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Introduction

The Madera Group in the Manzano Mountains consists of, in ascending order: Los Moyos Limestone, Wild Cow Formation, and Bursum Formation (Myers, 1973). This 500-m-thick sequence includes a wide variety of depositional environments representing Desmoinesian (Middle Pennsylvanian) to earliest Wolfcampian (earliest Permian) time. Many units are abundantly fossiliferous; however, although lists of identified taxa derived mainly from master's theses are available (Northrop, 1961; Kelley and Northrop, 1975), few detailed studies of the faunas have been published. During the past few years I have sampled fossil assemblages in several different facies throughout the Madera Group in an effort to understand better the taxonomic composition of faunas that lived in different paleoenvironments and to track changes in the faunas of each paleoenvironment through the Middle and Upper Pennsylvanian. In this paper I discuss briefly a diverse marine assemblage from the Sol se Mete Member of the Wild Cow Formation. The Sol se Mete Member is the lowest of three members of the Wild Cow Formation. The gastropods in this assemblage, though sparse, are considered in some detail and illustrated because Pennsylvanian gastropods in central New Mexico have been little studied and are poorly known.

Location and geologic setting

The fossils described herein were collected from a shallow, inactive quarry about 50 m east of NM–14, 2.4 km south of the village of Escabosa, and 27 km south of the town of Tijeras, Bernalillo County, New Mexico (Fig. 1). The rocks exposed in Escabosa quarry represent the upper part of the Sol se Mete Member (Hawley and others, 1982). The age of the Sol se Mete is Missourian based on the occurrence of diagnostic species of the fusulinid *Triticites* identified at other localities in the vicinity (Myers, 1969, 1973, 1982). Because the Sol se Mete is overlain conformably by the Pine Shadow Member (Virgilian), the Escabosa quarry fauna is probably of late Missourian age.

The quarry is developed in the basal 6 m of a 9–18-m-thick unit of massive gray limestones that typically forms the uppermost unit of the Sol se Mete in the Manzano Mountains. The floor of the quarry is about at the contact between this limestone sequence and an underlying sequence of brown to gray, platy, calcareous shales with local thin beds of hard argillaceous limestones. The majority of fossils discussed in this paper were collected from a 4-m-thick interval of this shaly unit, which is exposed in the northeastern part of the quarry. Approximately 2,650 specimens were collected from the shaly unit during intensive collecting efforts; every observed specimen larger than about 2 mm was collected. The relative abundances of the taxa from the shaly unit (Table 1) are probably representative of original relative abundances in the 4-m-thick interval sampled, although variations from bed to bed undoubtedly exist. All specimens discussed and illustrated are in the University of New Mexico, Department of Geology, paleontology collections. Illustrated specimens have been assigned UNM catalogue numbers.

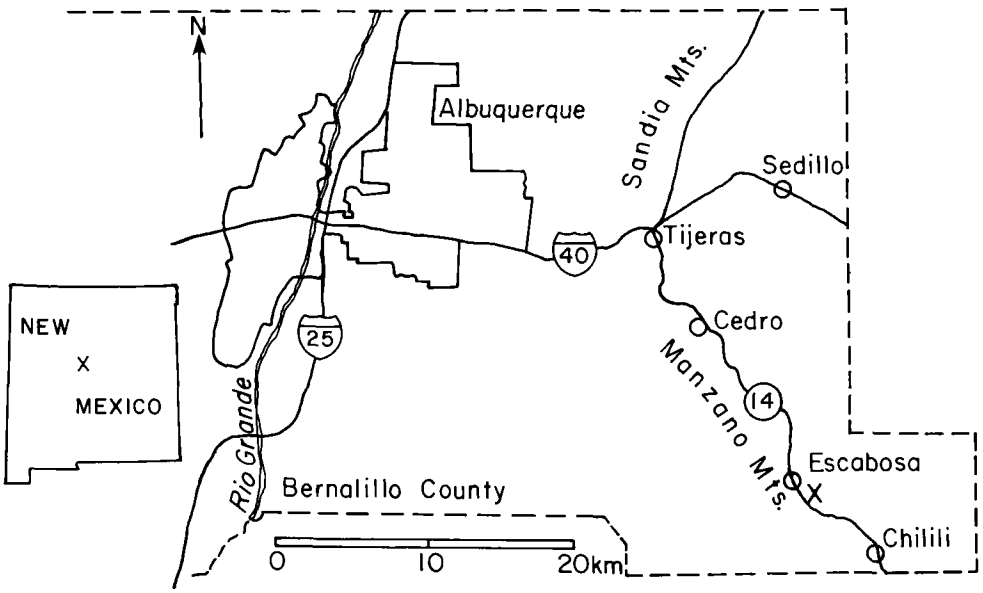

FIGURE 1—Location map of Escabosa quarry, Bernalillo County, New Mexico.

