

# A REVISION OF THE UPPER TRIASSIC ORNITHISCHIAN DINOSAUR *REVUELTOSAURUS*, WITH A DESCRIPTION OF A NEW SPECIES

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**Abstract**—Ornithischian dinosaur body fossils are extremely rare in Triassic rocks worldwide, and to date the majority of such fossils consist of isolated teeth. *Revueltosaurus* is the most common Upper Triassic ornithischian dinosaur and is known from Chinle Group strata in New Mexico and Arizona. Historically, all large (>1 cm tall) and many small ornithischian dinosaur teeth from the Chinle have been referred to the type species, *Revueltosaurus callenderi* Hunt. A careful re-examination of the type and referred material of *Revueltosaurus callenderi* reveals that: (1) *R. callenderi* is a valid taxon, in spite of cladistic arguments to the contrary; (2) many teeth previously referred to *R. callenderi*, particularly from the *Placerias* quarry, instead represent other, more basal, ornithischians; and (3) teeth from the vicinity of St. Johns, Arizona, and Lamy, New Mexico previously referred to *R. callenderi* pertain to a new species, named *Revueltosaurus hunti* here. *R. hunti* is more derived than *R. callenderi* and is one of the most derived Triassic ornithischians. However, detailed biostratigraphy indicates that *R. hunti* is older (Adamanian: latest Carnian) than *R. callenderi* (Revueltian: early-mid Norian). Both taxa have great potential as index taxa of their respective faunachrons and support existing biochronologies based on other tetrapods, megafossil plants, palynostratigraphy, and lithostratigraphy.

**Keywords:** *Revueltosaurus*, Triassic, ornithischian, teeth, Adamanian, Revueltian

## INTRODUCTION

Shortly after their origin in the early part of the Late Triassic, dinosaurs, particularly theropods and prosauropods, were diverse, and by mid-Late Triassic (Norian) time, locally abundant. Ornithischian dinosaurs, however, remain absolutely and comparatively rare, with *Pisanosaurus mertii* Casamiquela the only Triassic ornithischian known from postcrania. Consequently, most Late Triassic ornithischians are known only from isolated teeth from the Upper Triassic Chinle Group (Hunt, 1989; Padian, 1990; Hunt and Lucas, 1994; Heckert, 2001) or fissure fills in Europe (Godefroit and Cuny, 1997; Cuny et al., 2000). Although far from satisfactory, these teeth form the majority of fossil specimens available to document the early evolution of the Ornithischia, a group that would eventually become the most diverse clade of dinosaurs (excluding birds). One of the most ubiquitous and, to date, most misunderstood Triassic ornithischians is *Revueltosaurus*.

I re-examined the type and referred material of *Revueltosaurus* identified by Hunt (1989). I also examined specimens identified as *Revueltosaurus* by Padian (1990), Sereno (1991), Hunt and Lucas (1994), Kaye and Padian (1994), Long and Murry (1995) and Heckert and Lucas (1997), as well as undescribed fossils at the University of California Museum of Paleontology and teeth found at "Dinosaur hill" in Petrified Forest National Park that are now repositied there. In the course of this study I identified a second species of *Revueltosaurus*, which I describe here. Because of taxonomic confusion surrounding *Revueltosaurus*, establishing the new species requires a revision of the genus.

**Institutional abbreviations:** MNA = Museum of Northern Arizona, Flagstaff; NMMNH = New Mexico Museum of Natural History and Science, Albuquerque; PEFO = Petrified Forest National Park, Arizona; and UCMP = University of California Museum of Paleontology, Berkeley.

## TAXONOMY

One of the central aims of this paper is to clarify the systematics of Triassic ornithischians, specifically *Revueltosaurus*. Pres-

ently, there are essentially three positions in the paleontological community on the taxonomic utility of dinosaur teeth: (1) dinosaur teeth are almost never diagnostic of low taxonomic levels and should not be used to erect, or even discriminate taxa (e.g., Dodson and Dawson, 1991; Dodson, 1997); (2) taxa based on teeth have some utility but are "form genera" or "metataxa" (Padian, 1990; Sereno, 1991); (3) dinosaur teeth, particularly those of Triassic ornithischians, can be discriminated on the basis of differential diagnoses using synapomorphies and thus are as valid as any other taxon defined by similar criteria (Hunt and Lucas, 1994). These arguments are explored in much greater detail in the cited papers and in Heckert (2001). The following points, however, are the most salient to the taxonomic position of *Revueltosaurus*.

1. There is near-universal consent that dinosaur teeth are diagnostic to family- and higher taxonomic levels. In particular, all modern diagnoses of the clade Ornithischia included multiple characters based on teeth (e.g., Sereno, 1984, 1986, 1991, 1997, 1998, 1999; Benton, 1990, 1997; Sander, 1997).

2. Theropod dinosaurs typically have more plesiomorphic and simple teeth than herbivorous dinosaurs generally and ornithischian dinosaurs in particular.

3. Detailed analysis, description, and illustration of theropod teeth (e.g., Currie et al., 1990; Farlow et al., 1991) has demonstrated that at least several species of Cretaceous theropods (several of them sympatric) can be identified using teeth, in spite of ongoing changes in our understanding of theropod phylogeny (Holtz, 1994, 2000; Sereno, 1997, 1998, 1999; Padian et al., 1999).

Consequently, it is evident that isolated teeth can readily be identified as ornithischians and may, in some cases, be diagnostic to species level. Therefore, isolated teeth of *Revueltosaurus*

are readily identified as ornithischian by the synapomorphies identified by Sereno (1991, 1997, 1999), Thulborn (1992) and Hunt and Lucas (1994), among others. Ornithischian synapomorphies *sensu* Hunt and Lucas (1994, p. 227-228) are:

- (1) low, triangular tooth crown in lateral view (Sereno, 1986); (2) recurvature absent from maxillary and dentary teeth (Sereno, 1986); (3) well-developed neck separating crown from root (Sereno, 1986); (4) prominent large denticles arranged at 45° or greater to the mesial and distal edges; (5) premaxillary teeth distinct from dentary/maxillary teeth; (6) maxillary and dentary teeth asymmetrical in mesial and distal views.

All of these synapomorphies are present in *Revueltosaurus* (Hunt, 1989; Padian, 1990; Sereno, 1991; Hunt and Lucas, 1994). The more detailed descriptions and illustrations in the body of this text then demonstrate lower-level taxonomic differences that (1) differentiate *Revueltosaurus* from other basal ornithischians and (2) discriminate two distinct species of *Revueltosaurus*.

### TERMINOLOGY

In order to standardize discussion, I utilize dental terminology for the teeth described here. Therefore, the tip of the crown is apical, the base basal, the interior side lingual, and the outer labial. The only exceptions to this terminology are the terms "anterior" and "posterior," which I retain in lieu of "mesial" and "distal." My usage of the terms height, length, and width is as follows:

**Height:** the length of the tooth crown from base to tip, measured perpendicular to the base. When I provide a specific measurement or ratio, this is the total crown height (TCH).

**Length:** the length of the tooth crown across the base antero-posteriorly. When I provide a specific measurement or ratio, this is the total crown length (TCL).

**Width:** the length of the tooth crown across the base labio-lingually (=medio-laterally). When I provide a specific measurement or ratio, this is the total crown width (TCW).

Finally, from a functional standpoint, the term "constriction" applied to the narrower root relative to the crown in ornithischian teeth is a misnomer. Certainly the crowns are mesiodistally longer than the roots (TCL is longer than the root). However, the tooth pattern of Early Jurassic ornithischians demonstrates that this is not so much a constriction of the root but an expansion of the crown. This requires the teeth to be canted so that the maximum length of the tooth is oblique to the antero-posterior length of the tooth row (e.g., Sereno, 1991b, fig. 5c-d; Thulborn, 1992, fig. 1). Consequently, I use the term "expanded" to describe the base of the tooth crown, rather than referring to "constricted" roots in ornithischians and similar taxa

### HISTORY OF STUDY

To date, teeth of *Revueltosaurus* have been identified from several sites in both New Mexico and Arizona (Fig. 1). The type locality of *Revueltosaurus callenderi* is in the Bull Canyon Formation (NMMNH locality 1), and other localities in the area yield fossils of *R. callenderi* (Hunt, 1988, 1989, 2001). Padian (1990) first identified *R. callenderi* teeth from strata of the Painted Desert Member of the Petrified Forest Formation in PEFO. Long and Murry (1995) also identified teeth of "*R. callenderi*" from the Blue Hills near St. Johns, Arizona. Hunt and Lucas (1995b) pointed out

that this identification was incorrect, and indicated the presence of similar teeth in the Los Esteros Member of the Santa Rosa Formation in central New Mexico. Heckert and Lucas (1997) pointed out additional differences between the teeth identified as *R. callenderi* by Long and Murry and *R. callenderi*. Heckert and Lucas (2001a,b) briefly considered the Los Esteros specimens. Here I consider the Los Esteros teeth a distinct species of *Revueltosaurus*, and refer the Blue Hills specimens to that species. Teeth "possibly referable" to *Revueltosaurus callenderi* by Kaye and Padian (1994, p. 188-189) are not assignable to *Revueltosaurus*, and instead include teeth of *Tecovasaurus* (Kaye and Padian, 1994, fig. 9.108; Hunt and Lucas, 1994), and a new taxon named in my dissertation (Kaye and Padian, 1994, fig. 9.104-105; Heckert, 2001). Other, unillustrated teeth bearing the same MNA catalog numbers pertain to indeterminate ornithischians and non-dinosaurian archosaurs.

