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Stuart A. Northrop
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MISSISSIPPIAN AND PENNSYLVANIAN FOSSILS OF THE ALBUQUERQUE COUNTRY

STUART A. NORTHROP
University of New Mexico

MISSISSIPPIAN FOSSILS

Prior to 1951, no diagnostic fossils—with the exception of a foraminifer, **Endothyra baileyi**—had been found in pre-Pennsylvanian strata in New Mexico north of Ladron Peak, between Socorro and Belen. More than a century ago Marcou (1856; 1858) misidentified Pennsylvanian fossils from Pecos, the Sandia Mountains, and Tijeras Canyon as Mississippian species. He concluded that the Madera or Magdalena limestone was "calcaire du carbonifere inferieure" or limestone of the Lower Carboniferous. Later he called it the "Mountain Limestone" and stated that the Sandia rim was "composed of **Carboniferous Limestone**, which here merits most truly its name of **Mountain Limestone**, for it is the only limestone of any importance met with in the Rocky Mountain region." Within a few years other workers assigned this limestone to the Upper Carboniferous or Pennsylvanian.

Apparently, the first recognition of pre-Pennsylvanian Paleozoic strata in New Mexico north of Ladron Peak was in 1940, when the 7,407-foot well in the Rattlesnake field was completed; Needham and Bates (1942) assigned 215 feet of strata in this well to the Mississippian. This same year Thompson (1942) found 106 feet of pre-Pennsylvanian rocks at the north end of the Sandia Mountains near Placitas. Above the Precambrian he measured 16 feet of conglomerate and sandstone overlain by 90 feet of unfossiliferous limestone and hazarded the opinion that these rocks might be "of lower Paleozoic age" (Thompson, 1942, p. 19). During the period 1942-1947 it was suggested by several members of the U. S. Geological Survey that such scattered remnants of pre-Pennsylvanian strata might be Mississippian or older (Read and Henbest, 1942; Henbest, Read, and others, 1944; Read and others, 1944; Henbest, 1946a, 1946b; Kelley and Wood, 1946; Northrop and Wood, 1946; Northrop and others, 1946; Read and Wood, 1947). On the basis of **Endothyra**, Henbest (1946a, 1946b) correlated this unit in the Sangre de Cristo and Sandia Mountains with the Leadville of Colorado.

It remained for A. K. Armstrong, an undergraduate student at U.N.M., to discover the first diagnostic megafossils in the pre-Pennsylvanian rocks. Early in 1951 Armstrong was engaged in a field problem under the direction of J. Paul Fitzsimmons. He was examining Precambrian rocks at the south end of the Nacimiento Mountains west of Jemez Pueblo, when he found fossils in small patches of limestone faulted down into the Precambrian basement. The first two slabs of this limestone Armstrong submitted to me early in 1951 contained **Conularia** sp. and **Eumetria** sp. Recognizing the latter as a Mississippian form, I suggested that Armstrong make further search for fossils. Fitzsimmons concurred and the emphasis of the problem shifted from Precambrian to Mississippian. Further collections were made by Armstrong and some were made by Fitzsimmons and myself. On May 21, 1951, I submitted to Armstrong a memorandum on all the material, tentatively identifying a variety of brachiopods and representatives of five other classes of invertebrates. I wrote as follows:

> "The age of these fossils is Mississippian. I had anticipated that any Mississippian strata of northern New Mexico would prove to be older Mississippian, that is, Kinderhook or Osage, because these strata extend farther north in southern New Mexico than do younger Mississippian strata, such as Meramec and Chester. Again, in southern Colorado the Leadville or Madison limestone is chiefly Kinderhook or Osage in age.
>
> "However, the **Eumetria** in your collections seems close to **Eumetria verneuiliana**, which is found in the Middle Mississippian Meramec of the Mississippi Valley region (Salem limestone and St. Louis limestone) and ranges up into the Upper Mississippian Chester series."

I suggested to Fitzsimmons that, because these were the first pre-Pennsylvanian megafossils ever found in northern New Mexico in a distance of 200 miles between Ladron Peak, New Mexico, and Piedra River Canyon, Colorado, the fossils should be submitted to Mackenzie Gordon, Jr., a Mississippian specialist of the U. S. Geological Survey.