Fauna

The fauna of the calcareous shale–argillaceous limestone units at the base of Escabosa quarry is dominated by brachiopods, bryozoans, corals, and crinoid fragments (Table 1). Of the identifiable taxa, brachiopods are by far the most abundant and diverse. More than 60% of the brachiopod specimens, however, belong to only four species: *Hystriculina wabashensis* (Norwood and Pratten), *Chonetinella verneuiliana* (Norwood and Pratten), *C. flemingi* (Norwood and Pratten), and the various forms of *Composita subtilita* (Hall). Each of these species is well known in the Missourian of the Midcontinent (Dunbar and Condra, 1932) and as far east as Ohio (Sturgeon and Hoare, 1968). Most of the other brachiopod species are uncommon; the 15 least abundant of the 28 brachiopod taxa represent collectively only 5% of the total specimens. No inarticulate brachiopods were observed. Of special interest is the presence in the Sol se Mete of two species that are among the rarest of Pennsylvanian brachiopods: the minute inflated terebratulid *Cryptacanthia compacta* (White and St. John) and the smooth chonetid *Lissochonetes* cf. *L. plattsmouthensis* Dunbar and Condra.

Bryozoans and the small solitary rugose coral *Lophophyllidium*? also are common. The most conspicuous bryozoans are massive to encrusting forms, including some zoaria of *Fistulipora* that are more than 50 mm in diameter. Fragments of ramose bryozoans, especially *Rhombopora*, are abundant, but fenestrate bryozoans are less common and also typically highly fragmented. Crinoids are represented mainly by short portions of stems, but about 20 partial to complete calyxes of at least four species also were collected. Some local, thin, bioclastic limestones consist mainly of highly fragmented crinoid debris. Fusulinids are uncommon in the shaly unit, in contrast to their high abundance in the dark-gray limestones exposed in the quarry walls. The gastropods, described below, are relatively uncommon and poorly diverse. Bivalves are very rare. The predominance of stenohaline marine groups, the fragmentation of delicate fossils such as fenestrate and ramose bryozoans and crinoids, the preponderance of massive and encrusting bryozoans, and the presence of local thin beds of bioclastic skeletal debris all suggest that the calcareous shale–argillaceous limestone facies was deposited offshore, in relatively shallow water of normal marine salinity in conditions of moderate agitation, probably above wave base. ☞

TABLE 1—Taxa identified from Sol se Mete Member, Wild Cow Formation, Madera Group, at Escabosa quarry. Numbers are the percentage of the entire assemblage represented by each taxon in the lower shaly unit (fusulinids and crinoid fragments excepted), based on approximately 2,650 specimens. Abundance of taxa from lower shaly unit or upper massive, gray limestone unit is recorded as **A**, abundant; **C**, common; **UC**, uncommon; and **R**, rare, based mainly on field estimates. *Several forms of the polymorphic species *Composita subtilita* are included; of the total specimens of *C. subtilita*, the typical form = 42%; *C. "argentea"* = 24%; *C. "ovata"* = 17%; *C. "elongata"* = 4%, and indeterminate forms = 13%.

Group	Lower shaly unit (percent)	Upper massive limestone
FORAMINIFERIDA		
Triticites sp.	UC	A
COELENTERATA		
Lophophyllidium? sp.	11	—
BRACHIOPODA		
Rhipidomella carbonaria	1	—
Meekella cf. *M. striaticostata*	<1	UC
Derbyia sp.	<1	UC
Chonetinella flemingi	5	UC
C. verneuiliana	9	—
Lissochonetes cf. *L. plattsmouthensis*	<1	—
Hystriculina wabashensis	17	UC
Antiquatonia cf. *A. crassicostata*	<1	—
A. n. sp.?	<1	C
Echinaria cf. *E. semipunctata*	<1	UC
Juresania sp.	<1	UC
Cancrinella boonensis	<1	R
C. n. sp.?	<1	UC
Linoproductus platyumbonus	<1	C
Wellerella immatura	2	R
W. aff. *W. immatura*	<1	—
W. cf. *W. tetrahedra*	<1	—
W. aff. *W. dekalbensis*	<1	—
Rhynchopora cf. *R. illinoisensis*	<1	—
Hustedia mormoni	4	—
H. sp.	<1	—
*Composita subtilita**	12	UC
Crurithyris planoconvexa	3	UC
Neospirifer dunbari	5	—
Punctospirifer kentuckyensis	4	—
Phricodothyris perplexa	3	—
Beecheria bovidens	<1	—
Cryptacanthia compacta	<1	—
BRYOZOA		
Fenestella spp.	1	UC
Polypora spp.	<1	—
Penniretepora sp.	<1	—
Rhombopora sp.	5	—
Tabulipora? sp.	2	—
Fistulipora sp.	4	—
unidentified bryozoans	<1	—
MOLLUSCA–GASTROPODA		
Bellerophon (Pharkidonotus) percarinatus	<1	—
Knightites (Cymatospira) montfortianus	<1	—
Euphemites sp. indet.	<1	—
Glabrocingulum (Glabrocingulum) grayvillense	<1	—
Platyceras (Orthonychia) parvum	2	—
Goniasma lasallensis	<1	—
Donaldina stevensana	<1	—
unidentified steinkerns	<1	R
MOLLUSCA–BIVALVIA		
Acanthopecten carboniferus	<1	R
unidentified steinkerns	<1	—
MOLLUSCA–CEPHALOPODA		
unidentified nautiloids	<1	UC
TRILOBITA		
Ameura sp.	<1	—
Ditomopyge scitula	1	—
ECHINODERMATA		
unidentified crinoid calyxes	1	—
crinoid stem fragments	C	C
echinoid spine fragments	<1	—

The quarry walls consist of massive, hard, dark-gray, micritic to slightly argillaceous, locally chert-bearing limestones. They were not sampled intensively, mainly because specimens are difficult to extract in good condition. Thus, only a general indication of the fauna and relative abundances of various taxa is possible (Table 1). Although some important faunal elements of the shaly units are sparsely present in the limestones (e.g., *Composita, Chonetinella, Crurithyris*), the most abundant taxa of the limestone facies are organisms that are rare or absent in the underlying shales. Vast numbers of fusulinids occur in some beds, and several brachiopods, particularly the productids *Linoproductus platyumbonus* and *Antiquatonia* n. sp?, are common. The massive, gray limestone facies probably represents deposition in deeper marine waters farther from the shoreline than the shaly facies, and it reflects a rapid but gradual diminution of the influx of siliceous clastic grains into the area.

