Revista Mexicana de Ciencias Geológicas, volumen 14, número 2, 1997, p. 202–207.
Universidad Nacional Autónoma de México, Instituto de Geología, México, D.F.

NEW LATE TRIASSIC SCLERACTINIAN CORALS FROM THE ANTIMONIO FORMATION, NORTHWESTERN SONORA, MEXICO

George D. Stanley, Jr.[1], *and Carlos M. González-León*[2]

ABSTRACT

New Late Triassic corals have been recovered from sponge, coral, and mollusk biostromes in the middle part of the Antimonio Formation, Sierra del Álamo, northwestern Sonora. Together with taxa already described from that formation, these corals contribute to our knowledge of Late Triassic faunas. Three stylophyllid corals are described: *Anthostylis acanthophora* (Frech), *Anthostylis* sp., and *Meandrostylis antimoniensis* new species and a cuifastraeid, *Cuifastraea granulata* Melnikova. These corals range from the Norian to Rhaetian stages. One species is endemic and others are known from the Pamir Mountains, Russia, and the Alps of Austria. *Cuifastraea granulata* is already known from the Wallowa terrane of Oregon.

Key words: Paleontology, Scleractinian, Late Triassic, Antimonio Formation, Sonora, Mexico.

RESUMEN

En este estudio se describe nuevos corales del Triásico Tardío que fueron recolectados de biostromas de esponjas, corales y moluscos que están en la parte media de la Formación Antimonio en la sierra del Álamo, noroeste de Sonora. El estudio de estos especímenes, junto con los que ya previamente han sido descritos de esta sección, enriquece el conocimiento del las faunas del Triásico Tardío. Se describe los siguientes tres corales estilofílidos: *Anthostylis acanthophora* (Frech), *Anthostylis* sp., y la especie nueva *Meandrostylis antimoniensis*, así como el cuifastraeido, *Cuifastraea granulata* Melnikova. Estos especímenes se encuentran en rocas del Nórico y Rético de la Formación Antimonio. Una de las especies es endémica y las otras han sido descritas previamente de las Montañas Pamir, en Rusia, y de los Alpes de Austria. *Cuifastraea granulata* se conoce también del terreno Wallowa de Óregon.

Palabras clave: Paleontología, corales escleractinianos, Triásico Tardío, Formación Antimonio, Sonora, México.

INTRODUCTION

Late Triassic scleractinian corals occur in a number of tectono-stratigraphic terranes within the Cordilleran region of both North and South America (Smith, 1927; Squires, 1956; Stanley, 1979, 1994; Stanley and Whalen, 1989; Prinz-Grimm, 1995). There are no Triassic coral faunas reported from craton-bound rocks. Although widely distributed with respect to present-day latitude, the Cordilleran faunas are most often associated with early Mesozoic island arc terranes. Some coral faunas, in association with foraminifers, sponges, spongiomorphs, mollusks, echinoderms and other shallow-water invertebrates, developed large-scale reef structure. The coral faunas from the American Cordillera are all Late Triassic (Norian and Rhaetian) in age and their presence indicates tropical to subtropical, low-latitude marine environments. However, precision is poor in establishing paleolongitude (Stanley, 1996). At both genus and species levels, the corals are predominantly of Tethyan composition. At most sites, up to 60 or 70 percent are conspecific with taxa from the distant Tethys region.

New Late Triassic corals from Sonora, northwestern Mexico, are described below. Previously, Late Triassic corals from Sonora were reported from the Antimonio Formation at Sierra del Álamo, from Sierra Santa Teresa, and the locality of Barra los Tanques (Figure 1) (Stanley *et al.*, 1994). These faunas are important as they constitute the southernmost Triassic occurrences in North America. None are known from central or southern Mexico nor are they known from Central America. Triassic corals are found further south, occurring in the Peruvian Andes of South America (Stanley, 1994) and Chile (Prinz-Grimm, 1995). Rather than reefs, the corals of the Antimonio Formation form small-scale sponge, coral, and mollusk biostromes (see Goodwin and Stanley, 1997). In taxonomic composition and paleoecology they resemble biostromes from west-central Nevada (Stanley, 1979).