It was decided to name the formation the Arroyo Penasco formation. Gordon's report on the fossils, listing 39 species, corroborated my determination of a Meramec, possibly St. Louis, age. A paper by Fitzsimmons, Armstrong, and Gordon (1956) was submitted in June 1955 and published in August 1956. Meanwhile Armstrong (1955) had published independently a report that included observations on Mississippian rocks in the Sangre de Cristo, Sandia, Manzano, and Ladron Mountains. Chiefly on the basis of microfossils, he concluded that the upper part of the "Arroyo Penasco" of the Sangre de Cristos is Meramec in age but that the lower unfossiliferous strata might be equivalent to the Leadville of Colorado or the Caloso of Ladron Peak. In this connection it may be noted that Baltz and Read (1960) collected Early Mississippian fossils at several localities in the Sangre de Cristos; they named two new formations, the Tererro of Early Mississippian (Kinderhook and Osage) age, and the Espiritu Santo of possible Devonian age. In view of the fact that the Meramec fossils of the Arroyo Penasco at the type locality of that formation occur in the upper part, it is possible that the unfossiliferous lower part of the Arroyo Penasco may be Lower Mississippian and equivalent to the Tererro formation.

Fossils of the Arroyo Penasco formation are listed below. Practically all of these are from the type locality of the formation in Penasco Canyon near the southern end of the Nacimiento Mountains, T. 16 N., R. 1 E., Jemez Indian Reservation, San Ysidro quadrangle. The identifications, unless otherwise noted, are by Mackenzie Gordon, Jr. (in Fitzsimmons, Armstrong, and Gordon, 1956). Generic assignments for several of the brachiopods have been changed by me. Names followed by (1) were cited by Armstrong (1955); names followed by (2) were cited by Armstrong (1958).

FORAMINIFERA
- Endothyra sp. aff. E. baileyi
- E. macra (2)
- E. prodigiosa (2)
- E. sp. (1)
- E. (planispiral type)
- Plectogyra sp. (1,2)

SCYPHOZOA
- Conularia sp. (1)

ANTHOZOA
- Homalophyllites? sp.
- Syringopora sp.
- Trochophyllum? sp.
- Zaphrentites? sp.
- Zaphrentoid coral fragments

BRYOZOA
- Archimedes? sp. (1)
- Fenestella spp. (1)
- Septopora sp.
- Stenoporoid, gen. indet.
- Sulcoretepora sp. aff. S. lineata group

BRACHIOPODA
- Brachythyris sp. aff. B. altonensis
- B. sp.
- Composita sp. aff. C. lewisensis (1)
- C. sp.
- C.? sp.
- Dielasma cf. sinuatum
- Eumetria vera (1)
- E. verneuiliana (1)
- E. cf. verneuiliana
- Girtyella sp.
- Ovatia ovata (1)
- O. pileiformis
- O.? tenuicostus
- O.? sp.
- "Productus (Pustula?) cf. indianensis"
- Protoniella? n. sp. aff. P.? parva
- Pugnoides cf. ottumwa
- Punctospirifer sp.
- Setigerites scitulus
- Spirifer cf. pellaensis
- S. cf. subaequalis
- S. sp. (1)
- Strophomenoid, gen. and sp. indet.

PELECYPODA
- Leptodesma sp. (1)
- Lithophagus? sp.
- Fragment, gen. and sp. indet.

GASTROPODA
- Bellerophon cf. sublaevis
- Euomphalus sp.
- Euphemites sp.
- Straparolus sp. (1)
- S. sp. indet.
- Fragments, gen. and sp. indet.

OSTRACODA
- Ostracod molds, gen. and sp. indet.

CRINOIDEA
- Columnals and plates

INDETERMINATA
- Indet. fragments

In the Placitas area at the north end of the Sandia Mountains, Toomey (1953) measured ten sections of pre-Pennsylvanian strata, ranging from 20 to 81 feet in thickness. The only determinable fossils he found were poorly preserved **Euomphalus** sp., two high-spired gastropods, and a cephalopod. Later, in the Placitas area, Armstrong (1955) measured one section of 102 feet of pre-Pennsylvanian rock and cited poorly preserved **Straparolus?** [Euomphalus?] sp., **Stegocoelia?** sp., **Goniatites** sp., and **Plectogyra** sp. Subsequently Armstrong (1958) cited **Endothyra prodigiosa.**

At the south end of the Sandia Mountains in Tijeras Canyon, Szabo (1953) measured ten sections of the pre-Pennsylvanian sequence, ranging from 8 to 48 feet in thickness. However, in his thickest section, as much as 32 feet of red shale may be Pennsylvanian in age. If the questionable red shale that appears in most of his sections be assigned to the Pennsylvanian, the remaining pre-Pennsylvanian strata range from 8 to 27 feet in thickness. Armstrong (1955) measured only one section in Tijeras Canyon, 16 feet thick. Some of my colleagues hold the opinion that, in the absence of diagnostic fossil evidence, the so-called pre-Pennsylvanian rocks in Tijeras Canyon should be assigned to the Sandia formation. Certainly, along much of the Sandia crest, the pre-Pennsylvanian seems to be missing. On the other hand, Toomey (1953, p. 12) observed that the basal unit of the Sandia formation in the vicinity of the Sandia crest "contains numerous, large, reworked fragments of pre-Pennsylvanian limestone."