Gastropods

The gastropod fauna of the upper Sol se Mete Member at Escabosa quarry is limited to seven species, of which only three are represented by more than 10 specimens. In addition to specimens collected from the shaly units at the base of the quarry, a large anthill sample from the quarry floor was examined for gastropods. In the writer's experience, small gastropods that may not otherwise be collected from a locality are sometimes found in concentrations on anthills. However, the anthill material at Escabosa quarry yielded no gastropods, even though large numbers of fusulinids were present. Although the gastropods available for study are neither diverse nor as well preserved as could be desired, they are described here, both to augment the little information that is currently available on Pennsylvanian gastropods in central New Mexico and to document the gastropod component of an offshore brachiopod–bryozoan–coral–crinoid assemblage of Missourian age.

Bellerophon (Pharkidonotus) percarinatus Conrad, 1842

This species is represented by a single, incomplete, eroded specimen (Fig. 2A), but its characteristic ornamentation leaves no doubt as to its identity. A prominent raised ridge runs along the midline of the whorl, and broadly rounded transverse folds occupy the dorsal shell surface, forming nodes where they cross the median ridge. The transverse folds are separated by interspaces equal to or a little wider than a single fold and, at their maximum development, are nearly as high as the median ridge. The specimen is relatively small, with a maximum width of approximately 9 mm and a length, shortened by compression of the anterior lip against the body whorl, of approximately 7 mm.

This species is one of the most common bellerophontids in the Pennsylvanian of the central and eastern United States, but reports of its occurrence in New Mexico are few. Stevenson (1881, p. 295) recorded it from near Black Lake in the eastern Sangre de Cristo Mountains, and it also has been reported from the "Magdalena Group" in the Organ Mountains (Dunham, 1935), the "arkosic limestone member" of the Madera near Mora (Brill, 1952), and the Madera Limestone in the Jemez–Nacimiento area (Northrop, 1961). The species is common in the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984). Although *Bellerophon (Pharkidonotus) percarinatus* does not appear to range above the Virgilian in the central and eastern U.S. (Yochelson and Saunders, 1967), the species has been reported in the New Mexico Wolfcampian (Schmidt and Craddock, 1964; Hueco Limestone of the Jarilla Mountains). Otte (1959) listed a possibly conspecific form from the Laborcita Formation of the Sacramento Mountains. Whether these Permian reports actually represent *B. (Pharkidonotus) percarinatus* is uncertain; the specimens were neither described nor illustrated, and possibly they were forms more closely related to the late Wolfcampian to early Guadalupian species described by Yochelson (1960).

Knightites (Cymatospira) montfortianus? (Norwood and Pratten, 1855)

One poorly preserved specimen (Figs. 2B–C) is present in the Escabosa collections. Corrosion has obliterated much of the shell and fine details of the ornamentation, leaving essentially a steinkern with thin remnants of the shell adhering to it. Moreover, as is commonly the case (Girty, 1915), the widely expanded apertural lip characteristic of the subgenus *Cymatospira* has not been preserved. Accordingly, assignment to *K. (Cymatospira) montfortianus* is tentative and based mainly on the general proportions of the specimen and its distinctive transverse ornamentation. This ornamentation consists of broadly rounded, widely spaced transverse undulations that extend from the umbilical area across the dorsal surface of the shell to