This paper describes some new Late Triassic corals from the middle part of the Antimonio Formation and these descriptions further our understanding of the faunal diversity of the Antimonio terrane of Sonora (Stanley *et al.*, 1994; Stanley and González-León, 1995).

[1]*Department of Geology, The University of Montana, Missoula, Montana 59812, U.S.A. E-mail address: fossil@selway.umt.edu*
[2]*Estación Regional del Noroeste, Instituto de Geología, Universidad Nacional Autónoma de México, Apartado Postal 1039, 83000 Hermosillo, Sonora, Mexico.*

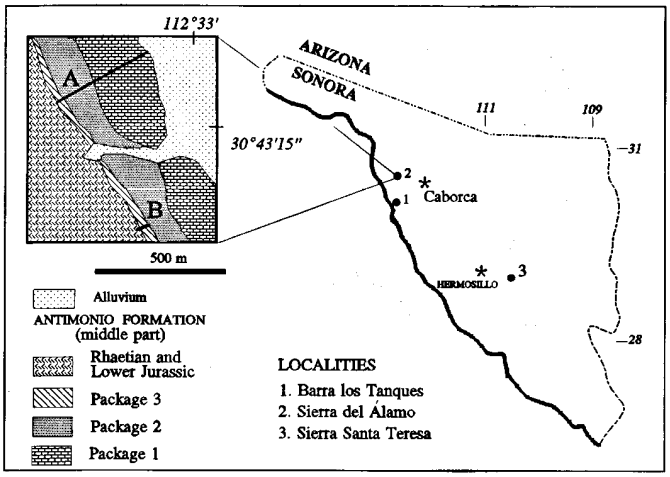

Figure 1. Map of Sonora showing locations with Late Triassic corals. Inset figure is a geologic map of the northeastern foothills of the Sierra del Álamo, showing outcrops along which stratigraphic sections (packages 1 to 3) A and B of Figure 2 were measured.

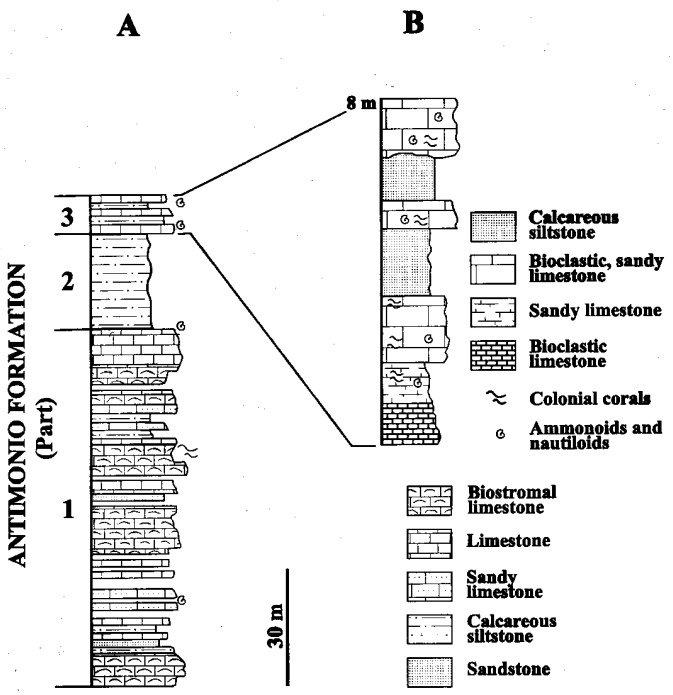

Figure 2. Stratigraphic section of the middle part of the Antimonio Formation, indicating the horizons in packages 1 and 3 which have yielded the corals decribed in this paper.

STRATIGRAPHY AND AGE

The new Triassic corals here described come from the Antimonio Formation at Sierra del Álamo in northwestern Sonora, Mexico (Figure 1), where faunas were previously described by Stanley and collaborators (1994). The Antimonio Formation is a mostly marine sedimentary succession about 4 km thick that ranges in age from Late Permian-Triasssic and Early Jurassic. Its detailed stratigraphy and age are described by González-León (1997).