At Bosque Peak in the southern Manzano Mountains, east of Los Lunas and a few miles southwest of Mosca Peak, Armstrong (1958) found 22 feet of limestone that may be Mississippian. He observed also a few isolated remnants of limestone, 20-30 feet thick, at several places in the Manzanita and Manzano Mountains between Tijeras Canyon and Bosque Peak.

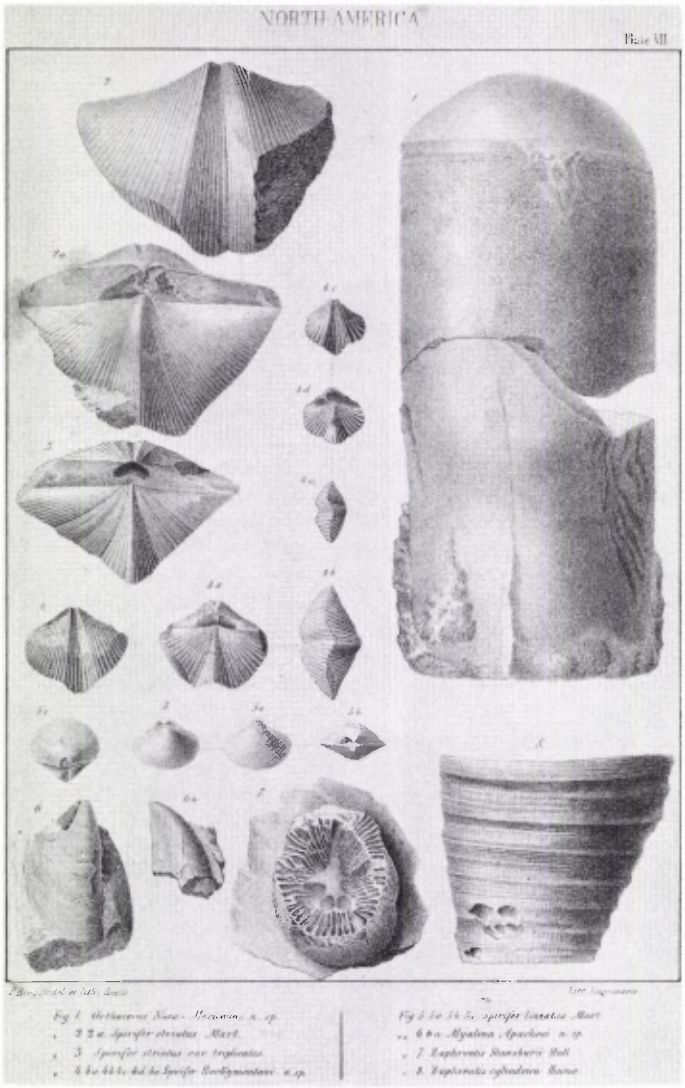
It now seems likely that all of the pre-Pennsylvanian rocks of the Sandia-Manzanita-Manzano area should be assigned to the Tererro (or Tererro and Espiritu Santo formations). As Baltz and Read (1960, p. 1768) have well said, "Further paleontologic studies and studies of the physical stratigraphy must precede correlation, firm assignments of age, and adjustments in the terminology of the Espiritu Santo, Tererro, and Arroyo Penasco formations."

PENNSYLVANIAN FOSSILS

The Pennsylvanian strata of north-central New Mexico, especially in the Albuquerque country, are abundantly fossiliferous at many localities. Good specimens of fossil plants are generally scarce, but marine invertebrates are common, diversified, and often well preserved. The total marine fauna probably numbers several hundred species. Excellent specimens can be collected at a number of localities in the Manzano-Manzanita-Sandia Mountains, in the Nacimiento Mountains, and especially in such canyons cutting the Jemez Plateau as Guadalupe Canyon (of the Rio de las Vacas) and San Diego Canyon (of Jemez River).

Fusulinids, brachiopods, bryozoans, and crinoids are perhaps most abundant; corals, pelecypods, gastropods, ostracods, and echinoids are common; other groups, such as sponges, conularids, nautiloid cephalopods, scaphopods, annelids, trilobites, and shark teeth, are less common and generally scarce at most localities. Groups not yet found or reported in the literature include blastoids, asteroids, crustaceans, insects, myriapods, scorpions, and eurypterids. Unfortunately there is no general report dealing with the paleontology of the Pennsylvanian of the State. Illustrations and descriptions of the fossils must be sought in many reference works and scattered papers in various technical journals dealing with the faunas of other regions.

