J. Paleont., 79(4), 2005, pp. 796–800

0022-3360/05/0079-796$03.00

A NEW MIDDLE TRIASSIC FLAT CLAM (PTERIOIDA: HALOBIIDAE) FROM THE MIDDLE ANISIAN OF NORTH-CENTRAL NEVADA, USA

EMILY K. HOPKIN[1] AND CHRISTOPHER A. MCROBERTS
Department of Geology, State University of New York at Cortland 13045 USA, <hopkin47@cortland.edu>, <mcroberts@cortland.edu>

INTRODUCTION

IN ADDITION to ammonoids and conodonts, the enigmatic and poorly understood ''flat clams'' belonging to the genera *Enteropleura* Kittl, 1912, *Daonella* Mojsisovics, 1874, *Halobia* Bronn, 1830, and *Monotis* Bronn, 1830 have proven to be of biochronologic value through the Middle and Upper Triassic (e.g., Silberling and Nichols, 1982; Brack and Rieber, 1993; Campbell, 1994; McRoberts, 1997). These ''flat clams,'' many belonging to the family Halobiidae, can be extremely abundant in the marine Triassic rocks of the former Panthalassic Ocean and especially the Tethyan Seaway, where many of these species were first described. Their widespread nature and high speciation rates make these bivalves exceptional biochronologic indicators, especially when integrated with the temporal distribution of other, more conventional indices such as ammonoids and/or conodonts. We describe and name a poorly documented halobiid species, *Enteropleura jenksi* n. sp., from the latest middle Anisian and therefore provide a robust correlation datum for the Shoshonensis Zone.

Geologic and stratigraphic setting.—The fossils described herein occur near McCoy Mine located in the Wild Horse Mining District, on the northeast side of the New Pass Range of north-central Nevada (Fig. 1). These fossils occur in two closely spaced stratigraphic horizons within the Middle Triassic Fossil Hill Member of the Favret Formation. Both at McCoy Mine and at its type locality in the Prida Formation at Fossil Hill on the east flank of the Humboldt Range (e.g., Muller et al., 1951; Nichols and Silberling, 1977; Silberling and Nichols, 1982), the Fossil Hill Member is composed of dark-grey to black, thin-bedded limestone, cherty limestone, and calcareous shale. At the McCoy mine locality, these strata were mapped as an informal unit of calcareous shale and thin-bedded limestone by Dane and Ross (1942). Neither the upper nor lower contact of the Fossil Hill Member is exposed at the McCoy Mine Locality. The fossils were obtained from two previously hand-dug pit and trench-cut horizons (localities 1 and 2, Fig. 1) that occur nearly along depositional strike and are part of a larger 20-m-thick, largely unexposed section that continues into the upper Anisian. Where observed, the strata dip moderately (30°–40°) to the northwest. The lithology of the *Enteropleura*-bearing horizons is a dark, organic-rich silty limestone containing a moderately abundant but low-diversity assemblage of *Enteropleura*, three-dimensional ammonoids, and conodonts. At this locality, the lithologic, taphonomic, and paleontological evidence suggest deposition in a moderately deep (below storm wave base) basin that was occasionally oxygen-starved. The sediments are commonly organic-rich, finely laminated, and devoid of trace fossils and, with a few exceptions, benthic fossils. The macroinvertebrates that do occur in these and stratigraphically higher horizons consisted of low-diversity but numerically rich accumulations of ammonoids, and the ''flat clam'' genera *Enteropleura*, *Daonella*, and *Bositria* De Gregorio, 1886, which were likely opportunists adapted to low-oxygen benthic conditions. It is likely that these strata were deposited onto the western continental margin of Pangea, covering the tectonically transported rocks of the Golconda Allocthon (Silberling et al., 1987).