González-León and collaborators (1996) described a Triassic-Jurassic boundary from the middle part of this formation exposed in the northeastern foothills of the Sierra del Álamo. This portion of the section was divided into five informal lithostratigraphic packages representing marine deposition. The corals come from packages 1 and 3 at intervals indicated in Figure 2. Package 1 is a lenticular interval that has a thickness ranging from 45 to 80 m. It extends as a laterally continuous belt for about 6 km toward the northwestern part of the Sierra del Álamo. It is composed of thin biostromal limestone (Goodwin and Stanley, 1997), interbedded with argillite, mudstone, and siltstone. Package 1 is dated by ammonoids as middle to upper Norian in age (Columbianus to Cordilleranus Zones). Locally it is partly covered, recrystallized, intruded by sills and dikes and cut by local faults as was mentioned by González-León and collaborators (1996).

Package 3 overlies with sharp contact fossiliferous calcareous siltstone of package 2. Package 3 gets thicker from the northern to the southern part of the area from 2 to 8 m (Figure 2). Lithologically package 3 is a bioclastic limestone (packstone/wackestone), siliclastic sandy limestone with some sandstone beds. It contains a mixture of invertebrate fossils such as corals, gastropods and bivalves, which occur abundantly. Package 3 also yields less common nautiloids, ammonoids, and aulacoceratids. Rarer components include thalamid sponges, crinoid ossicles and teeth and bone fragments (including ichthyosaur and fish). The common occurrence of the ammonoid *Choristoceras* of the Crickmayi Zone dates this unit as Rhaetian, but package 3 also yielded one example of the exclusively Norian, planktonic hydrozoan *Heterastridium* which was illustrated by González-León and collaborators (1996). It most likely indicates the upper Norian Amoenum Zone. Throughout North America and Eurasia, package 3 is the only site where *Heterastridium* and *Choristoceras* occur together. The carbonate-rich part of the unit contains abundant litho- and bioclasts (both rounded and angular) representing a wide variety of shallow-water invertebrates. Some of these are identical to those already known from package 1. Phosphate pebbles and litho- and bioclasts are both rounded and angular. Bivalves are whole but mostly disarticulated valves while many large coral colonies such as *Cuifastraea* (Figure 3) are preserved as broken, angular clasts. On the other hand, smaller nodular coral colonies of *Astraeomorpha* and common gastropods are rounded.

Unit 3 was interpreted by González-León and collaborators (1996) as either a tempestite (*i.e.*, a subtidal storm deposit) or a lag (concentration) deposit. The poorly sorted admixture of fossils from different environments and the presence of both Norian and Rhaetian fossils, would suggest reworking and a significant amount of time-averaging. The deposit was viewed as the result of a sea-level low stand followed by a significant rise in sea level (González-León *et al.*, 1996).