All fossils of *Revueltosaurus* are isolated teeth, with the exception of an undescribed skull fragment collected by Hunt (pers. comm.). These isolated teeth, however, are typically the only ornithischian teeth from the localities in question, and almost certainly represent one taxon, and possibly one individual, at each locality. Hunt (1989) tentatively identified recurved teeth of *Revueltosaurus* as premaxillary and conical teeth as maxillary or dentary. This reasoning is logical and I believe correct, but the only supporting evidence is comparison with ornithischians for which the dentition is known (e.g., Thulborn, 1970, 1971b). Analyses of basal ornithischians generally (Sereno, 1991; Thulborn, 1971b, p. 169) also noted that, in *Fabrosaurus*, maxillary teeth wear down with facets lower on the lingual surface, and dentary teeth wear with facets lower on the labial surface. Consequently, I tentatively identify teeth as premaxillary(?), maxillary(?), dentary(?) and maxillary/dentary(?) teeth as appropriate, but dispense with the question marks hereafter.

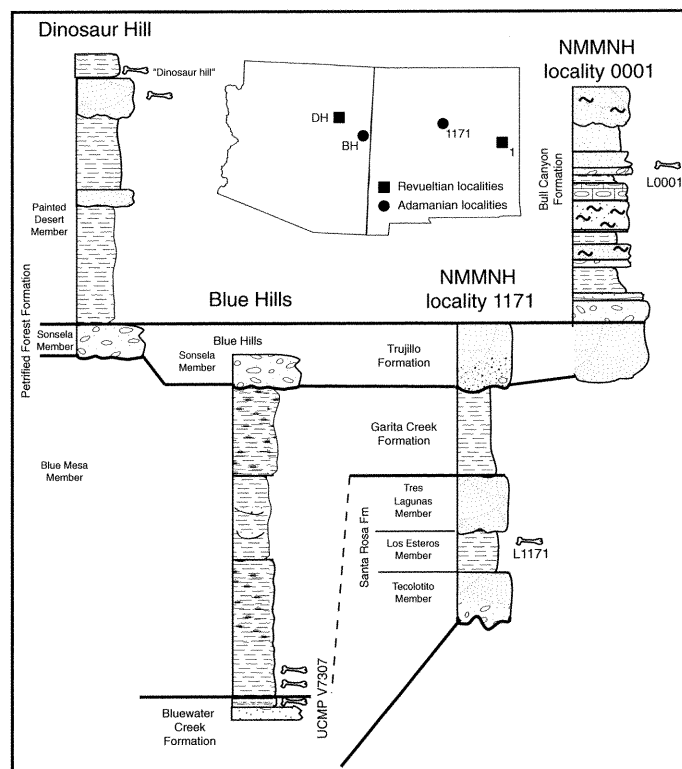


FIGURE 1. Geographic and stratigraphic distribution of *Revueltosaurus* fossils in the Chinle Group, southwestern U.S.A. Stratigraphic columns not to scale. BH = Blue Hills; DH = Dinosaur Hill.

## SYSTEMATIC PALEONTOLOGY

## DIAPSIDA Osborn, 1903

## ARCHOSAURMORPHA Huene, 1946

## ARCHOSAURIA Cope, 1869

## DINOSAURIA Owen, 1842

## ORNITHISCHIA Seeley, 1888

*Revueltosaurus* Hunt, 1989

**Type species:** *Revueltosaurus callenderi* Hunt

**Included species:** *R. callenderi* and *R. hunti*, n. sp.

**Revised diagnosis:** Moderately large, primitive ornithischian distinguished from all other ornithischians by a combination of its size (tooth crowns approximately 7-15 mm tall); numerous small denticles (more than 7/carina); denticles proportionately short and often worn to the enamel by precise occlusion; *Revueltosaurus* also lacks a true cingulum that was involved in mastication; differs from all ornithischians except heterodontosaurids by having premaxillary tooth crowns approximately twice as tall as maxillary/dentary tooth crowns.

**Distribution:** Upper Triassic strata (Carnian-Norian: Adamanian and Revueltian) of New Mexico and Arizona, U.S.A.

*Revueltosaurus callenderi* Hunt

(Figures 2-4)

(Tables 1-2)

*Revueltosaurus callenderi* Hunt, 1989, p. 355, pls. 8e-h, 9.

*Revueltosaurus callenderi*: Padian, 1990, p. 268, fig. 1.

*Revueltosaurus callenderi*: Hunt and Lucas, 1994, p. 227, figs. 7e-f, 8c,h.

*Revueltosaurus callenderi*: Heckert and Lucas, 1997, p. 58, fig. 1b.

**Holotype:** NMMNH P-4957, a nearly complete premaxillary tooth crown.

**Paratypes:** NMMNH P-4958, a nearly complete maxillary/dentary tooth crown with root; NMMNH P-4959, a nearly complete premaxillary tooth crown.

**Topotypes:** NMMNH P-4960, numerous broken tooth crowns; NMMNH P-16573, two incomplete tooth crowns; NMMNH P-33783-791, premaxillary teeth; NMMNH P-33792-797, maxillary/dentary teeth; NMMNH P-33798, premaxillary tooth.

**Referred specimens:** See below and in appendices (all type and referred specimens are tooth crowns or teeth in varying stages of preservation); CMNH PR1697-1699 (Padian, 1990). Several specimens are in the collections at PEFO but are not completely curated at this time.

**Type locality:** NMMNH locality 1, Quay County, New Mexico.

**Type horizon:** Bull Canyon Formation, Chinle Group (Upper Triassic: lower Norian).

**Distribution:** Upper Triassic (Revueltian: early-mid Norian) strata of New Mexico and Arizona, U.S.A.

**Revised diagnosis:** Species of *Revueltosaurus* distinguished by having denticles that extend equally far down anterior and posterior carinae; denticles very fine basally, coarser apically, and fine again near tip; denticles frequently offset linguallly near base on both the anterior and posterior margin and range from approximately 1.5-3.3/mm; tooth tips and denticles generally worn flat or perpendicular to tooth height; premaxillary teeth often less laterally compressed than maxillary/dentary teeth.

These characteristics effectively differentiate *R. callenderi* from all other Triassic and Early Jurassic ornithischians, including the new species *Revueltosaurus hunti* (see below), *Galtonia*, *Tecovasaurus*, *Pekinosaurus*, *Lucianosaurus*, *Technosaurus*, *Pisanosaurus*, *Fabrosaurus*, and *Heterodontosaurus* (Casamiquela,

TABLE 1. Measurements of teeth of *Revueltosaurus callenderi*

Specimen	Position	TCL	TCW	TCH	Total height
NMMNH P-4957 (holotype)	pmx	7.0	5.0	8.3	14.1
NMMNH P-4958 (paratype)	pmx	6.3	4.5	7.5	21.4
NMMNH P-4959 (paratype)	md	8.2	6.0	3	n/a
NMMNH P-33786	pmx	9.4		14.9	n/a
NMMNH P-33790	pmx	5.0	4.2	7.3	n/a
NMMNH P-33792	md	5.5	3.1	6.1	n/a
NMMNH P-33793	md	7.4	4.1	8.4	n/a
NMMNH P-33796	md	6.0	3.5	6.4	n/a
NMMNH P-33798	pmx	8.1		13.1	n/a

All measurements in mm.

pmx = premaxillary

md = maxillary/dentary

TABLE 2. Denticle density in *Revueltosaurus callenderi*

Specimen	Position	D/ht (ant)	D/mm (ant)	D/ht (post)	D/mm (post)
P-4957	pmx	9/4.5	2	12/6.5	1.8
P-4958	pmx	10/5	2	8/4	2
P-4959	md	10/5	2	11/7	1.5
P-16573	pmx?	9/4	2.3	13/15	.87
P-33783	pmx	13/3.5	3.7	17/6	2.8
P-33784	pmx	—	—	20/6(15/5)	3.3 (3.0)
P-33785	pmx	—	—	13/4(8/3)	3.25 (2.7)
P-33786	pmx	12/7	1.7	11/7	1.6
P-33787	pmx	10/6	1.7	—	—
P-33788	pmx	12/6	2.0	8/4AP	2*
P-33789	pmx	6/3AP	2*	6/3AP	2*
P-33790	pmx	4/2	2	6/3	2
P-33791	pmx	4/2	2	6/3	2
P-33792	md	6/3.5	1.7	7/4	1.8
P-33793	md	4/2AP	2*	9/6	1.5
P-33794	md	11/5.5	2	8/5	1.6
P-33796	md	13/5.5	2.4	4/2AP	2*
P-33797	md	11/6	1.8		
P-33798	md	16/8	2	7/4AP	1.8*

D = denticles

ant = anterior

post = posterior

ht = height measured as the length of the carina, not the tooth crown

pmx = premaxillary

md = maxillary/dentary

\* = measurement based on incomplete carina

() = measurements made exclusive of basal fine denticles

1967; Bonaparte, 1976; Chatterjee, 1984; Hunt, 1989; Padian, 1990; Sereno, 1991; Thulborn, 1970, 1971b, 1992; Hunt and Lucas, 1994). The fact that *R. callenderi* possesses ornithischian synapomorphies, particularly the expanded crown base, asymmetry in occlusal view, sub-triangular outline in labio-lingual views, and coarse denticles oblique to the tooth margins, differentiates it from theropods, sauropodomorphs, and other archosaurs (Hunt, 1989; Hunt and Lucas, 1994; Sereno, 1991, 1998, 1999; Novas, 1996).