Of possible interest to the professional as well as the amateur collector is the observation that, on the whole, better preserved fossils can be found in the Jemez-Nacimiento area than in the Sandia-Manzano area. At many places in the Jemez country, quantities of excellent fossils weather free from the matrix; with few exceptions, this is not true for the Sandia-Manzano country. Differences in ecology are apparent, also. For example, corals are generally small in size and relatively uncommon in the Jemez area, whereas they are larger and locally quite common in the Sandia Mountains. Their abundance here was



One of Marcou's plates (X½) illustrating Pennsylvanian fossils from the Sandia Mountains. (Plate 7 of "Geology of North America," by Jules Marcou, published in Zurich, 1858; P. Brugier del. et lith. Zuric; lier Imprimerie.)

Figure 1. — **Orthoceras Nova-Mexicana,** n. sp. "I found only one specimen of this species; it was in a block of blue limestone, with several beautiful specimens of the **Productus semi-reticulatus,** in a deep ravine near the summit of the Sierra de Sandia, behind Albuquerque" (p. 44).

Figures 2, 2a. — **Spirifer striatus** Mart. [=**Neospirifer**] ". . . it forms a complete bed of limestone a foot thick, in the **Mountain Limestone** of Pecos village . . . . I found it also at the summit of the Sierra de Sandia, 12,000 feet above the sea-level, and also at the village of Tigeras, New Mexico" (p. 49). Figured specimen from Pecos village.

Figure 3. — **Spirifer striatus var. triplicatus.** [=**Neospirifer dunbari**] " . . . abundant in the Rocky mountains, especially at Pecos village, at Tigeras, on the summit of the Sierra de Sandia . . . " (p. 49-50). Figured specimen from Pecos village.

Figures 4, 4a, 4b, 4c, 4d, 4e. — **Spirifer Rockymontani,** n. sp. [4, 4a, 4b = **Spirifer matheri** Dunbar and Condra; 4c, 4d, 4e = **Spirifer rockymontanus** Marcou] "I found this beautiful species in the Mountain Limestone of Tigeras, Canon of San Antonio, New Mexico; where it is not rare" (p. 50).

Figures 5, 5a, 5b, 5c. — **Spirifer lineatus** Mart. [= **Phricodothyris perplexa**] "I found it at Pecos village and at Tigeras, where it is not very common" (p. 50). Figs. 5, 5a, 5b: "Different views of specimen from Pecos." Fig. 5c: "Specimen from Tigeras, showing to the naked eye the reticulation of its surface."

Figures 6, 6a. — **Myalina Apachesi,** n. sp. " . . . near the ranchos of Pecos village" (p. 44).

Figure 7. — **Zaphrentis Stansburii** Hall. In the text (p. 52-53) the spelling stansburyi is used. "I saw a great many at Tigeras, on the summit of the Sierra de Sandia, and at Pecos village." Figured specimen from Tijeras: "fragment showing the interior of the turbine."

Figure 8. — **Zaphrentis cylindrica** Haime. "I saw a great number of specimens in ascending the Sierra de Sandia from [San] Antonito, and several limestone beds were full of them. I also found it at Tigeras" (p. 53). Figured specimen from Sandia Mountains.

noted more than a century ago by Jules Marcou (1858, p. 53). In describing a horn coral that he misidentified as **Zaphrentis cylindrica,** he wrote:

> "This gigantic species of coral ,so common in the Mountain Limestone of England, Belgium and France, had not been found previously in America. I saw a great number of specimens in ascending the Sierra de Sandia from [San] Antonito, and several limestone beds were full of them. I also found it at Tigeras [Tijeras]."

And, in describing another horn coral, **Zaphrentis stansburyi,** of which he "saw a great many at Tigeras, on the summit of the Sierra de Sandia, and at Pecos village," he observed that "the limestone in which it is found is so hard, that it is difficult to obtain well preserved and complete specimens."

Good specimens of brachiopods, bryozoans, and crinoid stems can be collected readily in the Jemez country. Such specimens occur in the Sandias and Manzanos but are usually more difficult to collect. Again, I have never observed any notable abundance of pelecypods or gastropods in the Sandia-Manzano area, such as may be found at several places in the Jemez country.

Two check lists of Pennsylvanian fossils are given below, one for the Jemez-Nacimiento Mountains area and one for the Sandia-Manzanita-Manzano Mountains area.