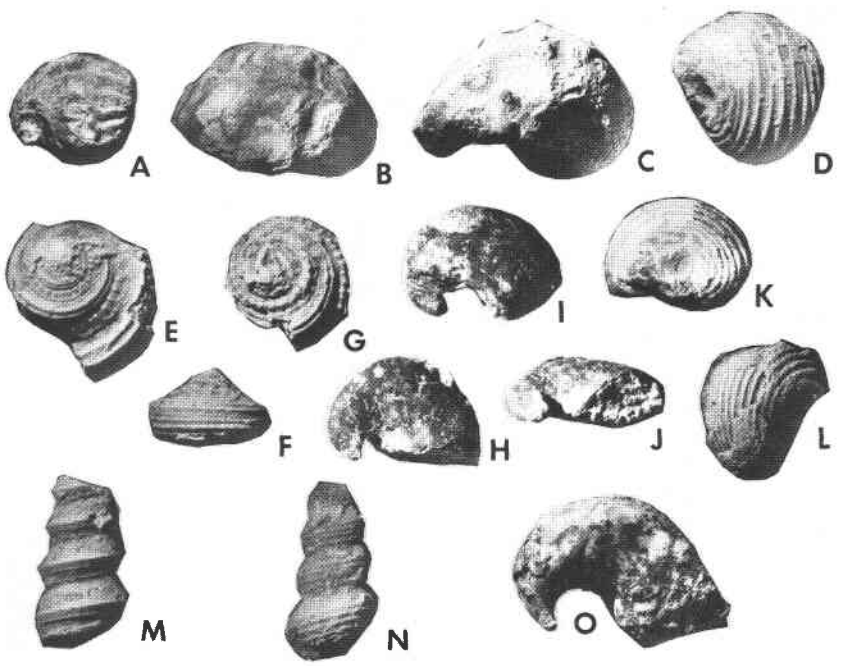

FIGURE 2—Gastropods from the Sol se Mete Member, Wild Cow Formation, at Escabosa quarry, Bernalillo County, New Mexico. **A**, *Bellerophon* (*Pharkidonotus*) *percarinatus* Conrad, oblique dorsal view, UNM 8820, ×2; **B–C**, *Knightites* (*Cymatospira*) *montfortianus*? (Norwood and Pratten), oblique dorsal and side views, UNM 8821, ×2; **D**, **K**, *Euphemites* sp. indet., oblique dorsal and side views, UNM 8822 ×2; **E–G**, *Glabrocingulum* (*Glabrocingulum*) *grayvillense* (Norwood and Pratten), oblique dorsal, side, and dorsal views of UNM 8824, 8825, and 8826, respectively, ×3; **H–J**, *Platyceras* (*Orthonychia*) *parvum* (Swallow), dorsal and apertural views, UNM 8828, ×2 (H, J), and dorsal view, UNM 8827, ×2 (I); **L**, *Euphemites* sp. indet., oblique dorsal view showing lirate inductura beneath partially exfoliated lirate coinductura, UNM 8823, ×3; **M**, *Goniasma lasallensis* (Worthen), side view, UNM 8830, ×2.5; **N**, *Donaldina stevensana* (Meek and Worthen), side view, UNM 8831, ×3; **O**, *Platyceras* (*Orthonychia*) *parvum* (Swallow), dorsal view of UNM 8829 from Desmoinesian Los Moyos Limestone, Cedro Canyon, ×1.5.

the edges of a narrow, flat, depressed selenizone. Connection of opposing undulations across the selenizone is manifested by a slightly elevated swelling that is lower and narrower than the undulations. Remnants of numerous fine spiral lirae of two ranks are present across the dorsal side of the body whorl. The body whorl is relatively narrow for much of its length but expands moderately at the anterior end. The specimen is 13.6 mm long and 10.7 mm wide across the anterior-most preserved part of the body whorl.

The features observed on this specimen also characterize some species of *K.* (*Retispira*), but most Pennsylvanian species of that subgenus have much less prominent transverse ornamentation, often restricted to transverse lirae rather than undulations. Species of *K.* (*Retispira*) with strongly developed transverse undulations are more characteristic of the Permian (Yochelson, 1960). This specimen was compared with specimens of *K.* (*Cymatospira*) *montfortianus* in various states of preservation from the Flechado Formation (Desmoinesian) near Taos, and it is similar to them in whorl dimensions, strength and spacing of the transverse undulations, and, apparently, in spiral ornamentation.

This species was previously recorded in New Mexico from Missourian and Virgilian strata in Cedro Canyon south of Tijeras (Szabo, 1953; Northrop, 1961; Kelly and Northrop, 1975), the "base of the Permian" (almost certainly the upper part of the Pennsylvanian Madera Formation) east of the Sandia Mountains (Herrick, 1900), the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984), and questionably from the Hueco Formation (Wolfcampian) in the Jarilla Mountains (Schmidt and Craddock, 1964).

Euphemites sp. indet.

The five specimens of *Euphemites* in the collections all lack the smooth anterior end of the body whorl, and most do not show clearly the nature of the lateral lips or the umbilicus. Thus, it is not possible to assign these specimens to species until better preserved material is available. The specimens are all small; the maximum length is approximately 10 mm. They possess two shell layers with spiral lirae; the outermost, presumed to be the coinductura, is relatively thick and has rather coarse, fairly sharply rounded lirae, whereas the layer beneath (inductura) is thinner and has finer, sharper lirae in the same positions as the lirae of the overlying coinductura (Fig. 2L). Moore (1941) and Yochelson (1960) summarized the relationships between inductura and coinductura on several species of *Euphemites*. In general, on some species the coinductura is restricted to the apertural region and forms a thickened callus, whereas on nongeniculate species both the coinductura and inductura may be present to the anterior end of the lirate region of the shell, but they are thin and distinguished only with difficulty. On the Escabosa specimens, it appears that both coinductura and inductura are conspicuous and that the coinductura covered the inductura for a considerable distance along the body whorl.

The shell of *Euphemites* sp. indet. is slightly geniculate, but a thickened callus is absent. Nodes or short diagonal lirae were not observed on any of the specimens, but too little of the anterior part of the body whorl is preserved to be certain of their absence on complete specimens. The umbilicus of the two specimens on which this feature is clearly displayed is relatively large, open, and shallow. The specimens show some variation in the number and spacing of spiral lirae and width of the body whorl. The largest specimen (Figs. 2D, K) has a relatively wide body whorl and 16 widely spaced, prominent coinductural lirae, with the interspaces between them being up to twice the width of a single lira. In contrast, some smaller specimens (Fig. 2L) have an estimated 20–22 rather closely spaced lirae and relatively narrow body whorls. In both forms the inductural lirae are sharper and more widely spaced than the coinductural lirae, but the number remains approximately the same. More specimens are needed to determine whether these differences are significant on the species level or represent extremes within a single variable species.