**Descriptions:** Hunt (1989), Padian (1990) and Hunt and Lucas (1994) have all provided detailed descriptions of the type and some referred specimens of *R. callenderi*. Teeth that Long and Murry (1995) assigned to *R. callenderi* are distinct (Hunt and Lucas, 1995b, 1997) and redescribed below as the new species *R. hunti*. For this study, I measured all suitably preserved teeth of *R. callenderi* (Tables 1-2) in the NMMNH collections and examined many under the SEM. I provide three figures (Fig. 2-4) and explanatory text that amplifies the diagnoses provided above. Most of the referred specimens described and illustrated here are topotypes.

One of the best-preserved premaxillary teeth, NMMNH P-

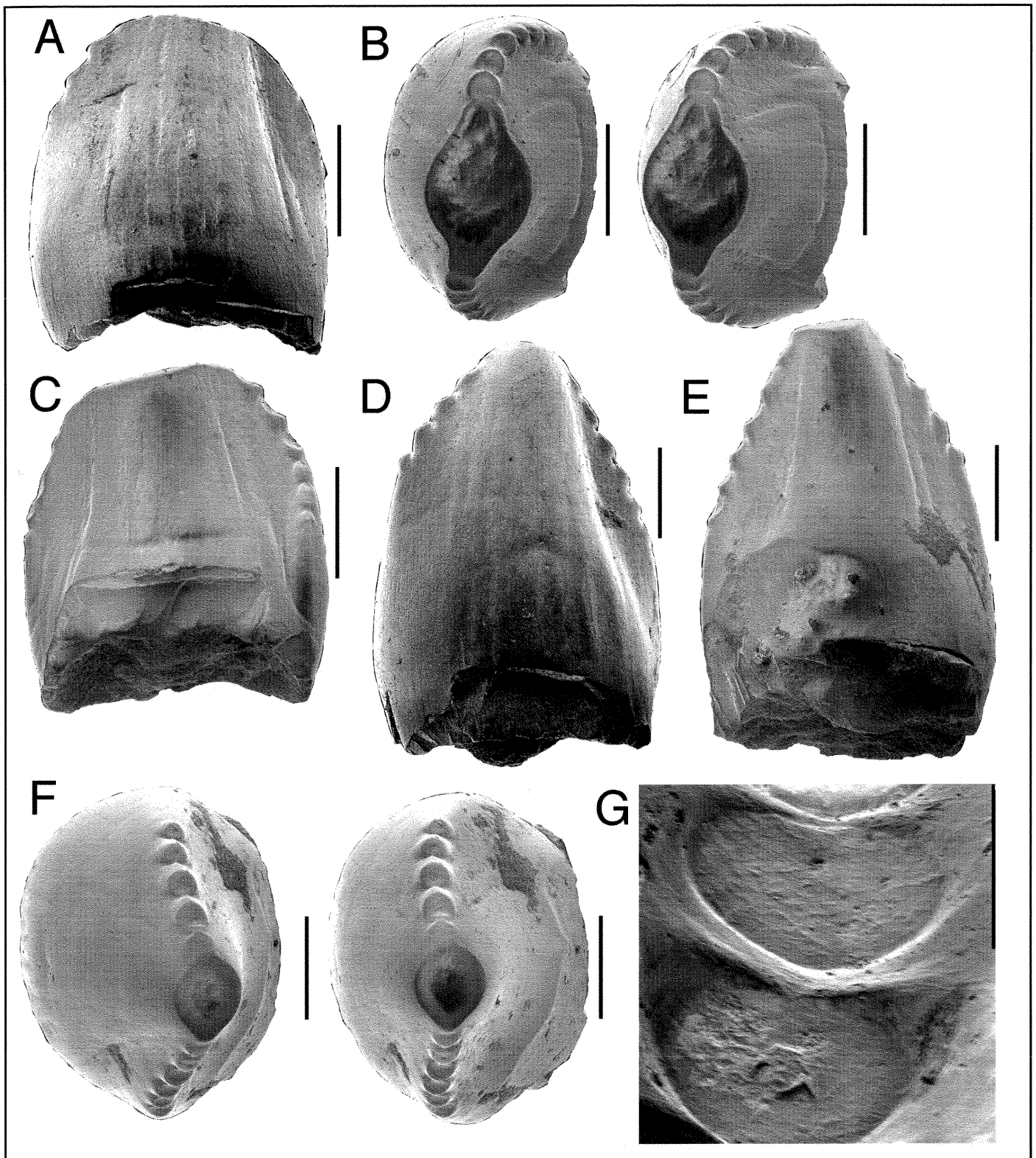


FIGURE 2. Topotype premaxillary teeth of *Revueltosaurus callenderi* from NMMNH locality 1. **A-C**, NMMNH P-33789 in **A**, labial, **B**, stereo occlusal, and **C**, lingual views; **D-G**, NMMNH P-33790 in **D**, labial, **E**, lingual, **F**, and stereo occlusal views; **G**, close-up of two apical denticles posterior to wear facets in (**F**). All scale bars = 1 mm except **G** = 200 microns.

33788, is a moderately low, weakly recurved tooth crown that is chipped lingually. The top is worn nearly flat and the denticles on both the anterior and posterior carinae are worn to the dentine (Fig. 2A-B).

A very similar tooth, NMMNH P-33791, shows even more

extensive wear (Fig. 2C-F). This tooth is low, and was probably conical to weakly recurved. The carinae are laterally compressed and give the tooth a somewhat spatulate appearance in lingual view, and the center of the tooth is more conical. The apex is worn flat and exposes the dentine in the center of the tooth. The den-



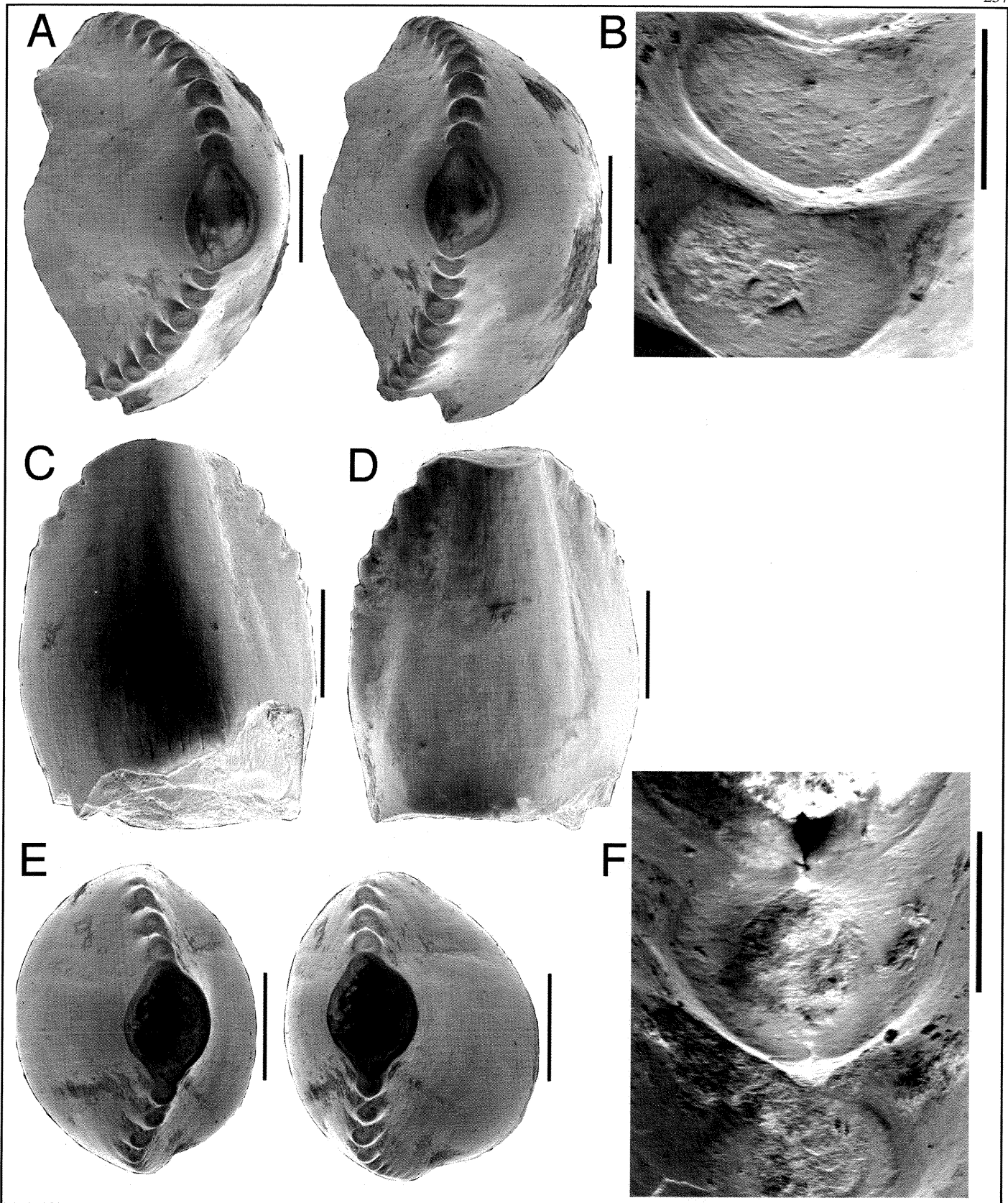


FIGURE 3. Topotype premaxillary teeth of *Revueltasaurus callenderi* from NMMNH locality 1. A-B, NMMNH P-33788 in A, stereo occlusal view and B, close-up of first two denticles posterior to apex; C-F, NMMNH P-33791 in C, labial, D, lingual, E, stereo occlusal and F, close-up views, close-up is of apex and first two posterior denticles. All scale bars = 1 mm except B, F = 200 microns.