Pennsylvanian Fossils of the Jemez-Nacimiento Mountains Area

Unless otherwise indicated, these are from Northrop and Wood (1946), which included microfossils by Henbest, Read, and others (1944). Other citations are indicated by key numbers in parentheses, as follows:

1. Bisbee (1932)
2. Needham (1937)
3. Moore and Dudley (1944)
4. Northrop and Wood (1945)

5. Thompson (1948)
6. Armstrong (1955)
7. Lovejoy (1958)

FORAMINIFERA
- Bradyina 2 sp.
- B.? sp.
- Climacammina sp.
- Endothyra sp.
- E.? sp.
- Fusulina of F. cylindrica group
- F. sp. aff. F. euryteines
- F. leei
- F. sp. aff. F. leei
- F. tregoensis?
- F. sp.
- Fusulinella carmani?
- F. sp. aff. F. iowensis
- F. cf. juncea (5)
- F. stouti
- F. sp.
- F.? sp.
- Millerella sp.
- Spiroplectammina sp.
- Tetrataxis sp.
- Textulariidae
- Triticites irregularis
- T. irregularis var.
- T. jemezensis [syntypes] (2)
- T. kellyensis [syntypes] (2)
- T. kellyensis?
- T. nebraskensis
- T. sp. aff. T. nebraskensis
- T. sp. aff. T. plummeri
- T. cf. rhodesi (7)
- T. ventricosus (7)
- T. ventricosus var.
- T. sp.
- T.? sp.
- Wedekindellina euthysepta
- W. excentrica
- W. excentrica?
- W. minuta
- W. sp.

PORIFERA
- New genus, new species (red siliceous sponge)
- Spicules (7)
- Sponge(?) borings

ANTHOZOA
- Aulopora cf. prosseri
- A. sp. (4)
- Axophyllum? sp.
- Chaetetes milleporaceus
- C. sp.
- Cyathaxonia distorta?
- Lophophyllidium proliferum (1)
- L. proliferum?
- Neozaphrentis? sp.
- Pleurodictyum? sp.
- Undet. horn corals

BRYOZOA
- Bascomella sp. (7)
- Batostomellid
- Cyclotrypa pelagia [holotype and paratypes] (3)
- Fenestellids
- Heteronema? sp. (7)
- Prismopora sp.
- Rhombopora cf. lepidodendroides
- Septopora biserialis
- Undet. genera of massive, encrusting, and foliate forms

BRACHIOPODA
- Antiquatonia coloradoensis
- A. cf. hermosana
- A. portlockiana
- A. portlockiana crassicostata (7)
- A. sp.
- A.? sp.
- Beecheria bovidens
- Cancrinella boonensis
- Chonetes granulifer
- C. granulifer meekanus (7)
- C. sp.
- Chonetinella flemingi alata (7)
- C.? sp.
- Cleiothyridina orbicularis (7)
- Composita cf. elongata (7)
- C. cf. gibbosa
- C. cf. magna (7)
- C. ovata (7)
- C. subtilita
- C. trilobata (7)
- C. cf. trilobata
- C. sp.
- Crurithyris planoconvexa
- Derbyia bennetti
- D. cf. bennetti
- D. crassa
- D. crassa texana
- D. crassa cf. texana
- D. cymbula?
- D. cf. haesitans
- D. sp. aff. D. haesitans
- D. plattsmouthensis (7)
- D. sp.
- Desmoinesia cf. missouriensis
- Echinaria moorei
- E. cf. moorei (7)
- E. semipunctata
- E. cf. semipunctata
- E. sp.
- Hustedia cf. miseri
- H. mormoni
- H. sp. (4)
- Hystriculina wabashensis
- Juresania nebrascensis
- Kozlowskia splendens (1)
- Lingula sp.
- Linoproductus cf. oklahomae
- L. platyumbonus
- L. sp. aff. L. platyumbonus
- L. prattenianus
- L. cf. prattenianus
- L. sp.
- "Marginifera" sp. [probably most = Kozlowskia]
- Meekella striatocostata
- M. cf. striatocostata
- M. sp.
- Neospirifer alatus
- N. dunbari
- N. cf. dunbari
- N. gibbosus (7)
- N. sp.
- Orbiculoidea? sp. (7)
- Petrocrania modesta
- Phricodothyris perplexa
- Pulchratia cf. ovalis
- P. symmetrica? (7)
- Punctospirifer kentuckiensis
- P. kentuckiensis?
- Schizophoria oklahomae (6)
- S. cf. oklahomae
- Schuchertella? sp. (7)
- Spirifer occiduus [formerly S. occidentalis]
- S. cf. occiduus
- S. opimus
- S. rockymontanus
- S. cf. rockymontanus
- S. sp. A (7)
- S. spp. (6)
- Wellerella immatura
- W. osagensis
- Genus undet. (7)

PELECYPODA
- Acanthopecten carboniferus
- Allorisma terminale
- A. sp.
- Anthraconeilo? sp.
- Astartella vera (1)
- Aviculopecten occidentalis (1)
- A. sp.
- A.? sp.