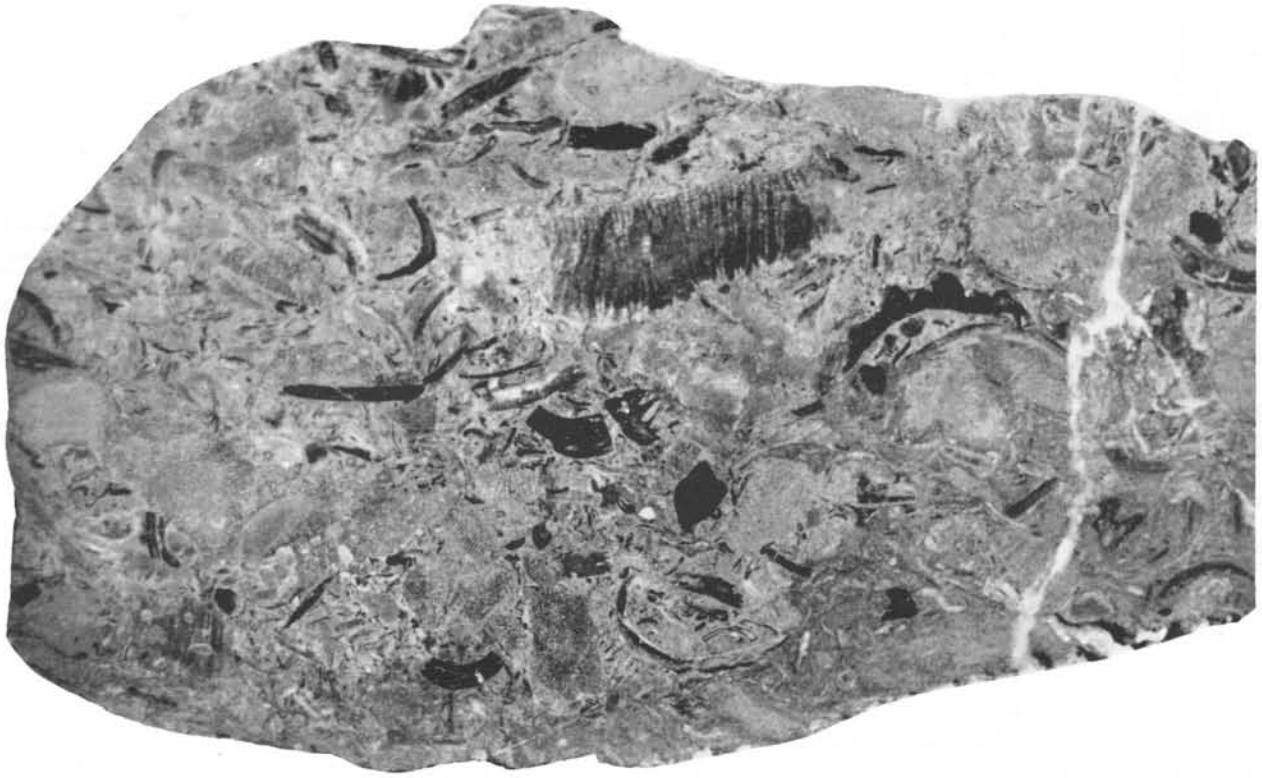

Figure 3. Polished limestone from package 3 showing the bioclastic limestone composed of mollusks and corals. The angular coral fragment in the middle upper part of the sample is *Cuifastraea granulata* Melnikova which is described in this paper.

All the material described herein is housed in the Instituto de Geología, UNAM, Hermosillo, Mexico and designated ERNO collection numbers.

SYSTEMATIC PALEONTOLOGY

Suborder Stylophyllina Beauvais, 1981
Family Stylophyllidae Frech, 1890

Genus *Anthostylis*

Type species—*Coccophyllum acanthophorum* Frech, 1890.

Remarks—The new genus *Anthostylis* was established by Roniewicz (1989) to include a species once referred to *Coccophyllum* by Frech (1890). Roniewicz already has given a good diagnosis and discussion in her revision. Cuif (1973) earlier illustrated and discussed many unique features of this species including the marginal and intracalicular septal spines and the microstructure.

***Anthostylis acanthophora* (Frech, 1890)**
(Plate 1, figures 1–2)

Coccophyllum acanthophorum Frech, 1890, p. 89, figs. 4–11; Cuif, 1973, p. 280, figs. 31, 32; Senowbari-Daryan, 1980, p. 40, pl. 4, fig. 6; Roniewicz, 1989, p. 133, pl. 41, figs. 5–7; Stanley, 1986, p. 29, pl. 3.1, figs. 8, 9.

Material—Three specimens: One well-preserved flat, platy colony 25 mm thick and 96 mm x 54 mm in dimensions (cut and polished) and two thin sections from this colony ERNO-2001; another partial colony 22 mm thick and 54–43 mm in colony dimensions (cut and polished in three pieces), ERNO-2002 and a third colony, 12 mm thick and 46 x 27 mm in diameter, ERNO-2003.

Remarks—The authors assign their Sonoran species to *Anthostylis acanthophora* as it resembles closely the material illustrated by Roniewicz (1989) from the Zlambach beds of Austria. Although microstructure is not present, the size and variable cerioid corallites, septal structures and closely spaced, convex dissepiments agree well with the material of Frech (1890) and Roniewicz (1989).

