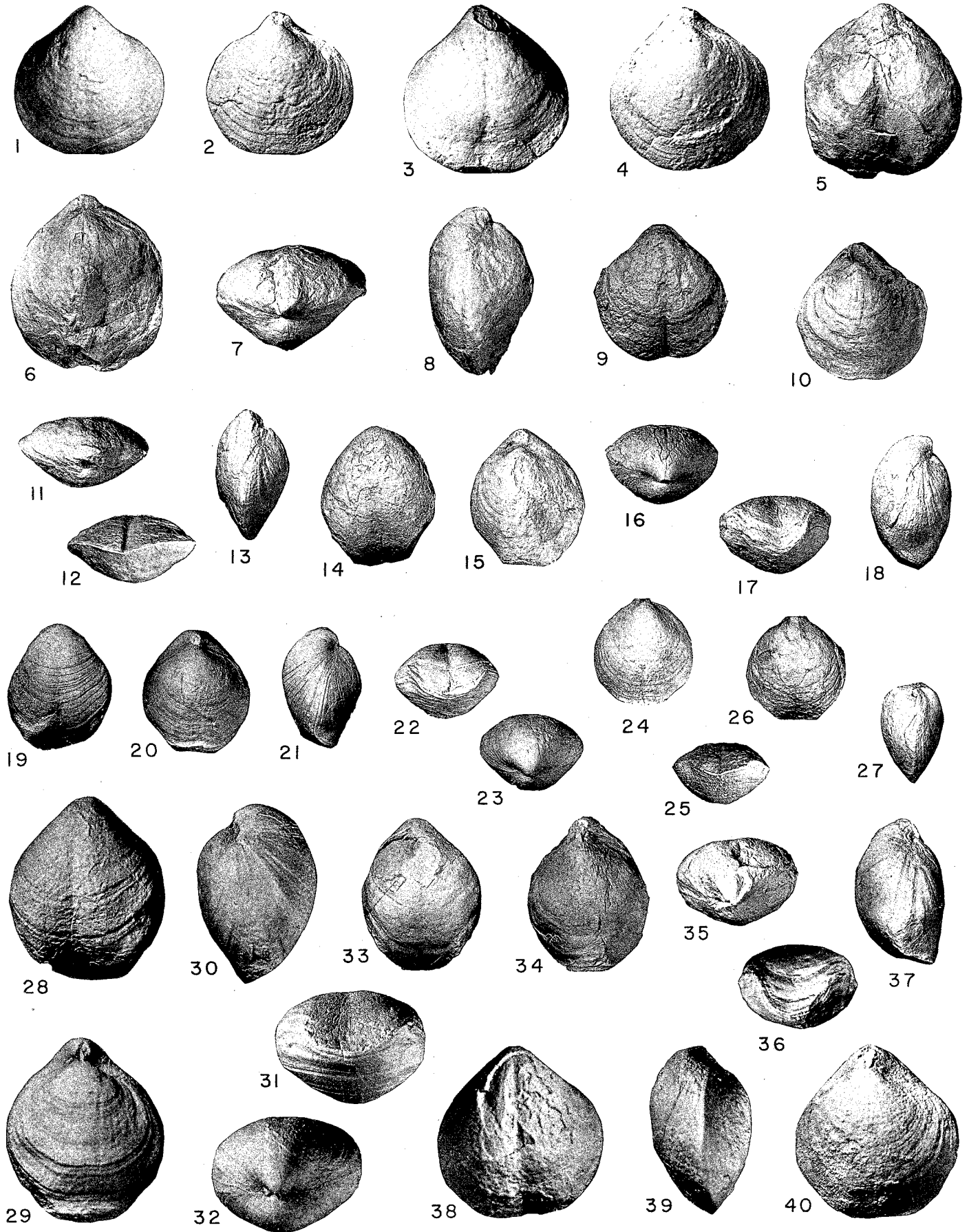
PLATE 4

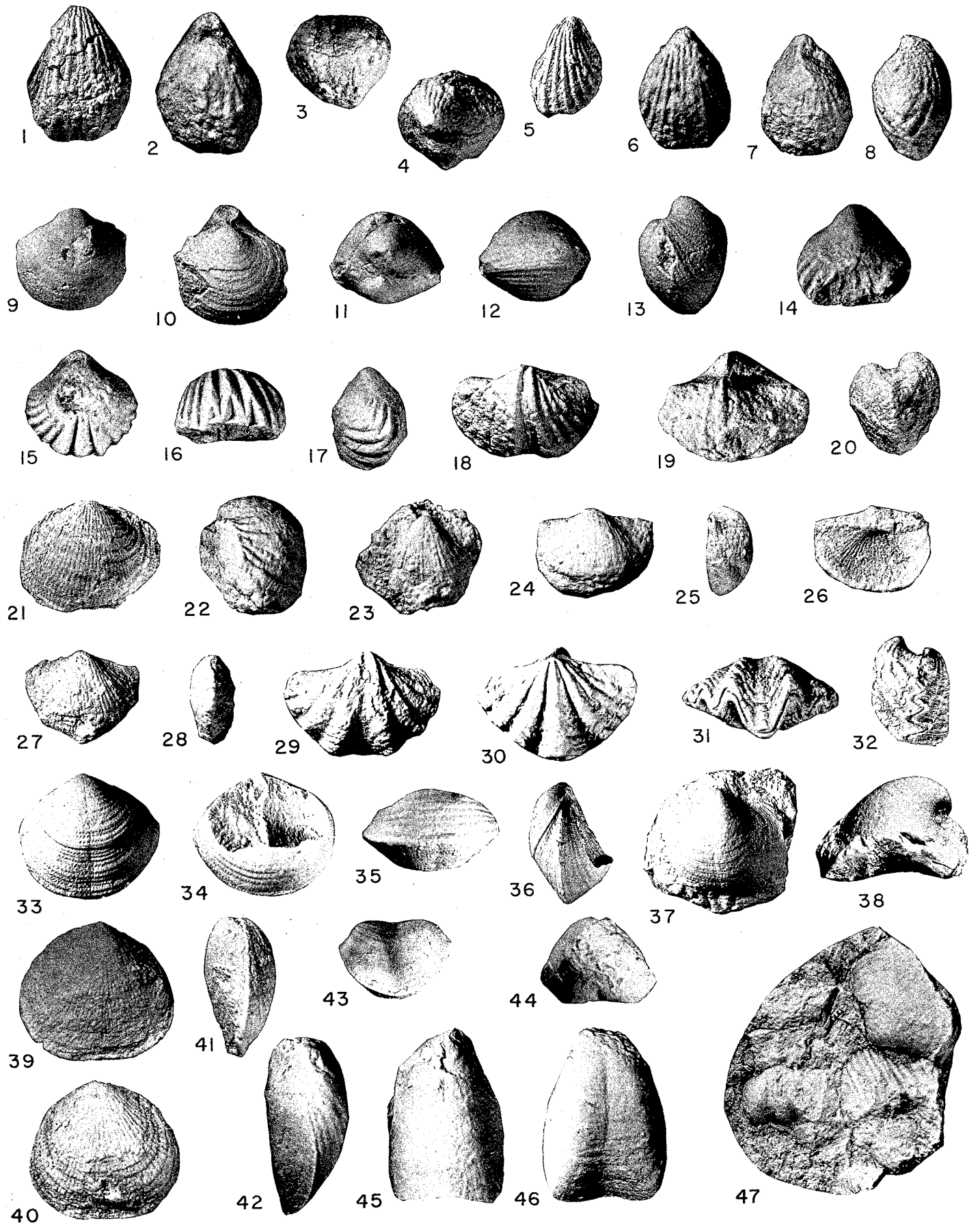
Figures		Page
1-2.	<i>Neospirifer</i> cf. <i>N. lams</i> Dunbar and Condra	15
	Ventral valve and anterior view of small specimen. No. 467. X 1.	
3-8.	<i>Buxtonia?</i> sp.....	17
	3-5. Ventral valve, dorsal valve, and profile of a well-preserved specimen. No. 476. 6-8. Ventral valve and posterior and side views of a second specimen. No. 477. Both X I.	
9-27.	<i>Composita derrya</i> , n. sp.....	12
	9-12. Holotype; ventral valve, dorsal valve, and posterior and profile views. No. 448. 13-15. Paratype; ventral valve, dorsal valve, and profile of specimen with characteristic sinus. No. 449. 16-19. Paratype; ventral valve, dorsal valve, and posterior and profile views. No. 450. 20-23. Para-type; ventral valve, dorsal valve, and anterior and profile views. No. 452. 24-27. Paratype; ventral valve, dorsal valve, and profile and anterior views. No. 453. All X 1.	
28-31.	<i>Coinposita</i> sp.....	14
	Ventral, dorsal, anterior, and profile views of a broken specimen. No. 463. X2.	
32-36.	<i>Composita malaya</i> , n. sp.....	13
	Holotype, ventral valve, dorsal valve, and posterior, anterior, and profile views. No. 451. X 1.	

NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES

PLATE 5

Figures	Page
1-4. <i>Composita argentea</i> (Shepard)	12
1-2. Ventral valve and dorsal valve of a typical specimen. No. 454. 3-4. Ventral valve and dorsal valve of a larger specimen. No. 447. Both X 2.	
5-13, <i>Composita ovata</i> Mather	13
24-27, 5-8. Ventral valve, dorsal valve, and posterior and profile views of a large specimen. No. 455. 9-13. Ventral valve, dorsal valve, and posterior, anterior, and profile views of a smaller specimen. No. 456. 24-27. Dorsal valve, anterior view, ventral valve, and profile of a small typical specimen. No. 457. All X 1. 38-40. Ventral valve, profile, and dorsal valve of an-other small specimen. No. 458. X 2.	
14-23, <i>Composita subtilita</i> (Hall)	13
28-37. 14-18. Ventral valve, dorsal valve, and posterior, anterior, and profile views of a typical specimen. No. 460. 19-23. Ventral valve, dorsal valve, profile, and anterior and posterior views of an excellently preserved specimen. No. 461. Both X 1. 28-32. Ventral valve, dorsal valve, profile, and anterior and posterior views of a small specimen. No. 462. X 2. 33-37. Ventral valve, dorsal valve, and posterior, anterior, and profile views of a fourth specimen. No. 459. X 1.	





NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES

PLATE 6

Figures	Page
1-8. <i>Hustedia mormoni</i> (Marcou)	10
1-4. Ventral valve, dorsal valve, and anterior and posterior views of a typical specimen. No. 444a. 5. Ventral valve of a small specimen. No. 444b. 6-8. Ventral valve, dorsal valve, and profile of a third specimen. No. 444c. All x 3.	
9-13, <i>Phricodothyris perplexa</i> (McChesney)	16
33-38. 9-13. Ventral valve, dorsal valve, and posterior, anterior, and profile views of a small specimen. No. 475. X 3. 33-36. Ventral valve, broken dorsal valve, and anterior and profile views of a specimen with well-preserved surface ornamentation. No. 474. X 2. 37-38. Ventral and profile views of another well-preserved ventral valve. No. 473. X 3.	
14-17. <i>Wellerella multiplicata</i> , n. sp.....	10
Holotype, ventral valve, dorsal valve, and anterior and profile views. No. 443 X3	
18-20. <i>Punctospirifer kentuckiensis</i> (Shumard)	11
Ventral valve, dorsal valve, and profile view of a typical specimen. No. 445 X 3	
21, 22. <i>Canocrinella boonensis</i> (Swallow)	17
Ventral and profile views of a small ventral valve. No. 478. X 3.	
23-28. <i>Chonetes striatus</i> , n. sp.....	17
23. Paratype; small ventral valve. No. 480. 24-26. Holotype, ventral valve, profile, and dorsal valve. No. 479. 27-28. Paratype; ventral and profile views of another ventral valve. No. 481. All X 3.	
29-32. <i>Reticulariina</i> cf. <i>R. spinosa</i> (Norwood and Pratten)	11
Ventral valve, dorsal valve, and anterior and profile views of a typical specimen. No. 446. X 2.	
39-41. <i>Rhipiclomella carbonaria</i> (Swallow)	10
Ventral valve, dorsal valve, and profile of a typical specimen. No. 442. X 3	
42-46. <i>Dielasma angulata</i> , n. sp.....	22
Holotype; profile, anterior, posterior, dorsal-valve, and ventral-valve views, showing median angulation of the sinus. No. 501. X 2.	
47. <i>Mesolobus mesolobus</i> (Norwood and Pratten)	21
Ventral valve on piece of limestone with <i>Phricodothyris perplexa</i> . No. 500. X 3.	