The age of the Fossil Hill Member at the McCoy Mine and other localities in the New Pass and Tobin Range and Augusta Mountains is determined by ammonoids as spanning the Hyatti, Taylori, and Shoshonensis Zones of the middle Anisian and the Rotelliformis Zone of the upper Anisian (Nichols and Silberling, 1977; Bucher, 1988, 1992; and data herein). It is interesting to note that the classic faunal sequence at the type locality of the Fossil Hill Member begins slightly higher up, within the Rotelliformis Zone (e.g., Silberling and Nichols, 1982). However, work in progress on ammonoids from the New Pass Range, Augusta Mountains, and previously undiscovered pre-Rotelliformis levels at Fossil Hill (Bucher, personal commun., 2004) has revealed two additional upper Anisian ammonoid levels between the traditional Shoshonensis and Rotelliformis Zones (sensu Silberling and Tozer, 1968; Silberling and Nichols, 1982; Bucher, 1992). Prior to the publication of these new ammonoid zones, we retain the traditional Shoshonensis–Rotelliformis sequence and recognize that the bivalves, ammonoids, and conodonts described herein may likely fall immediately below the new ammonoid zones.

[1] Present address: Department of Geological Sciences, University of British Columbia, 6339 Stores Road, Vancouver V6T 1Z4 Canada, <ehopkin@eos.ubc.ca>

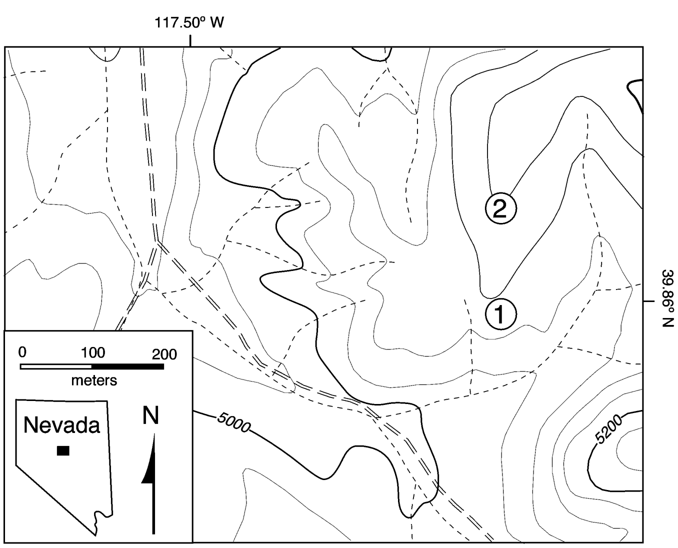


FIGURE *1*—Locality map of McCoy Mine area, north-central Nevada. Numbers indicate sample levels as discussed in text. Level 1 occurs along depositional strike and is approximately 1.5 m below level 2. The entrance to the McCoy mine is approximately 600 m northeast of the map area.

SYSTEMATIC PALEONTOLOGY

Refer to Figure 2 for general morphologic conventions and dimensions used in the descriptions. The described and illustrated specimens are deposited at the United States National Museum (USNM) in Washington DC and in the Geological Survey of Canada (GSC) national collection in Ottawa.

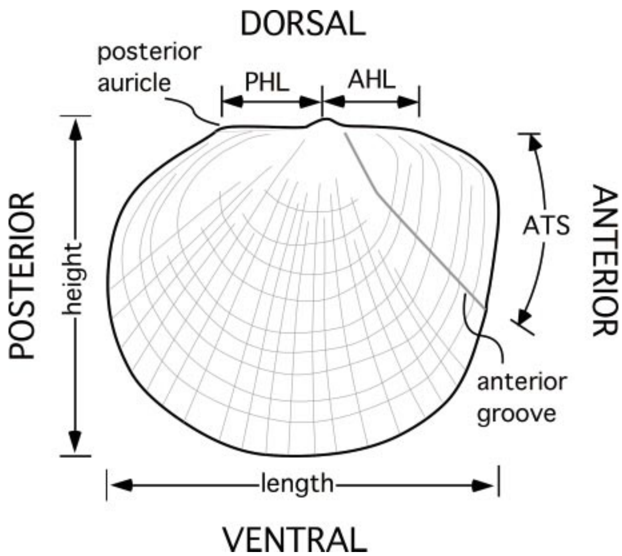


FIGURE *2*—Measurement conventions and morphology of a right valve of *Enteropleura* Kittl, 1912. Abbreviations: ATS, anterior triangular sector; PHL, posterior hinge length; AHL, anterior hinge length.