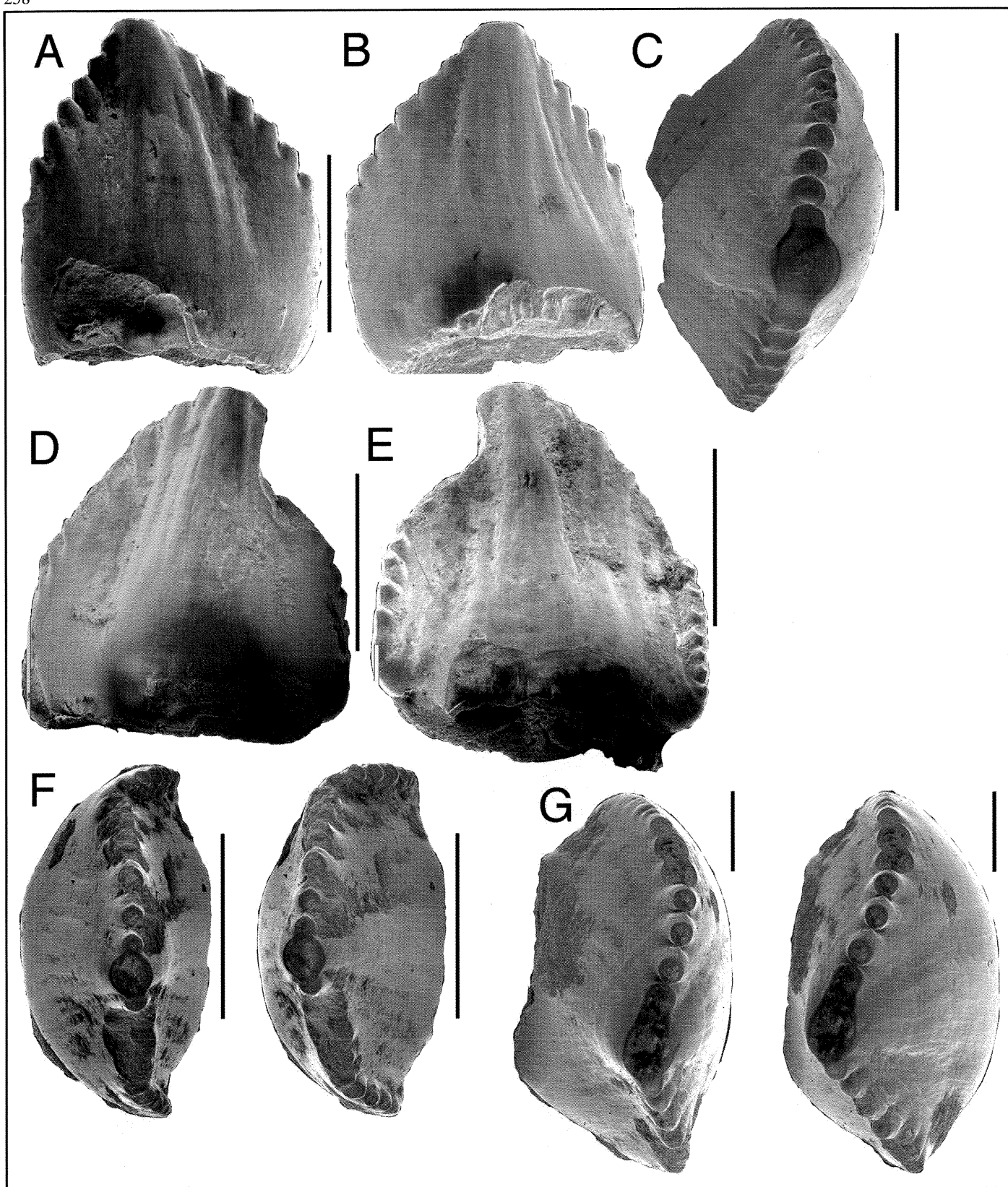


FIGURE 4. Topotype maxillary teeth of *Revueltosaurus callenderi* from NMMNH locality 1. A-B, NMMNH P-33792 in A, labial, and B, lingual views; C, NMMNH P-33794 in occlusal view; D-F, NMMNH P-33796 in D, labial, E, lingual, and F, stereo occlusal views; G, NMMNH P-33795 in stereo occlusal view. All scale bars = 1 mm.

ticles on the anterior and posterior carinae are similarly worn.

Another worn premaxillary tooth (NMMNH P-33789—Fig. 3A-C) is an incomplete, low premaxillary tooth crown that is broken and worn apically, the tip is flat labio-lingually but is slightly higher anteriorly than posteriorly.

Another premaxillary tooth (NMMNH P-33790—Fig. 3D-F) is a small, moderately low tooth crown. The tip is worn nearly flat, and the apical denticles are worn to the dentine.

Other topotype premaxillary teeth of *Revueltosaurus*, while not illustrated here, clearly are morphologically similar. These include NMMNH P-33783, a slightly worn premaxillary tooth that is flat apically. NMMNH P-33784 is an incomplete tooth lacking anterior denticles. Posteriorly there are five denticles in the first mm basally but only 15 in the next most apical 5 mm. The tip itself is broken, and the most apical denticles are not preserved. NMMNH P-33785 is an incomplete premaxillary tooth with only faint remnants of the anterior denticles. NMMNH P-33786 is an incomplete premaxillary tooth crown with worn posterior denticles, the labial surface is chipped and broken, but the top is worn flat. NMMNH P-33787 is a broken premaxillary tooth with somewhat lingually deflected carinae. NMMNH P-33798 is a relatively laterally compressed premaxillary tooth. NMMNH P-33783-791 are the tooth crowns that most closely resemble the new species described below, but they are still quite distinct.

Two maxillary/dentary teeth, NMMNH P-33792 and NMMNH P-33796, encapsulate the range of variation in maxillary/dentary teeth in *R. callenderi* and are illustrated here (Fig. 4). Of these, NMMNH P-33792 is low and triangular in labio-lingual views, somewhat laterally compressed, and has denticles oriented nearly vertically and extending little more than halfway down the tooth crown. The base is slightly expanded. The carinae are essentially straight, with minimal lingual deflection. NMMNH P-33796 is lower and slightly more asymmetric in occlusal view, with denticles extending to near the base of the tooth on carinae that are deflected lingually. The denticles themselves are somewhat finer (at least 2/mm) than in NMMNH P-33792 (1.7/mm—Table 2). The base of the tooth crown is strongly expanded.

Other topotype maxillary/dentary teeth include NMMNH P-33793, an incomplete maxillary/dentary tooth with anterior denticles broken or sheared off. A similar specimen, NMMNH P-33794, is maxillary/dentary tooth with the base chipped on one side. The top is worn flat and the denticles are worn to the dentine. NMMNH P-33795 is a maxillary/dentary tooth that is too chipped to measure, but possesses 3 denticles/mm basally. There is a low but prominent ridge on the labial surface. NMMNH P-33797 is a broken maxillary/dentary tooth. Finally, NMMNH P-16573 consists of two incomplete topotype teeth of *R. callenderi*. The more complete of these is worn farther labially than lingually; the other is exceedingly incomplete, preserving only a few denticles. The more complete, worn tooth is probably a mandibular tooth based on its wear pattern (e.g., Thulborn, 1971b).

**Discussion:** The holo-, para-, and topotype specimens of *Revueltosaurus callenderi* are the only ornithischian dinosaur teeth from the type locality (Hunt, 1989; Hunt and Lucas, 1994). In addition to their similar morphology, their size indicates that all pertain to a single taxon, and could conceivably have belonged to a single individual. Comparison with other ornithischian dinosaurs strongly supports the positional determinations of Hunt (1989), Hunt and Lucas (1994), and those made here.

When I determined that there were two distinct ornithischians with moderately large teeth in the Upper Triassic of western North America, I deliberately tried to find the teeth of *R. callenderi* that were most similar to the teeth of the second taxon. The tooth crowns I describe here, especially the topotype premaxillary teeth (NMMNH P-33783-791), are the fossils that most

closely resemble the new species *R. hunti*, yet are still distinct.

#### *aff. Revueltosaurus callenderi*

Several teeth of ornithischian dinosaurs in the collections at NMMNH may pertain to *R. callenderi* but are too incomplete to refer to the species unambiguously. These include several teeth (NMMNH P-17362, two teeth, and NMMNH P-17382, single tooth) from NMMNH locality 526 in the Bull Canyon Formation of east-central New Mexico. The best preserved of these teeth (NMMNH P-17362) is similar to the maxillary/dentary teeth of *R. callenderi*. Another tooth (NMMNH P-17382) is similar in size to *R. callenderi* but bears somewhat finer (4+/2mm), shorter denticles. Similarly, NMMNH P-17187 from NMMNH locality 498 in the Bull Canyon Formation is an indeterminate ornithischian tooth that is similar in size to teeth of *Revueltosaurus callenderi*.

#### *Revueltosaurus hunti*, sp. nov.

(Figures 5-7)

(Tables 3-4)

*Revueltosaurus callenderi*: Long and Murry, 1995, p. 191, fig. 194.

**Holotype:** NMMNH P-29357, a nearly complete tooth crown (Fig. 5).

**Referred specimens:** NMMNH P-29358, nearly complete tooth crown (paratype—Figs. 6A-C); NMMNH P-29359, incomplete tooth crown (paratype—Fig. 6D-F); NMMNH P-29347-29354, incomplete tooth crowns (topotypes); UCMP V173839, incomplete tooth crown (topotype); UCMP V173840, incomplete tooth crown (topotype—Fig. 7A); UCMP V173841, incomplete tooth crown (topotype—Fig. 7B-C); UCMP V139563, incomplete tooth crown (Fig. 8D-F), UCMP V139564-139572, incomplete tooth crowns; UCMP V139573, incomplete tooth crown (Fig. 8A-C); UCMP V139574-139575, incomplete tooth crowns. UCMP topotypes are from UCMP locality V92048, and UCMP V139563-139575 are from UCMP locality V7307 in the Blue Hills, east-central Arizona.