Glabrocingulum (*Glabrocingulum*) *grayvillense* (Norwood and Pratten, 1855)

This small pleurotomariacean is represented by 15 poorly preserved, distorted specimens (Figs. 2E–G). The shell is low spired, broadly conical, and nonturreted. A narrow, concave selenizone bordered above and below by a fine, sharp lira is situated on the lateral edge of the upper whorl surface, immediately above the whorl angulation. The upper whorl surface is flat to gently concave and covers the side of the previous whorl up to the angulation so that the selenizone is typically situated just above the suture. A prominent spiral lira is present immediately below the upper suture and is composed of large, widely spaced, circular nodes connected somewhat tenuously by a low ridge. Below this nodose lira is a smaller, subnodose lira, followed by one to three fine, nonnodose spiral lirae above the selenizone. The two upper lirae are crossed by obscure, low, gently prosoclinal transverse lirae that tend to connect adjacent nodes. The entire whorl surface, including the major spiral lirae and the selenizone, also is covered by numerous very fine to obscure spiral lirae numbering about 15 per mm. The lower whorl surface is gently concave and carries a small spiral lira immediately beneath the selenizone followed by two larger subnodose lirae below,

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the lower one forming the angulation between the nearly vertical lower whorl surface and the base of the whorl. The base has six to eight additional conspicuous, widely spaced, strongly nodose to subnodose spiral lirae. The largest specimen is approximately 8 mm wide.

Glabrocingulum (*Glabrocingulum*) *grayvillense* is variable in size and in the number and degree of node development of its spiral lirae (Girty, 1915; Sturgeon, 1964). The Sol se Mete specimens appear to have a consistently smaller number of spiral lirae on the upper whorl surface and a greater tendency toward node development than other assemblages of *G.* (*G.*) *grayvillense*, but the number of specimens is too low to evaluate adequately the importance of these features. These specimens may represent an undescribed species (Batten, written comm. 1984); more and better preserved specimens are required to establish their relationship with typical assemblages of *G.* (*G.*) *grayvillense*. Somewhat surprisingly, *G.* (*G.*) *grayvillense* has not been reported previously from the Sandia–Manzano–Manzanita Mountains area. It is present in the Pennsylvanian of the Sangre de Cristo Mountains (White, 1881; Stevenson, 1881; Brill, 1952), and it is common in the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984).

Platyceras (*Orthonychia*) *parvum* (Swallow, 1858)

Platyceras (*Orthonychia*) *parvum* (Figs. 2H–J) is the most abundant gastropod in the Sol se Mete fauna at Escabosa quarry, composing more than one half of all gastropod specimens collected. These specimens have small, distinctively hook-shaped shells with a rapidly expanding, disjunct body whorl and a large oval aperture with smooth or very gently sinuate margins. Most specimens are somewhat distorted, with the delicate protoconch broken off, leaving a shell that consists of less than one complete whorl. Knight (1934) described a late Desmoinesian assemblage of *P.* (*Orthonychia*) *parvum* from Missouri and emphasized the considerable intraspecific variability that characterizes this species. The Escabosa specimens display moderate variation in shell form and ornamentation. The shell surface is usually smooth with subdued, fine, closely spaced growth lines that are gently to rather sharply sinusoidal across the sides of the body whorl. A few specimens have several low folds paralleling the growth lines near the aperture, and one specimen displays a couple of obscure ridges along the sides of the shell extending from the aperture to about half the length towards the curved apex, but these are not as pronounced as the plications observed by Knight (1934) on a few of his specimens. The largest well preserved Escabosa specimen is 14.2 mm long, approximately half the maximum size of Knight's largest measured specimen.

The occurrence of *Platyceras* (*Orthonychia*) *parvum* at Escabosa quarry is limited to the calcareous shale–argillaceous limestone unit. Some specimens were present in thin lenses of crinoid fragments, presumably a consequence of the fact that they lived coprophagously on crinoid calyxes (e.g., Bowsher, 1956). The species has been reported from Desmoinesian and Missourian strata in Cedro Canyon, northern Manzano Mountains (Szabo, 1953, Northrop, 1961; Kelley and Northrop, 1975). At the trilobite locality near Tijeras, discussed by Kues (1982), Desmoinesian specimens of *P.* (*Orthonychia*) *parvum* appear to be larger, more elongate, and less strongly coiled (Fig. 2O) than those from Escabosa quarry. However, because these specimens are mainly steinkerns, little direct comparison is possible. Elsewhere in New Mexico, *P.* (*Orthonychia*) *parvum* has been reported from the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984), the Pennsylvanian near Santa Fe as *P. nebrascense* (White, 1877), an unspecified level within the Magdalena Group near Bernal (Lee and Girty, 1909), the middle to upper Missourian part of the Madera Limestone near Jemez Springs (Wood and Northrop, 1946), and the "arkosic limestone member" of the Madera (Desmoinesian–Virgilian) near Mora (Brill, 1952). Most adequately described specimens for which accurate stratigraphic information is available in the central and eastern parts of the U.S. are from Desmoinesian or older units (Yochelson and Saunders, 1967).