Class BIVALVIA Linné, 1758
Subclass PTERIOMORPHIA Beurlen, 1944 [emend. Waller, 1978]
Order PTERIOIDA Newell, 1965 [emend. Waller, 1978]
Suborder PTERIINA Newell, 1965 [emend. Waller, 1978]
Superfamily HALOBIOIDEA Campbell, 1994
Family HALOBIIDAE Kittl, 1912 [emend. Campbell, 1994]
Genus ENTEROPLEURA Kittl, 1912

Discussion.—Due to few published accounts and a temporal duration restricted to the middle Anisian, *Enteropleura* is possibly the least understood of halobiid genera. Very few *Enteropleura* species have been described, and *Enteropleura* has rarely been illustrated beyond the original sketch of *E. bittneri* Kittl, 1912 of Arthaber (1896, fig. 12) reproduced in Figure 3.13 and the illustration of the type species *E. gümbeli* (Kittl, 1912, pl. 1, figs. 16, 17). The status of *Enteropleura* has been in question for some time, and it is occasionally considered a subgenus of *Daonella* (e.g., Ichikawa, 1958). As interpreted here, we apply the name *Enteropleura* to Middle Triassic thin-shelled posidoniform bivalves having relatively short hinge margins, a clearly differentiated anterior triangular sector separated from the main disc by a radial groove and ornamented with faint radial ribs and commarginal growth lines. Several authors (e.g., Kittl, 1912; Cox and Newell, 1969) note the presence of two radial grooves delimiting the anterior triangular sector on the valve interior, although several specimens we now consider to be *Enteropleura* exhibit only one groove. We view the genus as valid and differing significantly from *Daonella* in the absence of strong radial ornamentation and the clearly differentiated anterior sector with radial groove. Cox and Newell (1969), and later Encheva (1978), considered *Enteropleura* along with *Daonella* and *Halobia* as belonging to the Posidonidae. The placement of *Enteropleura* within the family Halobiidae by Kittl (1912) and later Campbell (1994) is followed in this paper. However, due to lack of diagnostic family-level characteristics (shell structure, ligament support structures, muscle scars, etc.), *Enteropleura* is currently undergoing a complete revision by T. Waller (personal commun., 2003) to resolve better some of the morphologic uncertainties associated with this genus and to place it within the broader phylogenetic context of the Halobiidae.

TABLE *1*—Measurements of *Enteropleura jenksi* n. sp. See Figure 2 for abbreviations. † denotes a visual estimation, * measurement taken on commarginal growth line, + denotes holotype.

Specimen	Height (mm)	Length (mm)	PHL (mm)	AHL (mm)	ATS (°)
USNM 526057+	11	10	5	6	46
USNM 526058	7†	9†	3*	4†	—
USNM 526059	18†	19†	7†	9	30
USNM 526060	15	23†	8†	7	35
USNM 526061	6	8	3	3	37†
USNM 526063	27†	38†	17	13†	32
USNM 526064	20†	25†	11†	9†	30
USNM 526065	3	4	2	2	30
USNM 526066	6†	8†	4†	4*	25
—	20†	22†	8†	10	33
—	18†	21†	9	10	27
—	16†	21†	9†	9	35
—	13†	15†	6†	7	22
—	3*	4*	2*	2*	24
—	2*	3*	1*	2*	29
—	7*	9*	—	—	24†
—	19†	22†	11†	11	29
—	12†	14†	5†	6	23
—	18†	19†	6†	6	32
—	5*	7*	3*	3*	34