**Etymology:** After Adrian Hunt for his extensive and diverse contributions to our understanding of Triassic paleontology, biostratigraphy, and biochronology, particularly with regard to early dinosaurs.

**Type locality:** NMMNH locality 1171, Santa Fe County, New Mexico (Fig. 1).

**Type horizon:** Los Esteros Member, Santa Rosa Formation, Chinle Group (Upper Triassic: upper Carnian—Fig. 1).

**Distribution:** Upper Triassic (latest Carnian: Adamanian) strata of New Mexico and Arizona.

**Diagnosis:** Species of *Revueltosaurus* distinguished by having posterior denticles that are slightly coarser and extend farther basally than the anterior denticles; denticles generally coarser (1.5/mm, often 1.0/mm); denticles coarsening basally; pronounced bulge on lingual surface resulting in a lingually concave outline in mesio-distal views; anterior denticles frequently offset lingually near base, occasionally with carinae bifurcating, resulting in basal denticles labial and lingual to the split carina; apex of tooth worn oblique to vertical axis of tooth (down to the labial side on lower teeth, down to lingual side on upper teeth, following Thulborn [1971b]).

These characteristics effectively differentiate *R. hunti* from all other Triassic and Early Jurassic ornithischians, including *Revueltosaurus callenderi*, *Galtonia*, *Tecovasaurus*, *Pekinosaurus*, *Lucianosaurus*, *Technosaurus*, *Pisanosaurus*, *Fabrosaurus*, and *Heterodontosaurus* (Casamiquela, 1967; Bonaparte, 1976; Chatterjee, 1984; Hunt, 1989; Padian, 1990; Sereno, 1991; Thulborn, 1970, 1971b, 1992; Hunt and Lucas, 1994). The fact that *R. hunti* possesses ornithischian synapomorphies, particularly the expanded crown base, asymmetry in occlusal view, subtriangular outline in



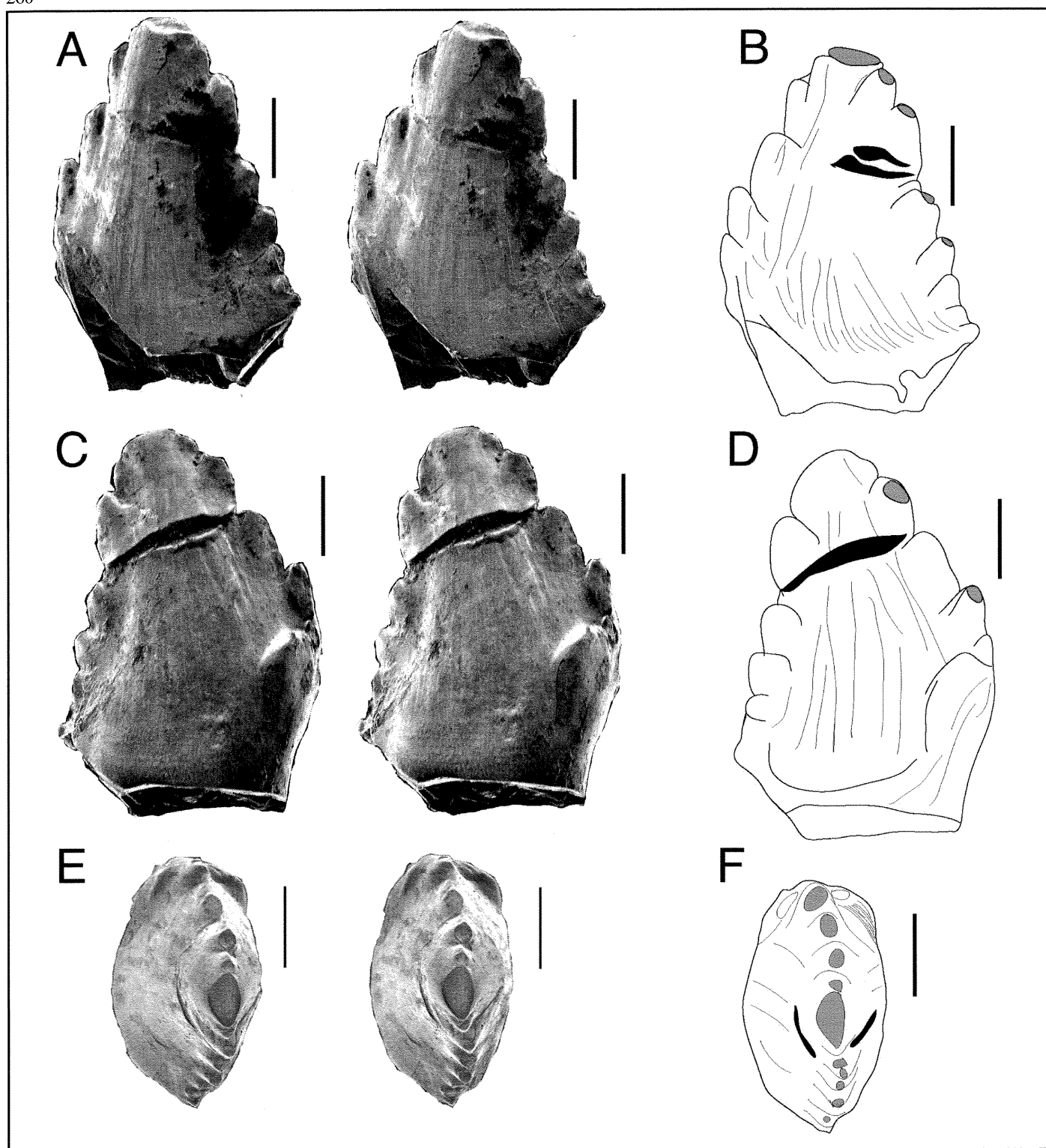


FIGURE 5. Scanning electronmicrographs (A,C,E) and interpretive sketches (B,D,E) of the holotype tooth (NMMNH P-29356) of *Revueltosaurus hunti*, n. sp. from NMMNH locality 1171. A, Stereopair in labial view, B, Sketch of right image, C, Stereopair in lingual view, D, Sketch of right image, E, Stereopair in occlusal view, F, Sketch of right image. Gray shading indicates wear, black shading indicates breakage. All scale bars = 1 mm.

labio-lingual views, and coarse denticles oblique to the tooth margin differentiate it from theropods and sauro-podomorphs (Hunt, 1989; Hunt and Lucas, 1994; Sereno, 1991, 1998, 1999; Novas, 1996).

**Description of holotype:** The holotype tooth (NMMNH P-29357) is moderately low, recurved, and asymmetric in occlusal

view (Fig. 5). It is coarsely denticled on both margins, with the posterior denticles extending farther basally. The tip of the tooth and many of the denticles are worn to the dentine. The tip and anterior denticles are especially worn on the lingual side. In mesial or distal view the tooth is concave lingually and convex labially, largely because there is a prominent bulge near the base of