Anthostylis acanthophora was listed from Vancouver Island, B.C., Canada (Wrangellia terrane) by Stanley (1979). Squires (1956) described a Late Triassic silicified coral from Lewiston, Idaho as *Coccophyllum acanthophorum* Frech. Stanley (1986) illustrated and described a similar specimen from the Lewiston locality which was presumed but not authenticated as Rhaetian age and belonging to the Wallowa terrane.

From the Lower Norian of Hells Canyon, Oregon (Wallowa terrane) Stanley and Whalen (1989) described *Coccophyllum* cf. *acanthophorum* from one single silicified fragment of a colony. Although number of septa and corallite diameters compare favorably with those of the type species,

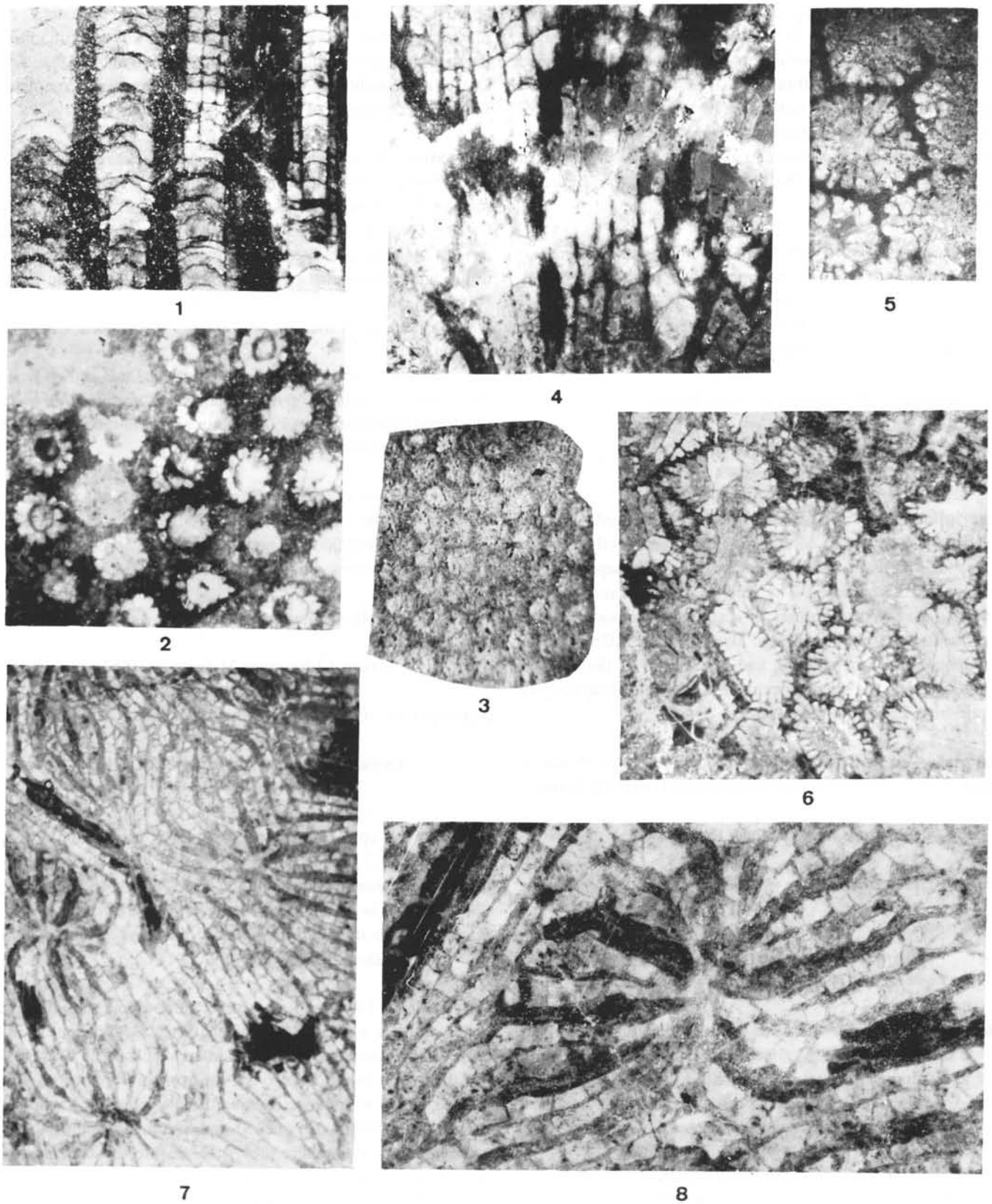

Plate 1. Figures 1, 2, *Anthostylis acanthophora* (Frech) polished surfaces, ERNO-2001; *1*, longitudinal polished section of a specimen showing the walls and convex upward tabula, x 6; *2*, transverse view of same colony, x 4. Figure 3, *Anthostylis* sp., view of the surface of this poorly preserved colony, ERNO-2004, x 3. Figures 4–6, *Meandrostylis antimoniensis* n. sp.; *4*, longitudinal polished section of holotype, ERNO-2005, x 5; *5*, polished transverse section view of the same specimen, x 3; *6*, polished cross sectional view of paratype, ERNO-2006, x 3. Figures 7, 8, *Cuifastraea granulata* Melnikova; *7*, transverse view of a portion of a colony in thin section, ERNO-2007, x 4; *8*, details of a corallite of the same specimen showing septa with poorly preserved menianes, x 10.

the poor quality of the material and lack of detail do not permit to include this species in our synonymy list. Similarly *Coccophyllum acanthophorum* Frech has also been described by Prinz-Grimm (1995) from the Rhaetian stage of northern Chile but the authors can not judge the validity of this species from the poorly preserved material represented by one recrystallized colony. The presence of a columella and other features do not appear similar to the type species and may indicate another taxon.

Occurrences—Sierra del Álamo section, Upper Triassic (Rhaetian), Antimonio Formation, lower part of the upper member, package 3 (González-León *et al.*, 1996).