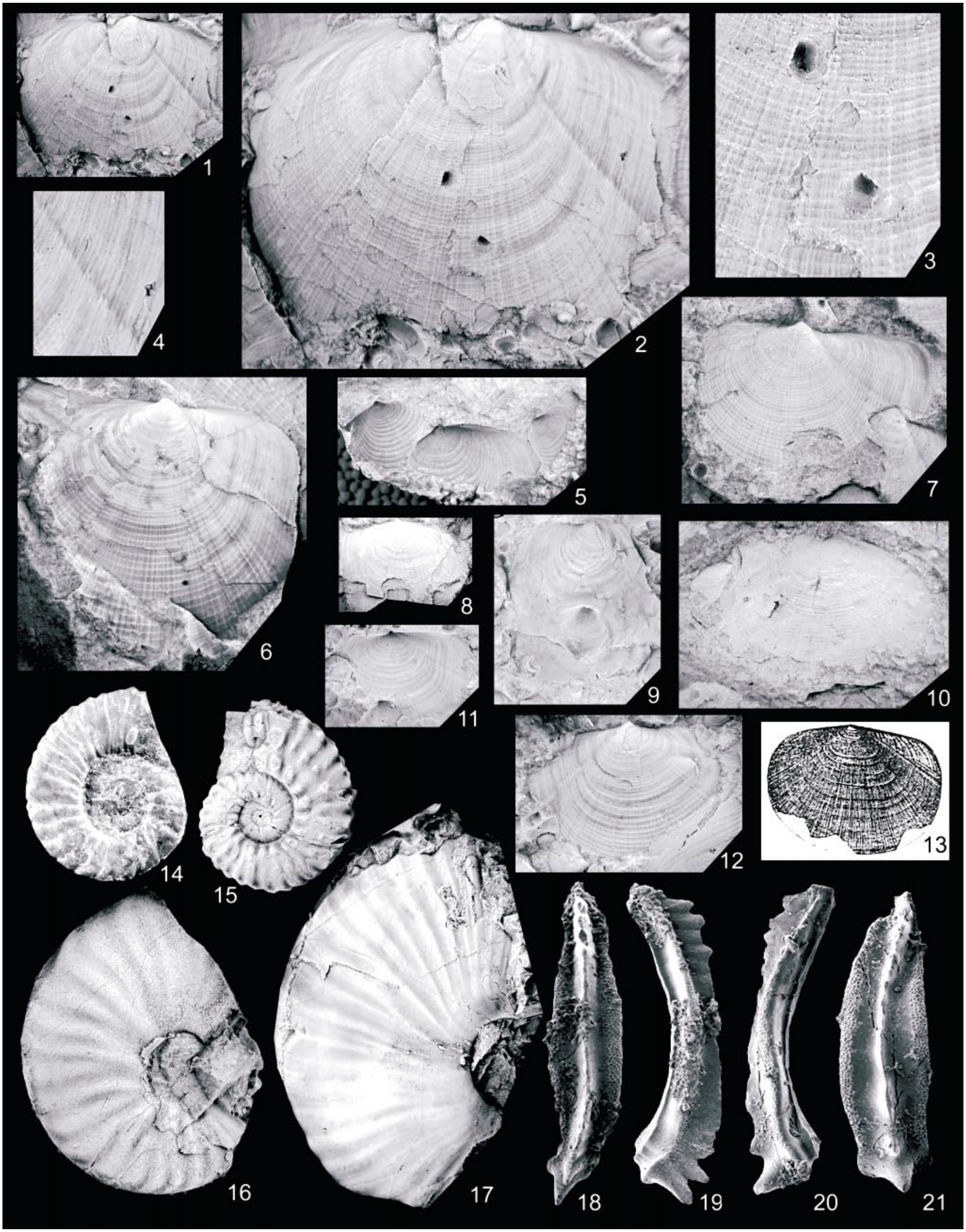
ENTEROPLEURA JENKSI new species
Figure 3.1–3.12

Diagnosis.—*Enteropleura* having fine commarginal sculpture and radial ribs; variable number of finer radial ribs between sequential coarser ribs, uneven spatial distribution of these finer ribs; undulating widely spaced commarginal ribs; single slightly curved groove radiating from beak to anterioventral margin distinguishing a broad anterior triangular sector.