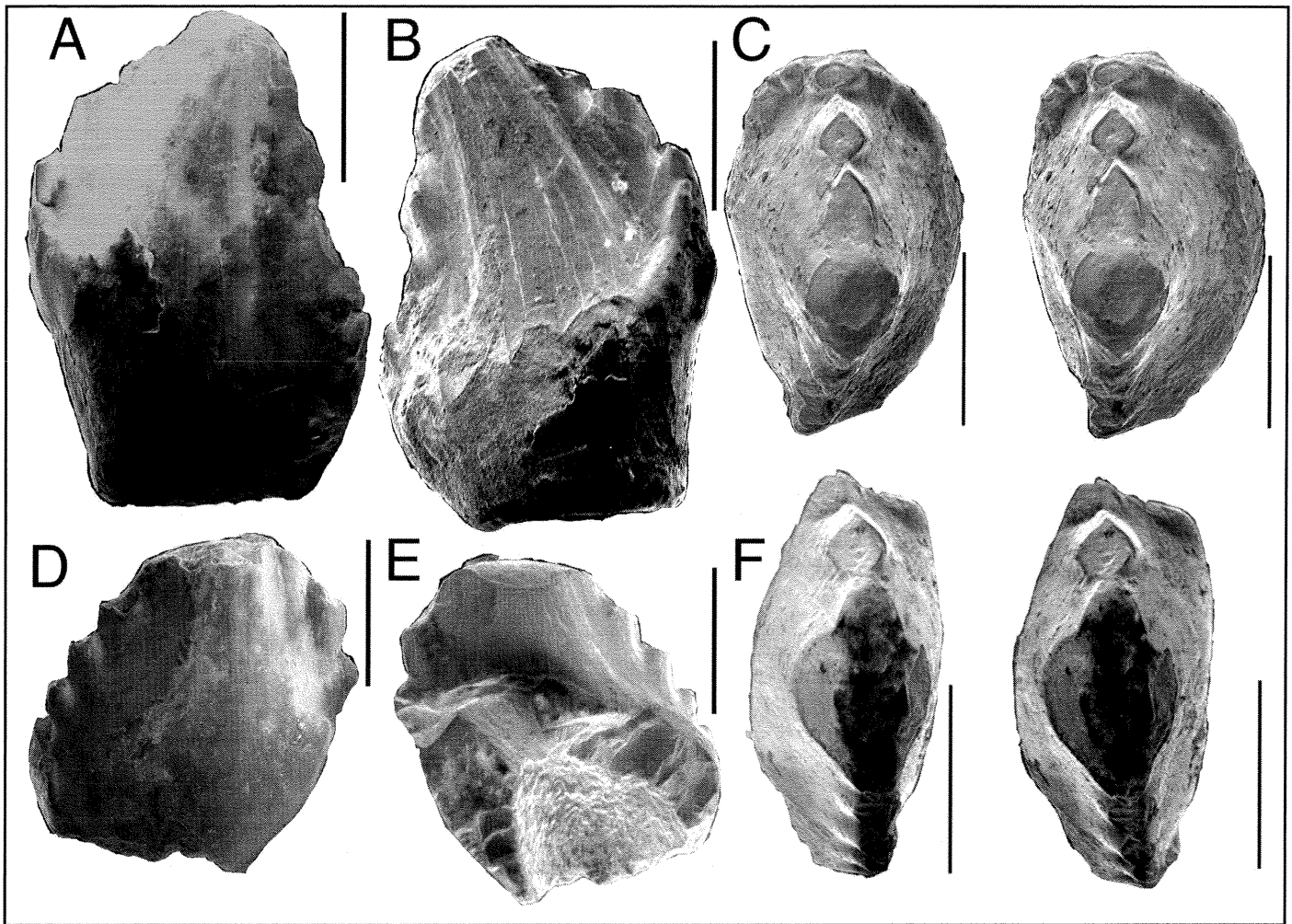


FIGURE 6. Paratype teeth of *Revueltosaurus huntii* n. sp. from NMMNH locality 1171. A-C, NMMNH P-29358 in A, labial, B, lingual, and C, stereo occlusal views; D-F, NMMNH P-29359 in D, labial, E, lingual and F, stereo occlusal views. All scale bars = 1 mm.

the lingual side that may represent an incipient cingulum. Broken enamel over this surface causes it to appear smaller than it actually is. Aside from the denticles the only other ornamentation on the tooth consists of faint longitudinal grooves on both the labial and lingual surfaces radiating basally from the tip of the tooth. The crown is expanded basally, especially anteriorly, where it overhangs the crown-root junction.

**Description of referred specimens:** The next best preserved tooth in the NMMNH collections from the type locality, NMMNH P-29358, is a nearly complete, moderately low, recurved tooth crown that is strongly asymmetric in occlusal view (Fig. 6A-C). The anterior margin is strongly convex and the posterior margin is weakly concave, such that the apex of the tooth is almost posterior to the posterior margin of the root. The tooth bears coarse denticles anteriorly and posteriorly, and the posterior carina extends farther basally than the anterior carina, which bifurcates labially and lingually. The lingual portion of the anterior carina is broken medially, but bore at least three denticles that extended posteriorly near the base of the crown. The labial portion of the anterior carina is less prominent and bears three denticles that are smaller than those of the lingual carina. The denticles on the primary carinae are extremely worn and expose the enamel on most denticles. The wear facets are inclined downwards toward the labial face of the tooth, indicating that this is probably a dentary tooth. The lingual carina fades into a prominent bulge on the lingual surface. As in the holotype, a weak ornamentation of longi-

tudinal grooves emanates from the apex of the tooth. The tooth is strongly expanded just above the base.

A much less well-preserved tooth (NMMNH P-29359—Fig. 6D-F) is an incomplete tooth crown that was probably moderately low and recurved. The tooth is coarsely denticled, with the anterior carina deflected lingually and the posterior carina extending farther basally than the anterior one. The tip is broken, but the preserved denticles are worn, with the dentine exposed on several. Wear facets are inclined down toward the labial surface, indicating that this was a dentary tooth. There are remnants of a prominent bulge near the base of the lingual side. Anteriorly the crown is expanded above the base, the posterior margin is broken.

Other paratype specimens of *Revueltosaurus huntii* include NMMNH P-29347, a broken tooth with posterior denticles lower than anterior denticles, a prominent lingual bulge and an expanded base. The dentine in the denticles is clearly exposed as a result of wear. NMMNH P-29348, is an incomplete tooth that is essentially identical to NMMNH P-29347. NMMNH P-29349 is an incomplete, moderately low, weakly recurved, weakly laterally compressed tooth crown with the anterior denticles deflected lingually. The posterior margin is broken, but the preserved denticles are coarser than their counterparts on the anterior margin. The tip is also broken. The tooth is distinctly concavo-convex in mesio-distal view and has a prominent bulge near the base of the lingual surface. The base of the crown is expanded, especially



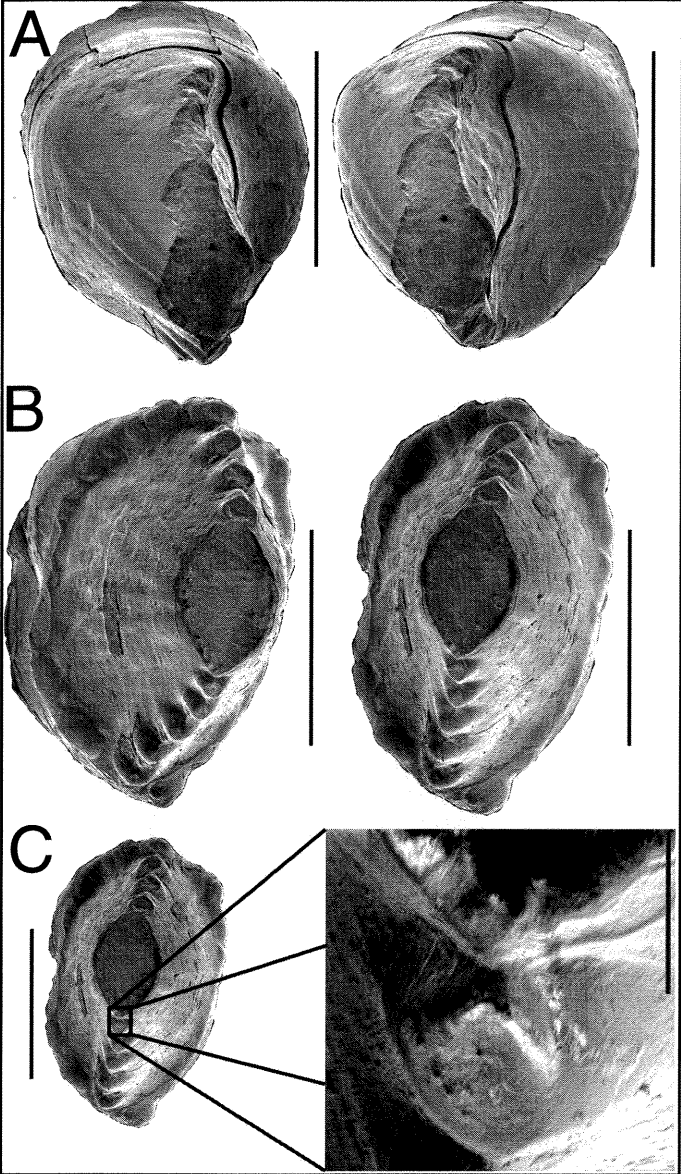


FIGURE 7. Topotype teeth of *Revueltosaurus hunti* n. sp. **A**, UCMP V173840 in stereo occlusal view, **B-C**, UCMP V139841 in **B**, stereo occlusal view and **C**, right image of (B) with close-up view of most apical posterior denticle showing wear facet and exposed enamel. All scale bars = 2 mm except for close-up of C = 200 microns.

anteriorly. NMMNH P-29350 is a worn and broken tooth that is recurved with lingually deflected carinae. The base is expanded.

NMMNH P-29351 is a possible premaxillary tooth of *R. hunti*. This moderately low, recurved, laterally compressed to very slightly asymmetric tooth is expanded basally. The carinae are coarsely denticled with posterior denticles extending farther basally than anterior denticles, which are deflected slightly labially, not lingually. The tooth is weakly concavo-convex in anterior or posterior view. Anteriorly there are approximately 5 denticles/3.5 mm, posteriorly there are 7 denticles/4.3 mm. The tip is broken (rough) not worn. Apically the denticles are worn down to the lingual side. As in the holotype, this tooth also possesses relatively strong longitudinal grooves emanating from the apex.

NMMNH P-29352 is a broken tooth that is moderately low, recurved, and strongly asymmetric in occlusal view. Most of the anterior margin is sheared off. The posterior denticles appear relatively coarse and there is a prominent lingual bulge basally.