Aviculopinna nebrascensis
A. peracuta
A. cf. peracuta
Edmondia aspinwallensis (1)
E. gibbosa
E. cf. gibbosa
E. nebrascensis
E. sp.
Limipecten? sp.
Myalina (Myalinella?) sp.
M. (Orthomyalina) cf. stocomi
M. (Orthomyalina) subquadrata
M. (Orthomyalina) sp.
M. sp.
Nuculana sp.
Pleurophorus sp. aff. P. tropidophorus
Pseudomonotis equistriata
P. robusta (1)
P. sp.
P.? sp.
Schizodus cuneatus
S. subcircularis? (1)
S. wheeleri (1)
S. sp. (1)
S.? sp.
Septimyalina sp.
Solenomya cf. trapezoides
S.? sp.
Streblochondria sp.

GASTROPODA
Amphiscapha catilloides
A. cf. subrugosa
A. sp.
Bellerophon cf. giganteus
B. sp.
Euomphalus sp.
E.? sp.
Euphemites nodocarinatus
Meekospira? sp. ~~(1)~~
Naticopsis sp. (7)
Orthonychia parva
Pharkidonotus percarinatus (1)
Phymatopleura? sp. (1)
Shansiella carbonaria (1)
Straparolus sp.
Strobeus primogenius (1)
S. sp.
S.? sp.
Strophostylus remex (1)
S. sp.
Trepospira depressa (1)
T. discoidalis (7)
T. sp.
T.? sp.
Worthenia sp. (1)
Undet. large form

CEPHALOPODA
Dolorthoceras? sp.
Endolobus? sp.
Ephippioceras cf. ferratum
Mooreoceras? sp.
"Orthoceras" sp.
Tainoceras sp.

SCAPHOPODA
Dentalium? sp.

ANNELIDA
Spirorbis sp.
S.? sp.
Worm (?) borings

TRILOBITA
Ameura sp.
Ditomopyge parvula? (1)
D. new species (7)
D. sp.
Undet. pygidium

CRINOIDEA
Delocrinus sp. (1)
Hydreionocrinus sp. (1)
Undet. columnals and plates

ECHINOIDEA
Echinocrinus sp. (plates and spines)

VERTEBRATA
Shark teeth and a fin spine

Pennsylvanian Fossils of the Sandia-Manzanita-Manzano Mountains Area

Citations are indicated by key numbers in parentheses, as follows:

1. Marcou (1858)
2. White (1877)
3. Herrick (1900)
4. Herrick and Bendrat (1900)
5. Herrick and Johnson (1900)
6. Bisbee (1932)
7. Dunbar and Condra (1932)
8. Needham (1937)
9. Szabo (1953)
10. Toomey (1953)
11. Werrell (1961)
12. Read, C. B. (personal communication)

FORAMINIFERA
Fusulina euryteines (8,11)
F. rockymontana (11)
F. socorroensis (11)
F. sp. aff. F. taosensis (11)
F. sp. (9,11)
Triticites fresnalensis (8)
T. irregularis (9)
T. nebraskensis (11)
T. ventricosus (8,9)
T. ventricosus, 2 var. (11)
T. wellsi (8)
T. spp. (10,11)
Wedekindellina euthysepta (8)
W. excentrica (8,11)
W. sp. (9,10)

SCYPHOZOA
Conularia sp. (4)

ANTHOZOA
Amplexus coralloides? (1) [= an English species]
Aulopora? anna (9)
Caninia torquia (9)
C.? sp. (10)
Chaetetes milleporaceus (9,10)
C. cf. milleporaceus (6)
Dibunophyllum valeriae (9)
D. sp. (10)
Lophophyllidium proliferum (6,9)
Neozaphrentis sp. (10)
Pleurodictyum sp. (10)
Syringopora multattenuata (9)
S. cf. multattenuata (6)
S. sp. (10)
Zaphrentis cylindrica (1) [= an English species]
Z. stansburyi (1) [probably = Neozaphrentis]

BRYOZOA
Cystodictya sp. aff. C. carbonaria (4)
Fenestella albuquerqucana [syntypes] (4)
F. limbata (4)
F. norwoodiana (4)
F. spp. (9,10)
Fistulipora incrustans (9)
F. nodulifera (9)
Megacanthopora sp. (9)
Penniretepora trilineata (4)
P. cf. whitei (4)
P. spp. (9,10)
Polypora coyotensis [holotype] (4,5)
P. elliptica (9)
P. fastuosa (4)
P. sp. (10)
Prismopora sp. (9,10)
Rhombopora lepidodendroides (9)
R. sp. (10)
Septopora biserialis (4)
S. sp. (9)
Tabulipora heteropora (9)
T. sp. (10)
Undet. bryozoans (1)

BRACHIOPODA
Antiquatonia portlockiana (9,10)
A. portlockiana crassicostata (9,10)