Goniasma lasallensis (Worthen, 1890)

This distinctive, high spired species (Fig. 2M) is represented by about 20 poorly preserved, incomplete specimens. The lateral whorl profile is characterized by a flat to very gently concave upper surface that slopes downward and outward at about 60° from the upper suture to a prominent angulation about two-thirds of the distance to the lower suture. The lower whorl surface slopes slightly inward from the angulation to the lower suture. The angulation includes a strong, sharply rounded carina; a smaller spiral lira marking the base of the selenizone is situated just below the carina, and another lira of about the same size is present just above the lower suture. The upper whorl surface is smooth and lacks ornamentation, although in a few specimens there is a hint of a spiral lira just beneath the upper suture. The base of the body whorl is not clearly displayed on any of the specimens, but it appears to be unornamented. The largest fragment consists of most of the last 3 1/2 whorls and is 11.2 mm high; a smaller specimen with the first 7 1/2 whorls is 6.4 mm high and has a maximum width of 2.6 mm.

This long-ranging species is present in lower Desmoinesian to lower Wolfcampian units in New Mexico. In the Manzano–Manzanita Mountains area it has been reported previously from Missourian and Virgilian strata in Cedro Canyon, south of Tijeras (Szabo, 1953; Northrop, 1961; Kelley and Northrop, 1975). Other occurrences in New Mexico are in the "arkosic limestone member" of the Madera (Alamitos Formation of Desmoinesian to Virgilian age) near Pecos (Brill, 1952), the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984), the Magdalena? Group (Laborcita Formation of Wolfcampian age) in La Luz Canyon, Sacramento Mountains (Girty, 1939; Otte, 1959), and in the Red Tanks Member of the Madera (Virgilian–Wolfcampian) in the Mesa Lucero area west of Los Lunas. In the central and eastern parts of the U.S. the species appears to have been reported only from Desmoinesian to upper Missourian strata (Yochelson and Saunders, 1967).

Donaldina stevensana (Meek and Worthen, 1866)

Two fragmentary specimens of *Donaldina stevensana* are present in the Escabosa collections. This narrow, high-spired species has an evenly and moderately convex lateral whorl surface with four widely spaced, thin, sharply rounded spiral lirae restricted to the lower two-thirds of the whorl surface. The upper one-third of the whorl surface lacks ornamentation. A fifth spiral lira appears on the base of the body whorl. Growth lines are faint; they swing gently backwards across the upper part of the whorl, then bend at about the uppermost lira to extend somewhat more sharply forward to the lower suture. Knight (1931) reported that the number of lirae on the whorls of specimens from the upper Desmoinesian of Missouri was variable and that occasional faint lirae may be present on the upper, normally unornamented part of the whorl surface. The position of the spiral lirae on the Escabosa specimens is very similar to that of a specimen illustrated by Knight (1931, plate 1, fig. 1e). One of the Escabosa specimens (Fig. 2N), consisting of the last four whorls, is 8.1 mm high, indicating a shell larger than any mentioned by Knight.

Donaldina stevensana has been reported previously in New Mexico only from the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984) and from the upper Virgilian–lower Wolfcampian Red Tanks Member of the Madera Formation in the Mesa Lucero area. In the central and eastern U.S. the species ranges from Atokan to Missourian (Yochelson and Saunders, 1967).

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Dunbar, C. O., and Condra, G. E., 1932, Brachiopoda of

the lower one forming the angulation between the nearly vertical lower whorl surface and the base of the whorl. The base has six to eight additional conspicuous, widely spaced, strongly nodose to subnodose spiral lirae. The largest specimen is approximately 8 mm wide.

Glabrocingulum (*Glabrocingulum*) *grayvillense* is variable in size and in the number and degree of node development of its spiral lirae (Girty, 1915; Sturgeon, 1964). The Sol se Mete specimens appear to have a consistently smaller number of spiral lirae on the upper whorl surface and a greater tendency toward node development than other assemblages of *G.* (*G.*) *grayvillense*, but the number of specimens is too low to evaluate adequately the importance of these features. These specimens may represent an undescribed species (Batten, written comm. 1984); more and better preserved specimens are required to establish their relationship with typical assemblages of *G.* (*G.*) *grayvillense*. Somewhat surprisingly, *G.* (*G.*) *grayvillense* has not been reported previously from the Sandia–Manzano–Manzanita Mountains area. It is present in the Pennsylvanian of the Sangre de Cristo Mountains (White, 1881; Stevenson, 1881; Brill, 1952), and it is common in the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984).

Platyceras (*Orthonychia*) *parvum* (Swallow, 1858)

Platyceras (*Orthonychia*) *parvum* (Figs. 2H–J) is the most abundant gastropod in the Sol se Mete fauna at Escabosa quarry, composing more than one half of all gastropod specimens collected. These specimens have small, distinctively hook-shaped shells with a rapidly expanding, disjunct body whorl and a large oval aperture with smooth or very gently sinuate margins. Most specimens are somewhat distorted, with the delicate protoconch broken off, leaving a shell that consists of less than one complete whorl. Knight (1934) described a late Desmoinesian assemblage of *P.* (*Orthonychia*) *parvum* from Missouri and emphasized the considerable intraspecific variability that characterizes this species. The Escabosa specimens display moderate variation in shell form and ornamentation. The shell surface is usually smooth with subdued, fine, closely spaced growth lines that are gently to rather sharply sinusoidal across the sides of the body whorl. A few specimens have several low folds paralleling the growth lines near the aperture, and one specimen displays a couple of obscure ridges along the sides of the shell extending from the aperture to about half the length towards the curved apex, but these are not as pronounced as the plications observed by Knight (1934) on a few of his specimens. The largest well preserved Escabosa specimen is 14.2 mm long, approximately half the maximum size of Knight's largest measured specimen.