TABLE 3. Measurements of teeth of *Revueltosaurus hunti*

Specimen	Position	TCL	TCW	TCH	Total height
NMMNH P-29357*	pmx	4.5	2.8	7.6	n/a
NMMNH P-29348	pmx	4.3AP	4.4	9.3	n/a
NMMNH P-29351	pmx	4.2	2.3	5.3AP	n/a
UCMP V139564	?	8.1	5.7	11.8	n/a
UCMP V139570	?	5.3	3.7	8 9.8	
UCMP V139571	?	6.0	4.0	8.5	n/a
UCMP V139573	md	5.0	3.4	7.6	8.4
UCMP V173840	pmx?	5.0	4.3	8.2	10.1
UCMP V173841	pmx?	6.0	4.0	9.1AP	n/a

All measurements in mm.  
\*holotype  
AP = as preserved  
pmx = premaxillary  
md = maxillary/dentary

TABLE 4. Denticle density in *Revueltosaurus hunti*

Specimen	Position	D/ht (ant)	D/mm (ant)	D/ht (post)	D/mm (post)
NMMNH P-29347	pmx	—	—	3/2.9	1
NMMNH P-29349	pmx?	3/2.6	1.2	2/2.5	0.8
NMMNH P-29351	max?	5/3.3	—	6/3.9	1.5
NMMNH P-29357†	pmx	5-6/5(4/4)	1.7(1.0)	6/4	1.75
NMMNH P-29359	pmx?	3/1*	3.0*	4/1.5*	2.7*
UCMP V139563	pmx	3/1.9	1.6	3/2.8	1.1
UCMP V139564	pmx?	4/3.6	1.1	6/5	1.2
UCMP V139565	pmx	8/5.6	1.4	—	—
UCMP V139566	pmx	5/4.6	1.0	6/4.4(3/3.5)	1.4(0.9)
UCMP V139567	pmx	—	—	6/5.9	1.0
UCMP V139568	pmx	—	—	6/7.4	0.8
UCMP V139569	?	—	—	6/5.6	1.1
UCMP V139570	pmx	—	—	6/6.8	0.9
UCMP V139571	md	6/3.5(4/2.1)	1.7(1.9)	—	—
UCMP V139572	md?	8/4.8**	1.7	4/2.5	1.6
UCMP V139574	pmx	3/3.4	0.9	7/7.7	0.9
UCMP V139575	pmx	3/3.6	0.8	—	—
UCMP V173840	pmx?	3/3.1	1.0	8/5.6	1.4
UCMP V173841	pmx?	7/5.5	1.3	7/5.6(6/4.7)	1.25(1.3)

D = denticles; ant = anterior; post = posterior  
ht = height measured as the length of the carina, not the tooth crown  
( ) = measured exclusive of deflected denticles  
† = holotype  
\* all denticles worn or broken, measurement is of overlap of bases and probably spurious  
\*\* includes several very fine apical denticles  
pmx = premaxillary  
md = maxillary/dentary

NMMNH P-29353 is a broken tooth crown. Only the anterior denticles are preserved, and these bifurcate basally.

NMMNH P-29354 is a worn and broken tooth crown. This tooth is probably moderately low, but the tip is broken. Both margins are denticled and the preserved denticles are worn. The tooth is weakly asymmetric in occlusal view and would be more so but the lingual bulge is sheared off. The crown is strongly expanded just above the base. The longitudinal grooves are very strong—essentially crenulations. Both the anterior and, possibly, the posterior margin bifurcate labially and lingually near the base.

P. Bircheff collected the following UCMP specimens from UCMP locality V92048, “Ananosia well.” Map data, tooth preservation, and color all indicate that this is the same site as NMMNH locality 1171 (also discovered by Bircheff), so these teeth are topotypes of *R. hunti*.

UCMP V173839 is the basal half of a possible premaxillary tooth of *R. hunti*. The tooth is broken below the anterior denticles,

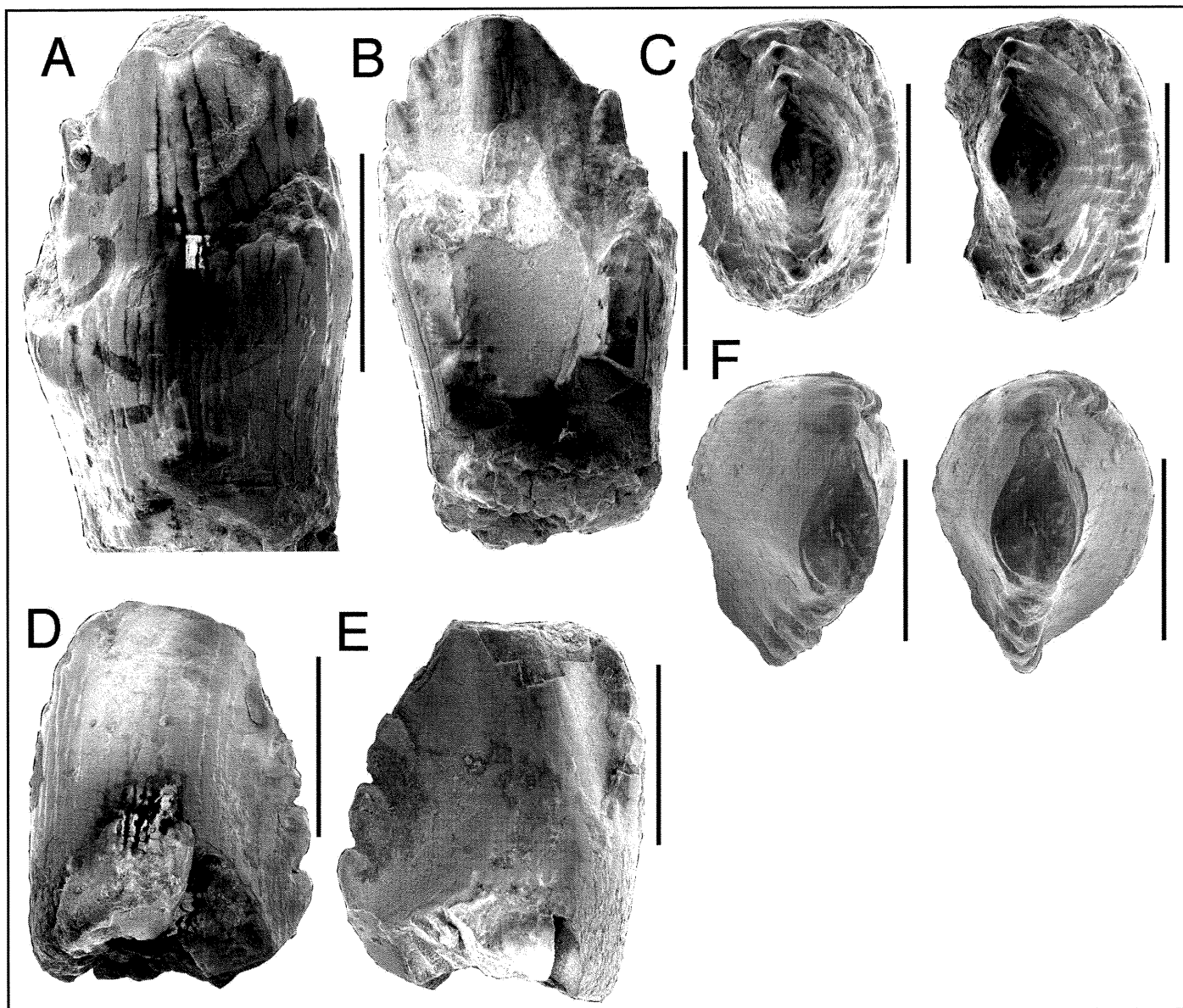


FIGURE 8. Teeth of *Revueltosaurus huntii* n. sp. from UCMP locality V7307 in the Blue Hills, Arizona. A–C, UCMP V139573 in A, labial, B, lingual, and C, stereo occlusal views; D–F, UCMP V139563 in D, labial, E, lingual and F, stereo occlusal views. All scale bars = 2 mm.

but the posterior denticles are medially deflected. This tooth is proportionately narrower than the other topotypes, with no anterior expansion of the crown base, although the posterior margin is expanded.

Another probable premaxillary tooth, (UCMP V173840—Fig. 7A) is a nearly complete, moderately low, recurved tooth crown with a broken tip. The base is strongly expanded, and the anterior denticles are slightly finer than the posterior denticles and lingually deflected basally. The posterior denticles extend farther basally than the anterior denticles. The labial bulge is strongly pronounced, and the tooth is concavo-convex in antero-posterior views. Some longitudinal striations or fluting emanating from the apex are evident on the labial surface.

Another probable premaxillary tooth, (UCMP V173841—Fig. 7B–C) is a nearly complete tooth crown with a broken tip that is probably not worn. The labial margin is strongly convex. There are some longitudinal striations on both sides. The anterior carina appears to bifurcate basally, deflecting both lingually and labially. The posterior carina extends farther basally and also bi-

furcates. Bulges are apparent both lingually and, to a lesser extent, labially (Fig. 7B). Many denticles are worn to the dentine, and the wear facets are inclined lingually (Fig. 7C).

The following UCMP specimens were collected by C.L. Camp from the Blue Hills (UCMP locality 7307), either high in the Bluewater Creek Formation or low in the Blue Mesa Member of the Petrified Forest Formation.

An incomplete tooth crown (UCMP V139563—Fig. 8D–F) has anterior denticles slightly smaller than posterior denticles and deflected lingually; this tooth is labially convex with its tip deflected lingually and a prominent lingual bulge near the base. UCMP V139564 is similar but more worn, somewhat crushed, and bears faint, arcuate, longitudinal striations or fluting and the tip is worn slightly farther labially than lingually. UCMP V139566 is a broken and worn tooth with both carinae deflected lingually, especially the posterior carina. The tip is worn lower on the labial side than the lingual.

Another incomplete tooth crown (UCMP V139573—Fig. 8A–C) preserves part of the root as well. The tooth is crushed and

worn, but was probably moderately low and spatulate originally. Teeth such as this are the most likely candidates for maxillary/dentary teeth in *R. hunti*. The anterior carina bifurcates distally. This tooth was supposedly illustrated by Long and Murry (1995, fig. 193c) but does not resemble that tooth very closely. Angielczyk (this vol.) reports numerous instances where the numbers given by Long and Murry (1995) for illustrated specimens are incorrect, but I have not been able to determine which tooth Long and Murry (1995, fig. 193c) illustrated.

The following brief descriptions demonstrate the remarkably uniform morphology of teeth I assign to *R. hunti*. Most of these teeth are not illustrated here. However, even isolated descriptions such as these falsify the assertions of Charig and Crompton (1974) and Sereno (1991) that basal ornithischian dinosaur teeth are not diagnostic to genus.