Description.—Medium-sized shell (maximum height = 27 mm; maximum length = 38 mm); valves circular to slightly subcircular in outline (height to length ratio average 0.94); inflated 1–2 mm in depth; valves very thin (around 0.25 mm thick); beak generally straight to slightly prosogyrous, projecting slightly above straight hinge, situated slightly anterior; beaks smooth for about the first 1.5 mm. Hinge length about 0.5–0.8 maximum valve length. Radial ribs fine and straight to curved slightly toward anterior, moderately dense (about 30 ribs per 90° of arc at 1 cm from beak), becoming faint on posterior and anterior sectors, split by division; interrib furrows range from 0.3 mm to 1 mm in width; valves covered with narrow commarginal ribs, evenly spaced about 0.5 mm apart on the ventral portion of shell; width between commarginal ribs decreases dorsally towards beak, abrupt decrease of this width may be observed around 5 mm from the beak; commarginal ribs occasionally superimposed or delimit broader commarginal folds in central part of disc. Most specimens possess a single radial groove extending from beak to anterioventral margin, curving slightly anterior and distinguishing a broad anterior triangular sector of around 40°; a differentiated posterior triangular sector is not observed, although the posterior hinge margin is somewhat flattened to produce a small posterior auricle; specimens exhibit a slight indentation on the anterior margin of the shell exterior where the pronounced anterior groove meets the margin. Interior of the valve is generally smooth; in juvenile forms, the commarginal folds are often visible on the interior of the shell, but there is little to no indication of the finer commarginal or radial ribs; neither muscle scars nor their bounding ridges observed; dentition or ligament supporting structures not observed.

Etymology.—In honor of Triassic ammonoid enthusiast, Jim Jenks, who greatly aided our field work in Nevada.

Types.—Holotype, USNM 526057; paratypes, USNM 526058–526065.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

Other material examined.—Nearly 80 valves were collected; among these, three recrystallized left valves (two exteriors and one interior) and one recrystallized right valve exterior contributed significantly to this description.

Occurrence.—At the McCoy Mine locality, *Enteroplura jenksi* occurs within the Fossil Hill Member of the Favret Formation. At this locality, recognition of the Shoshonensis ammonoid Zone is based on two stratigraphic levels containing the bivalve *Enteropleura jenksi*, the ammonoids *Balatonites* cf. *B. shoshonensis* Hyatt and Smith, 1905, *Gymnotoceras* aff. *G. ginsbergi* Bucher, 1992, *Favreticeras ransomei* (Smith, 1914), and other ammonoids (see Fig. 3). These taxa, especially *Enteropleura jenksi* and *B.* cf. *B. shoshonensis*, have been previously documented from the uppermost Middle Anisian throughout north-central Nevada (e.g., Bucher, 1992). Conodonts from the these sampled horizons are characterized by an abundance of *Neogondolella shoshonensis* Nicora, 1976, first described from the Shoshonensis ammonoid Zone of the Tobin Range by Nicora (1976). The two forms of *N. shoshonensis* (A and B) recognized by Nicora (1976) occur in abundance.

Elsewhere in Nevada, specimens attributed to *Enteropleura jenksi* occur at South Canyon in the New Pass Range (T. Waller, personal commun., 2003) and Augusta Mountains (data from USGS and GSC collections). In alpine Europe and elsewhere, other species of *Enteropluera* are consistent with this upper middle Anisian Age assignment (e.g., Kittl, 1912).

Discussion.—Given the large sample size of our collection, it is clear that *Enteropleura jenksi* exhibits little variation in its specific characters, such as angle of anterior triangular sector and ribbing characteristics, and differs from the other illustrated species of the same genus. *Enteropleura jenksi* most closely resembles *E. bittneri*, known from the northern alpine region of Austria. Unfortunately, the type specimen of *E. bittneri* has not been located (Waller, personal commun., 2003) and the comparisons of this species to *E. jenksi* are based solely on Arthaber's original illustration (Arthaber, 1896, fig. 12) reproduced in Figure 3.13. *Enteropleura jenksi* differs from *E. bittneri* in that *E. jenksi* has only one pronounced radial groove present on the anterior of the valve exterior and may or may not have another much fainter groove closer to the anterior dorsal margin; finer radial ribs are not as evenly distributed between slightly coarser radial ribs on *E. jenksi* as on *E. bittneri*; and the anterior triangular sector appears much broader in *E. jenksi* as compared to the shallower anterior triangular sector on *E. bittneri*. *Enteropleura jenksi* differs from *E. gümbeli* Mojsisovics, 1874 primarily due to the much more pronounced commarginal ribs of *E. gümbeli*.