The occurrence of *Platyceras* (*Orthonychia*) *parvum* at Escabosa quarry is limited to the calcareous shale–argillaceous limestone unit. Some specimens were present in thin lenses of crinoid fragments, presumably a consequence of the fact that they lived coprophagously on crinoid calyxes (e.g., Bowsher, 1956). The species has been reported from Desmoinesian and Missourian strata in Cedro Canyon, northern Manzano Mountains (Szabo, 1953, Northrop, 1961; Kelley and Northrop, 1975). At the trilobite locality near Tijeras, discussed by Kues (1982), Desmoinesian specimens of *P.* (*Orthonychia*) *parvum* appear to be larger, more elongate, and less strongly coiled (Fig. 2O) than those from Escabosa quarry. However, because these specimens are mainly steinkerns, little direct comparison is possible. Elsewhere in New Mexico, *P.* (*Orthonychia*) *parvum* has been reported from the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984), the Pennsylvanian near Santa Fe as *P. nebrascense* (White, 1877), an unspecified level within the Magdalena Group near Bernal (Lee and Girty, 1909), the middle to upper Missourian part of the Madera Limestone near Jemez Springs (Wood and Northrop, 1946), and the "arkosic limestone member" of the Madera (Desmoinesian–Virgilian) near Mora (Brill, 1952). Most adequately described specimens for which accurate stratigraphic information is available in the central and eastern parts of the U.S. are from Desmoinesian or older units (Yochelson and Saunders, 1967).

Goniasma lasallensis (Worthen, 1890)

This distinctive, high spired species (Fig. 2M) is represented by about 20 poorly preserved, incomplete specimens. The lateral whorl profile is characterized by a flat to very gently concave upper surface that slopes downward and outward at about 60° from the upper suture to a prominent angulation about two-thirds of the distance to the lower suture. The lower whorl surface slopes slightly inward from the angulation to the lower suture. The angulation includes a strong, sharply rounded carina; a smaller spiral lira marking the base of the selenizone is situated just below the carina, and another lira of about the same size is present just above the lower suture. The upper whorl surface is smooth and lacks ornamentation, although in a few specimens there is a hint of a spiral lira just beneath the upper suture. The base of the body whorl is not clearly displayed on any of the specimens, but it appears to be unornamented. The largest fragment consists of most of the last 3 1/2 whorls and is 11.2 mm high; a smaller specimen with the first 7 1/2 whorls is 6.4 mm high and has a maximum width of 2.6 mm.

This long-ranging species is present in lower Desmoinesian to lower Wolfcampian units in New Mexico. In the Manzano–Manzanita Mountains area it has been reported previously from Missourian and Virgilian strata in Cedro Canyon, south of Tijeras (Szabo, 1953; Northrop, 1961; Kelley and Northrop, 1975). Other occurrences in New Mexico are in the "arkosic limestone member" of the Madera (Alamitos Formation of Desmoinesian to Virgilian age) near Pecos (Brill, 1952), the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984), the Magdalena? Group (Laborcita Formation of Wolfcampian age) in La Luz Canyon, Sacramento Mountains (Girty, 1939; Otte, 1959), and in the Red Tanks Member of the Madera (Virgilian–Wolfcampian) in the Mesa Lucero area west of Los Lunas. In the central and eastern parts of the U.S. the species appears to have been reported only from Desmoinesian to upper Missourian strata (Yochelson and Saunders, 1967).

Donaldina stevensana (Meek and Worthen, 1866)

Two fragmentary specimens of *Donaldina stevensana* are present in the Escabosa collections. This narrow, high-spired species has an evenly and moderately convex lateral whorl surface with four widely spaced, thin, sharply rounded spiral lirae restricted to the lower two-thirds of the whorl surface. The upper one-third of the whorl surface lacks ornamentation. A fifth spiral lira appears on the base of the body whorl. Growth lines are faint; they swing gently backwards across the upper part of the whorl, then bend at about the uppermost lira to extend somewhat more sharply forward to the lower suture. Knight (1931) reported that the number of lirae on the whorls of specimens from the upper Desmoinesian of Missouri was variable and that occasional faint lirae may be present on the upper, normally unornamented part of the whorl surface. The position of the spiral lirae on the Escabosa specimens is very similar to that of a specimen illustrated by Knight (1931, plate 1, fig. 1e). One of the Escabosa specimens (Fig. 2N), consisting of the last four whorls, is 8.1 mm high, indicating a shell larger than any mentioned by Knight.

Donaldina stevensana has been reported previously in New Mexico only from the lower Desmoinesian part of the Flechado Formation near Taos (Kues, 1984) and from the upper Virgilian–lower Wolfcampian Red Tanks Member of the Madera Formation in the Mesa Lucero area. In the central and eastern U.S. the species ranges from Atokan to Missourian (Yochelson and Saunders, 1967).

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Geographic names

U.S. Board on Geographic Names

Balitas, Cerro—peak, elevation 2,419 m (7,935 ft), in the Jemez Mountains, 1.6 km (1 mi) east of Cochiti Canyon and 14.5 km (9 mi) northwest of Cochiti Pueblo; balitas means little bullets in Spanish, in reference to the occurrence of numerous and similar small stones; Sandoval County, NM; 35°43′58″ N. 106°24′09″ W.; *not:* Cerro Boletas.