This is also confirmed from southern Vancouver Island and from suspected Rhaetian strata at Lewiston, Idaho. As far as it is known, *Anthostylis acanthophora* is an exclusively Rhaetian taxon with occurrences in the Tethys.

Anthostylis sp.
(Plate 1, figure 3)

Description—Only one partial and poorly preserved colony is available. It consists of cerioid corallites consistently 2.0 mm in diameter and with up to 44 poorly developed septa. Cycles can not be differentiated. The smaller diameter and uniform corallite size is in contrast to *Anthostylis acanthophora* described above. *Anthostylis* sp. also seems to differ from *A. acanthophora* in the spacing and orientation of the dissepiments. Because the single specimen is not well preserved, we refrain from assigning it to a species.

Material—One partial colony 10 mm thick and 24 x 25 mm in diameter. ERNO-2004. Package 3, Antimonio Formation, Sonora.

Genus *Meandrostylis* Frech, 1890

Type species—*Stylophyllum* (*Meandrostylis*) *irregulare* Frech, 1890.

Meandrostylis antimoniensis new species
(Plate 1, figures 4–6)

Diagnosis—Cerioid coral with prominent, granulated septa which extend into a deep calicular pit. The colonies are massive and compact (tabular to cone shaped). Budding is extracalicular, producing conical-shaped corals in which corallites expand rapidly. Maximum colony diameters: 4.5–9.0 cm.

	Corallum diameter	Number septa
Holotype ERNO–2005	7.5–5.0 (mean 6.3)	24–28
Paratype ERNO-2006	7.0–4.0 (mean 5.3)	26–30

Corallites are strongly pentagonal with tectiform walls formed by septal ridges. Septa are in two cycles. S1 extend approximately two-thirds the distance to the corallite center. In the holotype they become disassociated into a few papilla near the center of the corallite. The S2 are slightly shorter than S1. One or more additional cycles are rudimentary and incomplete. Endotheca composed of tabuloid dissepiments.

Discussion—Specimens recovered from package 3 resemble *Meandrostylis grandiseptus* Stanley and Whalen (1989), from the Upper Triassic (Norian) Martin Bridge Formation in Hells Canyon, Oregon. The Sonoran material differs in having much larger five-sided corallites and massive growth. The main distinguishing characteristics of this Sonoran coral are the large corallites and the size of the large prominent granulated septa which differ from the smaller species from Hells Canyon, Oregon.