Beecheria bovidens (6,9,10)
Cancrinella boonensis (4,9)
Chonetes granulifer (3,6,9,10)
Chonetinella flemingi (9)
C. flemingi crassiradiata (10)
C. verneuiliana (6,9)
Cleiothyridina orbicularis (9,10)
Composita argentea (9)
C. elongata (9,10)
C. magna (9,10)
C. ovata (9,10)
C. subtilita (1,4,6,9,10)
C. trilobata (9,10)
Crurithyris planoconvexa (6,9)
Cryptacanthia compacta (7)
Derbyia crassa (4,6,9,10)
Desmoinesia missouriensis (9)
D. muricatina (9,10)
Dictyoclostus americanus (10) [probably = Antiquatonia]
Echinaria semipunctata (6,9,10)
E. semipunctata knighti (9)
Enteletes hemiplicatus (6,9)
E. hemiplicatus plattsburgensis (9)
Hustedia mormoni (6,9,10)
Hystriculina wabashensis (9,10)
Juresania nebrascensis (4,6,9,10)
Kozlowskia splendens (6,9,10)
Lingula tighti (4)
Linoproductus insinuatus (9)
L. oklahomae (9)
L. platyumbonus (9)
L. cf. platyumbonus (10)
L. prattenianus (1,2,4,6,9,10)
Meekella striatocostata (6,9,10)
Mesolobus mesolobus (4,9,10)
M. mesolobus decipiens (10)
Neospirifer alatus (10)
N. cameratus (6,9)
N. dunbari (1,9)
N. gibbosus (9,10)
N. latus (9)
Orbiculoidea capuliformis (3)
O. missouriensis (9,10)
O. ? nitida (4) [= an English species]
Phricodothyris perplexa (1,4,6,9,10)
Productus costatus (6) [probably = Antiquatonia]
P. flemingi (1) [= an English species; probably Desmoinesia]
P. punctatus (1) [see Echinaria]
P. pustulosus (1) [= English Mississippian]
P. pyxidiformis (1) [= English Mississippian]
P. scabriculus (1) [= English Permian; Juresania]
P. semireticulatus (1,4,6) [see Antiquatonia]
Punctospirifer kentuckiensis (6,9,10)
Retaria lasallensis (9,10)
Rhipidomella carbonaria (6) [formerly R. pecosi]
Rhynchonella sp. (4) [probably Rhynchopora]
Schizophoria cf. oklahomae (10)
S. resupinoides (9)
Schuchertella pratteni (10)
Spirifer fultonensis? (4) [not recognizable]
S. matheri (7,9)
S. occiduus (9,10) [formerly S. occidentalis]
S. occiduus, var. (9)
S. opimus (4,9,10)
S. rockymontanus [types] (1,9,10)
Terebratula plano-sulcata (1) [= Cleiothyridina]
Wellerella immatura (10)
W. osagensis (6,9,10)

PELECYPODA

Acanthopecten carboniferus (9,10)
Allorisma terminale (9,10)
Annuliconcha interlineata (9)
Astartella concentrica (9)
A. newberryi (4)
A. varica (4)
Aviculopecten basilicus (10)
A. occidentalis (9)
A. occidentalis? (4)
A. sp. (10)
Aviculopinna nebraskensis (9)
A. peracuta (9)
Bakewellia parva (3)
Cypricardinia carbonaria (4)
Dunbarella knighti (9)
Edmondia aspinwallensis (9)
E. gibbosa (9)
E. nebrascensis (9)
E. nebrascensis? (4)
E. sp. (3)
Fasciculoconcha scalaris (4)
Lima retifera (4)
Myalina (Myalina) wyomingensis (9)
M. (Orthomyalina) subquadrata (9)
M. sp. (10)
M.? sp. (3)
Nuculana bellistriata (9,10)
N. bellistriata attenuata (9)
Parallelodon obsoletus (9)
P. tenuistriatus (9)
Pleurophorus subcuneatus (3)
P. tropidophorus (9)
Promytilus swallovi (3)
Pseudomonotis equistriata (9)
P. hawni (9) [= Permian species]
Pteria? longa (3)
Schizodus wheeleri (9)
Septimyalina perattenuata (3)
Streblochondria? tenuilineata (4)
Yoldia glabra (9)

GASTROPODA

Amaurotoma? sp. (10)
Anomphalus rotulus (9)
Bellerophon crassus (9)
B. crassus? (4)
B.? sp. (10)
Cymatospira montfortiana (3,9)
Euconospira missouriensis (9)
E. turbiniformis (9)
Euomphalus plummeri (9)
E. reedsi (9)
Euphemites carbonarius (9)
E. nodocarinatus (9)
E. vittatus (10)
Goniasma lasallensis (9)
Meekospira? sp. (6)
Naticopsis remex (9)
N. scintilla (9,10)
Orthonychia parva (9,10)
Pseudozygopleura perversa (9)
Strobeus primogenius (9)
Worthenia speciosa (9)
Yunnania subsinuata (9)