Chavez Box—canyon, 1.6 km (1 mi) long, in the course of Chavez Creek 9.7 km (6 mi) east–northeast of Brazos; named for Dionicio Chavez, who owned a ranch in the area in the late 1800's; Rio Arriba County, NM; 36°47′00″ N., 106°26′55″ W. (northeast end), 36°46′20″ N., 106°27′30″ W. (southwest end); *not:* Chaves Box.

Guadalupe Mountains—mountains, 105 km (65 mi) long, and 32 km (20 mi) wide; southeast of Sacramento Mountains and east of Brokeoff Mountains; extend north–northwest and northeast from Guadalupe Peak in Texas into New Mexico, 16 km (10 mi) southwest of Carlsbad; bound on the north by Fourmile Canyon, on the east by Pecos River valley, and on the west by Piñon Creek, Big Dog Canyon, Valley Canyon, Middle Dog Canyon, and West Dog Canyon; Chavez, Otero, and Eddy Counties, NM, and Hudspeth and Culberson Counties, TX; 32°43′00″ N., 105°08′00″ W. (northwest end), 31°53′30″ N., 104°51′30″ W. (southeast end); 1907 decision revised; *not*: Sacramento Mountains (BGN 1907).

Horn Spring—spring, on the northwest slope of Chosa Mesa, 0.32 km (0.2 mi) south–southwest of Aspen Spring and 14.5 km (9 mi) southeast of Gobernador; Rio Arriba County, NM; sec. 26, T. 28 N., R. 4 W., NMPM; 36°37′38″ N., 107°13′39″ W.

Horse Heaven—mesa, highest elevation 2,408 m (7,903 ft), east of Cañada Gurule and 4.8 km (3 mi) southwest of Llaves; Rio Arriba County, NM; T. 25 N., R. 1 W., NMPM; 36°21′30″ N., 106°53′50″ W.; *not:* Horse Haven.

Horse Heaven Canyon—canyon, 3.2 km (2 mi) long, heads on Horse Heaven at 36°21′38″ N., 106°54′00″ W., trends north–northeast to Cañoncito de las Yeguas 2.7 km (1.7 mi) west of Llaves; Rio Arriba County, NM; 36°23′18″ N., 106°53′08″ W.; *not:* Horse Haven Canyon.

Jaroso Creek—stream, 11 km (6.8 mi) long, heads at an unnamed spring at 36°36′36″ N., 106°19′42″ W., flows northeast to Rio Vallecitos 3.7 km (2.3 mi) south–southwest of Burned Mountain and 26.2 km (16.3 mi) northeast of Cebolla; Rio Arriba County, NM; sec. 19, T. 28 N., R. 7 E., NMPM; 36°38′52″ N., 106°13′39″ W.; *not*: Jarosa Creek.

La Cañada Ditch—ditch, 4.8 km (3.1 mi) long, connects La Cruz Ditch with Ensenada Ditch 1.3 km (0.8 mi) north of Tierra Amarilla; Rio Arriba County, NM; 36°43′25″ N., 106°31′50″ W. (east end), 36°43′28″ N., 106°33′44″ W. (west end).

La Cruz Ditch—ditch, 4.3 km (2.7 mi) long, connects Park View Ditch and Ensenada Ditch; east part within Ensenada and the west part 0.97 km (0.6 mi) southeast of Los Ojos; Rio Arriba County, NM; 36°43′28″ N., 106°31′50″ W. (east end), 36°43′22″ N., 106°34′16″ W. (west end); *not*: Encinado Ditch.

Las Cuatas Creek—stream, 2.1 km (1.3 mi) long, heads on the northeast slope of Stove Ridge at 36°59′18″ N., 106°43′40″ W., flows southwest to join Estufa Creek to form Spring Creek 17 km (10.5 mi) northwest of Chama; Rio Arriba County, NM; 36°58′35″ N., 106°44′20″ W.; *not*: Stove Creek.

Las Nutrias—locality, on Rio Nutrias 13.5 km (8.4 mi) south–southeast of Tierra Amarilla and 19.2 km (11.9 mi) east of El Vado; Spanish name, means The Beavers; Rio Arriba County, NM; 36°34′57″ N., 106″31′00″ W.; *not*: Nutrias.

—David W. Love
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Geologic highway markers

Texts for 57 new and revised highway marker signs designating geologic points of interest along major New Mexico highway routes have been submitted to the Cultural Properties Review Committee for approval. The signs will be erected by the Highway Department in the near future. Both Highway Department and Travel and Tourism Division funds are involved in the joint agency effort to review and upgrade the entire Historical Highway Marker Program. Bill Hatchell, geologist with the Energy and Minerals Department (EMD), initiated the effort to enlarge the geological coverage. Frank Kottlowski, Director of NMBMMR, and geologists at EMD and Los Alamos National Laboratory, assisted Hatchell with 57 texts that will be added to approximately 36 existing signs demarcating geologic, physiographic, and natural resource elements in all five New Mexico highway maintenance districts. As soon as the new signs are erected, travellers will note the new color scheme of white letters on a brown background, which is in conformity with the federal government's *Manual on uniform traffic control devices standards*. The traditional New Mexico colors of yellow and red will be phased out on signs along highway rights-of-way affected by the federal standards.