Two Tethyan species of *Meandrostylis* are known from the Zlambach beds. *M. irregularis* and *M. frechi* have been illustrated by Roniewicz (1989). Both are cerio-meandroid and quite different from the Sonoran species.

Material—Two specimens prepared as polished specimens and thin sections. Holotype ERNO-2005 from package 3 and paratype ERNO-2006 from package 1, Upper Triassic (Norian-Rhaetian), Antimonio Formation, Sierra del Álamo.

Family Cuifastraeidae Melnikova, 1983

Genus *Cuifastraea* Melnikova, 1983

Type species—*Cuifastraea granulata* Melnikova, 1983.

Cuifastraea granulata Melnikova, 1983
(Plate 1, figures 7–8)

Tricycloseris sp. Montanaro-Gallitelli, Russo, and Ferrari, 1979, pl. 3, figs. 3, 4.

Cuifastraea granulata Melnikova, 1983, p. 43–46, fig. 2a–c; Stanley, *in* Stanley and Whalen, 1989, p. 807, fig. 6.4.

Pamiroseris rectilamellosa (Winkler). Stanley, *in* Stanley and collaborators (1994), p. 16, fig. 12.1–12.2.

Description—Tabular to massive thamnasterioid colony with large corallites which are flat and characterized by slightly sinuous biseptal laminae. Budding is intercalicular. The c-c corallite diameters range from 6–10 mm (mean 7.1 mm). Septa number 20–33 in three well distinguished cycles and possibly a fourth, poorly developed one. S1 and S2 thick, reaching to the center of corallites where they fuse. S3 are thin and poorly developed and do not reach the center of corallite. S4 when present are thin and weak and do not reach very far into the corallite. Septal surfaces are characterized by distinctive menianes about 2–3 in number per one mm; the edges of the menianes bear poorly preserved granulations. Parietal columella present in some corallites. It is formed by the convergence of

distal ends of septa of S1 and S2 cycles. Abundant vesicular dissepiments characterize the endotheca.

Discussion—The limited material at hand agrees well in size and in most other characteristics (especially the biseptal laminae with menianes) with the type of Melnikova (1983). This species was incorrectly assigned to *Pamiroseris rectilamellosa* by Stanley (Stanley *et al.*, 1994). Reexamination of the original material from Sonora confirms the presence of menianes and other characteristic features of *Cuifastraea granulata* so that examples of these corals once regarded as *Pamiroseris rectilamellosa* must be reevaluated. This species has also been described from Hells Canyon, Oregon by Stanley (Stanley and Whalen, 1989) and incorrectly referred to *Tricycloseris* sp. by Montanaro-Gallitelli and collaborators (1979). However the material from Hells Canyon was described from silicified material rather than from thin section. Material referred to as *Pamiroseris rectilamellosa* from the Luning Formation of the Pilot Mountains, Nevada (Stanley, 1979) is most probably also *Cuifastraea granulata*.

Material—One partial colony, 7 cm in length (polished) and one thin section ERNO-2007.

Occurrences—Rhaetian, Antimonio Formation, package 3, Sonora; lower Norian, Martin Bridge Formation, Hells Canyon, Oregon; upper Norian, Pamir Range, Russia.

ACKNOWLEDGMENTS

We wish to thank the National Science Foundation, International Program and Consejo Nacional de Ciencia y Tecnología project 3934-T94 for support of this research. Dr. Ewa Roniewicz and Dr. Priska Schäfer as reviewers, provided helpful comments to improve this paper.

BIBLIOGRAPHICAL REFERENCES

Beauvais, Louise, 1981, Sur la taxonomie des Madréporaires Mésozoïques: Acta Palaeontologia Polonica, v. 25, nos. 3–4 (1980), p. 345–360.

Cuif, J.P., 1973, Recherches sur les Madréporaires du Trias; 1, Famille des Stylophyllidae: Bulletin du Muséum National d'Histoire Naturelle, sér. 3, v. 97 (1972), Sciences de la Terre, v. 17, p. 211–291, 33 figs.