ACKNOWLEDGMENTS

We would like to thank J. Jenks for locality information and logistical support with various aspects of the field work. We are grateful to M. Orchard for providing conodont data and images. Thanks also to H. Bucher for sharing his knowledge of Anisian ammonoids, T. Waller for providing helpful discussions regarding his work in progress, and both T. Beatty and V. Atudorei for assistance in the field. Thanks also to N. Silberling and J. Carter, who provided helpful reviews leading to an improved manuscript. Acknowledgment is made to the Donors of the American Chemical Society Petroleum Research Fund for partial support of this research. This research is a contribution to IGCP 467.

REFERENCES

ARTHABER, G. 1896. Die Cephalopodenfauna der Reiflinger Kalke, Abtheilung II: Die Fauna des Fundortes Rahnbauerkogel. Beiträge zur Paläontologie und Geologie Österreich-Ungarns und des Orients, 10:192–242.

BEURLEN, K. 1944. Beiträge zur Stammesgeschichte der Muscheln. München Akademie Sitzungsberichte, 11:113–131.

BRACK, P., AND H. RIEBER. 1993. Towards a better definition of the Anisian/Ladinian boundary: new biostratigraphic data and correlations of boundary sections from the southern Alps. Eclogae Geologicae Helvetiae, 86(2):415–572.

BRONN, H. 1830. Über die Muschel-Versteinerungen des sud-Deuschen Steinsalzgebirges, welche bisher unter dem Namen *Pectines salinarius* zusammenbegriffen wurden. Jahrbuch für Mineralogie, Geognosie, Geologie, und Petrefaktenkunde, 1:279–285.

BUCHER, H. 1988. A new Middle Anisian (Middle Triassic) ammonoid zone from northwestern Nevada (USA). Eclogae Geologicae Helvetiae, 81(3):723–762.

BUCHER, H. 1992. Ammonoids of the Shoshonensis Zone (Middle Anisian, Middle Triassic) from Northwestern Nevada (USA). Jahrbuch der Geologisch Bundesanstalt, 135(2):425–465.

CAMPBELL, H. J. 1994. The Triassic bivalves *Halobia* and *Daonella* in New Zealand, New Caledonia, and Svalbard. Institute of Geological & Nuclear Sciences Monograph, 4:1–166.

COX, L. R., AND N. D. NEWELL. 1969. Family Posidoniidae, p. N342–N344. *In* R. C. Moore and C. Tiechert (eds.), Treatise on Invertebrate Paleontology, Pt. N, Mollusca 6. Geological Society of America and Kansas University Press, Lawrence.

DANE, C. H., AND C. P. ROSS. 1942. The Wild Horse quicksilver district Lander county, Nevada. U.S. Geological Survey Bulletin, 931-K:259–278.

DE GREGORIO, A. 1886. Monographie des fossils de Valpore (Mont Grappa) du sous-horizon Grappin de Greg. Annales de Géologie et de Paléontologie, 2:1–20.

ENCHEVA, M. G. 1978. Phylogenetic development of the family Posidoniidae and the genera *Daonella* and *Halobia* (Bivalvia, Triassic). Geologica Balanica, 8(2):55–67.

HYATT, A., AND J. P. SMITH. 1905. The Triassic cephalopod genera of America. U.S. Geological Survey Professional Paper, 40:1–394.

ICHIKAWA, K. 1958. Zur taxonomie und phylogeni der triadschen ''Pteriidae'' (Lamellibranch), mit besonderer beruksichtigung der gattung *Claraia*, *Eumorphotis*, *Oxytoma* und *Monotis*. Palaeontographica, A, 3: 131–212.

KITTL, E. 1912. Materialen zu einer Monographie der Halobiidae und Monotidae der Trias. Resultate der Wissenschaftlichen Erforschung des Balatonsees, I Band, I Teil. Paleontologie. Hofbuchdruckerei Viktor Hornyánszky, Budapest, 229 p.