CEPHALOPODA

Metacoceras cornutum (9)
M. perelegans (9)
Mooreoceras sp. (9)
"Orthoceras nova-mexicana" [holotype] (1)

SCAPHOPODA

Dentalium sp. (10)

TRILOBITA

Ameura major (5)
A. sangamonensis (9)
A. sangamonensis? (6)
Ditomopyge olsoni (9,10)
D. parvula? (6)
D. sp. (10)
"Phillipsia new species" A (5)
"P. new species" B (5)
"P. sp." (4)

OSTRACODA

Amphissites 2 sp. (11)
Bairdia chaseae (11)
B. 7 undet. spp. (11)
Bairdiacypris cf. acuminata (11)
Bythocypris procera (11)

B. sp. (11)
Cytherella sp. aff. C. footei (11)
C. sp. (11)
Kellettina binoda, 2 var. (11)
Kirkbya sp. aff. K. canyonensis (11)
K. sp. (11)
Paraparchites claytonensis (11)
Silenites sp. (11)
CRINOIDEA
Cibolocrinus punctatus (9)
C. tumidus (9)
Delocrinus cf. verus
D. n. sp.
Ulocrinus sp. (10)
Crinoids, gen. and sp. undet. (9)
ECHINOIDEA
Echinocrinus sp. (6,10)
VERTEBRATA
Shark teeth, undet. (9)
PLANTS
Asterophyllites equisetiformis (12)
Calamites sp. aff. C. suckowii (12)
Cardiocarpon sp. (9,10)
Cordaites sp. (9,10)
Lebachia sp. (9)
Neuropteris ovata (12)
N. scheuchzeri (9,10)
N. tenuifolia (9,10)
Pecopteris vestita (9)
Sigillaria sp. (9)

The first significant attempt to correlate the Pennsylvanian strata of New Mexico with standard sequences in other regions was by Needham (1937) in his bulletin on New Mexico fusulinids. In 1940 he published a short paper entitled "Correlation of Pennsylvanian rocks in New Mexico." Using about twenty-five species of fossils, chiefly brachiopods and a few fusulinids, he suggested that the oldest Pennsylvanian strata of central New Mexico are younger than Bend, Morrow, or lower Pottsville. Two years later, Thompson (1942) proposed the term Derry series for the essentially pre-Desmoinesian Pennsylvanian rocks of central to south-central New Mexico, and correlated the Derry with the Atoka of Oklahoma, Cheney's Lampasas of Texas, and the basal part of the Des Moines of some areas in the Mid-Continent region. He did not believe that the New Mexico Pennsylvanian sequence included any part of Morrowan time.

Thompson correlated the Sandia formation of the Sandia Mountains with his Elephant Butte formation of the Armendaris group of Desmoinesian age. According to him, a section at the northern end of the Sandia Mountains includes rocks of Desmoinesian, Missourian, and Virgilian age, while sections at Jemez Springs include rocks of Derryan age as well. However, in the same year, Read and Henbest (1942) stated that the Pennsylvanian of northern New Mexico includes rocks of Morrowan age. In 1944 Henbest and Read recognized the **Millerella** zone in the Jemez country near Jemez Pueblo and again at the Soda Dam, and concluded that it is of probable Morrowan age. (See also Read and Wood, 1947.) Northrop and Wood (1945; 1946) assigned a Morrowan age to certain strata in the Jemez country, citing especially the large and distinctive brachiopod **Schizophoria** cf. **oklahomae** (ranging up to 73 mm across), which occurs in the Wapanucka and Morrow of Oklahoma. We collected this striking brachiopod near the base of the Sandia formation at two localities in Guadalupe Canyon, about 7 and 9 miles, respectively, north of Jemez Pueblo. Later, Armstrong (1955) found an abundance of good specimens of this species in Penasco Canyon, about 7½ miles west of Jemez Pueblo.

In 1946 Northrop and Wood reported for the Jemez-Nacimiento area a total of about 185 species, based on a preliminary study of nearly 100 collections from 33 stratigraphic sections, and proposed five faunal zones—designated A, B, C, D, and E (from oldest to youngest)—"each of which is characterized either by species having short stratigraphic ranges, by the earliest appearance of longer-ranging species, by a notable abundance of certain long-ranging species which range through more than one zone, or by a combination of these." Faunal zone A = Morrowan; B = late Morrowan, Lampasan, and early Desmoinesian; C = late Desmoinesian and earliest Missourian; D = remainder of Missourian; and E = Virgilian.

In conclusion, it seems likely that the Pennsylvanian sequence in the Jemez country ranges from Morrowan to Virgilian, whereas the sequence in the Sandia country may lack representatives of Morrowan and Lampasan (Atokan) time.

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