Frech, Fritz, 1890, Die Korallenfauna der Trias: Palaeontographica, v. 37, p. 1–116.

González-León, C.M., 1997, Sequence stratigraphy and paleogeographic setting of the Antimonio Formation (Late Permian–Early Jurassic), Sonora, Mexico: Revista Mexicana de Ciencias Geológicas, v. 14, no. 2, p. 136–148.

González-León, C.M.; Taylor, D.G.; and Stanley, G.D., Jr., 1996, The Antimonio Formation in Sonora, Mexico, and the Triassic-Jurassic boundary: Canadian Journal of Earth Sciences, v. 33, no. 3, p. 418–428.

Goodwin, D.H., and Stanley, G.D., Jr., 1997, Norian sponge and coral biostromes in the Antimonio Formation, northwestern Sonora, Mexico: Revista Mexicana de Ciencias Geológicas, v. 14, no. 2, p. 160–166.

Melnikova, G.K., 1983, New Upper Triassic Scleractinia from the Pamir region: Paleontological Journal, v. 17, no. 1, p. 41–49.

Montanaro-Gallitelli, E.; Russo, A.; and Ferrari, P., 1979, Upper Triassic coelenterates of western North America: Bolletino della Societa Paleontologica Italiana, v. 18, no. 1, p. 133–156.

Prinz-Grimm, P., 1995, Triassiche Korallen der Südliche Zentral-Anden: Geologica et Paläontologica (Philipps-Universität Marburg), v. 10, p. 233–243.

Roniewicz, Ewa, 1989, Triassic scleractinian corals of the Zlambach Beds, Northern Calcareous Alps, Austria: Denkschriften der Österreichische Akademie der Wissenschaften, Math.- Naturwissenschaftliche Klasse, v. 126, p. 1–152.

Senowbari-Daryan, Baba, 1980, Fazielle und paläontologische Unter-suchungen in oberrhätischen Riffen (Feichtenstein und Gruberriff bei Hintersee, Salzburg, Nördliche Kalkalpen): Facies, v. 3, 237 p.

Smith, J.P., 1927, Upper Triassic marine invertebrate faunas of North America: U.S. Geological Survey Professional Paper 141, 262 p.

Squires, D.F., 1956, A new Triassic coral fauna from Idaho: American Museum Novitates, no. 1797, p. 1–27.

Stanley, G.D., Jr., 1979, Paleoecology, structure and distribution of Triassic coral buildups in western North America: University of Kansas Paleontological Contributions 65, p. 1–58.

———1986, Late Triassic coelenterate faunas of western Idaho and northeastern Oregon—implications for biostratigraphy and paleogeography: U.S. Geological Survey Professional Paper 1435, p. 23–36.

———1994, Upper Triassic corals from Peru, *in* Stanley, G.D., Jr., ed., Paleontology and stratigraphy of Triassic to Jurassic rocks in the Peruvian Andes: Palaeontographica, Abteilung A, Palaeozoologie-stratigraphie, v. 233, p. 75–98.

———1996, Confessions of a displaced reefer: Palaios, v. 11, no. 1, p. 1–2.

Stanley, G.D., Jr., and González-León, C.M., 1995, Paleogeographic and tectonic implications of Triassic fossils and strata from the Antimonio Formation, northwestern Sonora, *in* Jacques-Ayala, César; González-León, C.M.; and Roldán-Quintana, Jaime, eds., Studies on the Mesozoic of Sonora and adjacent areas: Geological Society of America Special Paper 301, p. 1–16.

Stanley, G.D., Jr.; González-León, C.M.; Sandy, M.R.; Senowbari-Daryan, Baba; Doyle, Peter; Tamura, Minoru; and Erwin, D.H., 1994, Upper Triassic invertebrates from the Antimonio Formation, Sonora, Mexico: The Paleontological Society Memoir 36, 33 p.

Stanley, G.D., Jr., and Whalen, M.T., 1989, Triassic corals and spongiomorphs from Hells Canyon, Wallowa terrane, Oregon: Journal of Paleontology, v. 63, no. 6, p. 800–819.