←

FIGURE 3—*Enteropleura jenksi* n. sp. and associated ammonoids and conodont elements from McCoy Mine, Nevada. All figures are natural size unless otherwise specified. *1–12, Enteropleura jenksi* n. sp., Shosonensis Zone; *1–4,* holotype, right valve, USNM 526057, (level 1), *1,* natural size, *2,* same specimen, ×2, *3,* same specimen illustrating reticulate ribbing pattern, ×5, *4,* same specimen, anterior groove, ×4; *5,* two left valve interiors, USNM 526058 (level 2), ×1.5; *6,* right valve, USNM 526059 (level 1), ×2.5; *7,* right valve, USNM 526060 (level 1), ×2; *8,* right valve, USNM 526061, (level 1); *9,* right valve, USNM 526062 (level 1), ×2.5; *10,* left valve, USNM 526063 (level 1); *11,* right valve, USNM 526064 (level 1); *12,* right valve, USNM 526065 (level 1), ×2. *13, E. bittneri* Kittl, 1912, reproduction of Artharber's original figure of ''*Posidonomya* nov. sp.'' (Arthaber, 1896, fig. 12), Anisian, Rhahnbauerkogel, Austria, natural size; *14, Platycuccoceras* sp. indet., Shoshonensis Zone, USNM 526068 (level 1), left lateral view, ×2.5; *15, Balatonites* cf. *B. shoshonensis* Hyatt and Smith, 1905, right lateral view, Shoshonensis Zone, USNM 526066 (level 1). *16, Gymnotoceras* aff. *G. ginsbergi* Bucher, 1992, left lateral view, Shoshonensis Zone, USNM 526067 (level 1). *17, Favreticeras ransomei* (Smith, 1914), Shosonensis Zone, left lateral view, USNM 526069. *18, 19, Neogondolella shoshonensis* Nicora, 1976, B form, upper and lateral views, GSC 120166 (GSC loc. C-306713), ×40. *20, 21, Neogondolella shoshonensis* Nicora, 1976, A form, lateral and upper views, GSC 120167 (GSC loc. C-306713), ×40.

LINNÉ, C. 1758. Systema Naturae per Regna Naturae. Laurentius Salvius, Stockholm, 824 p.

MCROBERTS, C. A. 1997. Late Triassic North American Halobiid bivalves: stratigraphic distribution, diversity trends, and their circum-Pacific correlations, p. 198–208. *In* J. M. Dickins et al. (eds.), Late Paleozoic and Early Mesozoic Circum-Pacific Events. Cambridge University Press, Cambridge.

MOJSISOVICS, E. VON. 1874. Über Die Triadischen Pelecypoden-Gattungen *Daonella* und *Halobia*. Abhandlungen der Kaiserlich Königlich Geologischen Reichsanstalt, 7:1–35.

MULLER, S. W., H. G. FERGUSON, AND R. J. ROBERTS. 1951. Geology of the Mount Tobin quadrangle, Nevada. U.S. Geological Survey Geological Quadrangle Map, GQ-7.

NEWELL, N. D. 1965. Classification of the Bivalvia. American Museum Novitates, 2206:1–25.

NICHOLS, K. M., AND N. J. SILBERLING. 1977. Stratigraphy and depositional history of the Star Peak Group (Triassic), northwestern Nevada. Geological Society of America Special Paper, 178:1–73.

NICORA, A. 1976. Conodont-fauna, stratigraphic position and relations to the Tethyan successions of the Shoshonensis Zone (Pelsonian) of Nevada. Rivista Italiana di Paleontologie e Stratigrafe, 82(4):627–650.

SILBERLING, N. J., AND K. M. NICHOLS. 1982. Middle Triassic molluscan fossils of biostratigraphic significance from the Humboldt Range, northwestern Nevada. U.S. Geological Survey Professional Paper, 1207:1–38.

SILBERLING, N. J., AND E. T. TOZER. 1968. Biostratigraphic classification of the marine Triassic in North America. Geological Society of America Special Paper, 110:1–63.

SILBERLING, N. J., D. L. JONES, M. C. J. BLAKE, AND D. G. HOWELL. 1987. Lithotectonic terranes of the western conterminous United States. U.S. Geological Survey Miscellaneous Field Studies Map, MF-1874-C.

SMITH, J. P. 1914. The Middle Triassic marine invertebrate faunas of North America. U.S. Geological Survey Professional Paper, 83:1–148.

WALLER, T. R. 1978. Morphology, morphoclines and a new classification of the Pteriomorphia (Mollusca: Bivalvia). Philosophical Transactions of the Royal Society of London, ser. B, 284:345–365.

ACCEPTED 27 JULY 2004