UCMP V139567 is a broken tooth crown with a very strong basal expansion, the posterior denticles extend farther basally than the anterior denticles and are slightly coarser, and the anterior carina is deflected slightly lingually. UCMP V139568 is an incomplete tooth crown. The tip is worn farther labially than lingually. UCMP V139569 is a broken tooth crown with the posterior carina extending much farther basally than the anterior carina. UCMP V139570 is a nearly complete tooth crown and incomplete root. The crown possesses a very strong lingual shelf and anterior denticles that are finer than the posterior denticles and thus do not extend as far basally. The tip is slightly more worn or broken on the lingual side.

UCMP V139571 is a tooth crown that is relatively shorter than the others described here and thus probably represents a more posterior tooth. The anterior carina is deflected slightly anteriorly and the denticles are subequal in size but the posterior denticles do extend farther down the tooth. UCMP V139574 is a broken tooth tip, illustrated by Long and Murry (1995, fig. 193d). The anterior carina is deflected farther lingually than the posterior carina, but does not extend as far basally. UCMP V139575 is an incomplete tooth crown that is not the specimen illustrated by Long and Murry (1995, fig. 193a-b).

**Discussion:** Teeth of *Revueltosaurus hunti* are clearly ornithischian, as they are expanded basally, asymmetrical in occlusal view, and bear coarse denticles oblique to the tooth margin. I assign these teeth to *Revueltosaurus* because the denticles are relatively fine compared to more derived ornithischians of similar size and because the premaxillary(?) and indeed, possibly all teeth, are weakly recurved. Many details of tooth shape, especially the shape and distribution of the denticles, readily distinguish *R. hunti* from *R. callenderi*. In *R. hunti*, the denticles are finest apically and coarsen basally, whereas *R. callenderi* has fine denticles both apically and basally, with the coarsest denticles low on the carinae but above very fine denticles. The posterior denticles in *R. hunti* coarsen more rapidly than their anterior counterparts, and therefore always extend farther down the posterior margin than the anterior denticles do down the anterior margin. In *R. callenderi* corresponding anterior and posterior denticles are approximately equal in size and generally extend equally far down the tooth. The carinae in *R. hunti* sometimes bifurcate basally, they never do in *R. callenderi*.

To the extent that denticle counts are possible, the anterior and posterior carinae of *R. hunti* bear almost exactly the same number of denticles. Therefore, the greater basal extent of the posterior denticles is a direct result of their somewhat larger size relative to the anterior denticles. Specifically, the denticles increase in size basally more rapidly on the posterior carina than on the anterior carina. Consequently, while the number of denticles on each side is the same, the posterior denticles always extend farther basally.

The wear on denticles of *Revueltosaurus* teeth is distinct between the two species. In *R. hunti*, the wear facets are always inclined—down to the labial side on upper teeth and down to the lingual side on lower teeth. In *R. callenderi*, the denticles are worn equally on their labial and lingual surfaces, and many teeth are essentially worn flat apically. Indeed, if wear facets in *R. callenderi* are inclined at all, they are inclined down to the posterior side.

The two taxa also have significant differences in overall shape. Teeth of *R. hunti* possess a prominent bulge on the lingual surface basally, giving them a concavo-convex shape in antero-posterior view. Teeth of *R. callenderi* lack such a bulge, and therefore have more vertical lingual margins in antero-posterior view. To date all teeth of *R. hunti* are at least slightly recurved, unlike the subtriangular maxillary-dentary teeth of *R. callenderi*.

On all of these teeth the longitudinal striations are somewhat variable, but appear to occur only on the labial side of strongly concavo-convex teeth and on both sides of straighter specimens. No one has attributed taxonomic significance to these features in ornithischian teeth previously, nor do I do so here.

Although superficially similar to *R. callenderi*, there is no overlap of the morphological details I use to distinguish *R. hunti* in *R. callenderi*. Teeth of *R. hunti* are the same size as those of *R. callenderi*, so the morphological differences are not ontogenetically related. No indication of substantial sexual dimorphism in dinosaur dentitions has been documented, so sexual variation is highly unlikely. Given that both taxa occur at multiple localities and are each known from 20 or more teeth, the statistical possibility that the two species represent one taxon, with *R. callenderi* based on teeth from one position in the mouth and *R. hunti* from others, is extremely small.

Because the general size, shape, and overall denticle density of the teeth are similar to each other, I see no reason to erect a new genus for *R. hunti*. Indeed, if some continue to insist on referring to *Revueltosaurus* as a “form genus” (e.g., Padian, 1990), then I think it informative to keep *R. hunti* in that same genus. I follow Hunt and Lucas (1994) and consider some Triassic ornithischian taxa based on teeth valid taxa and not “form genera” because each of these taxa is apomorphy-based and diagnosable from other ornithischians.

#### aff. *Revueltosaurus hunti*

The following specimens match known specimens of *R. hunti* in at least some characteristics and were found in association with teeth of *R. hunti*, but are too poorly preserved to assign to *R. hunti* with certainty. NMMNH P-29355 is a badly worn and broken tooth that appears to have the general shape of the others, especially the prominent lingual bulge. NMMNH P-29359 is a small, worn, broken crown that is recurved with deflected denticles. UCMP V139565 is a badly eroded, broken tooth with an expanded base. UCMP V139572 matches the other UCMP specimens in general shape, but is broken basally and posteriorly.

#### BIOCHRONOLOGICAL SIGNIFICANCE

Both *R. callenderi* and *R. hunti* occur at multiple localities in New Mexico and Arizona. Lithostratigraphic and biostratigraphic correlations demonstrate that all occurrences of *R. hunti* are of Adamanian age, and all occurrences of *R. callenderi* are Revueltian (Fig. 9). Indeed, this is further evidence that the two are discrete taxa, although stratigraphic distribution alone is never a valid criterion for distinguishing species.

The type locality of *R. hunti* is in the Los Esteros Member of the Santa Rosa Formation. The Los Esteros fauna includes a few age-diagnostic taxa, including the phytosaurs *Angistorhinus* and *Rutiodon* (Hunt et al., 1993; Hunt and Lucas, 1995b). Together these

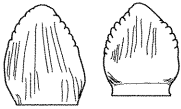

AGE		LVF	
Late Triassic	Rhaetian	Apachean	
	Norian	Revueltian	 <i>R. callenderi</i>
	Carnian	Adamanian	 <i>R. huntii</i>
		Otschalkian	

FIGURE 9. Biochronology of *Revueltosaurus* occurrences, defining an Adamanian *R. huntii* biochron and a Revueltian *R. callenderi* biochron.

taxa indicate an earliest Adamanian age, as *Rutiodon* is an Adamanian index taxon and *Angistorhinus* is an Otschalkian index taxon whose range extends into the lowermost Adamanian (Hunt et al., 1993). The other occurrence of *R. huntii*, in the Blue Hills near St. Johns, Arizona is from the Bluewater Creek Formation or Blue Mesa Member of the Petrified Forest Formation. Here *R. huntii* co-occurs with the aetosaur *Stagonolepis* and the phytosaur *Rutiodon* and is clearly of Adamanian age.

Hunt (1989), Padian (1990) and Hunt and Lucas (1994) established that *R. callenderi* occurs in the Bull Canyon Formation and the Painted Desert Member of the Petrified Forest Formation. The Bull Canyon Formation records are part of the type Revueltian fauna (Lucas and Hunt, 1993; Lucas, 1998; Hunt, 2001). The aetosaur *Typothorax* and the phytosaur *Pseudopalatus*, index taxa of the Revueltian lvf, are abundant in the Painted Desert Member as well (Hunt and Lucas, 1995a; Long and Murry, 1995; Lucas, 1998). Recently Beuhler et al. (2001) and Hunt (2001) indicated that *R. callenderi* is limited to the lower portion of the Painted Desert Member and Bull Canyon Formation, and is conspicuously absent higher in the stratigraphic section. While preliminary, this

may indicate that the *R. callenderi* biochron is shorter than the Revueltian and may perhaps represent only an early Revueltian age (Barrancan sub-lvf of Hunt, 2001).

*Revueltosaurus* thus has great utility as an index fossil. Padian (1990) and Hunt and Lucas (1994) both demonstrated that *R. callenderi* could be used to correlate Revueltian strata, and Beuhler et al. (2001) and Hunt (2001) hypothesize that the range of *R. callenderi* actually subdivides Revueltian time. Similarly, *R. huntii* can be used to correlate Adamanian strata. Indeed, teeth of *Revueltosaurus* are potentially among the best index taxa for these faunachrons because they are locally abundant, easily identified, and have a limited stratigraphic range. This could be especially important as workers in the Chinle continue to investigate dinosaur-bearing deposits, which are often paleosols or distal floodplain deposits lacking the typical aetosaurian and phytosaurian index fossils.

## DISCUSSION

This paper demonstrates that teeth historically referred to *Revueltosaurus callenderi* actually belong to two distinct species of *Revueltosaurus*. Details of tooth shape, denticulation, and wear all demonstrate differences between *R. huntii* and *R. callenderi*. According to most phylogenetic hypotheses (e.g., Thulborn, 1971a,b; Sereno, 1991; Hunt and Lucas, 1994), *R. huntii* may be more derived, as it has a lingual bulge that may represent an incipient cingulum, although I have found no evidence that this portion of the tooth was directly involved in mastication. Both teeth demonstrate precise tooth-to-tooth wear, but the wear facets on each are distinct. Hunt (1991) first noted that Triassic dinosaurs were typically only found in distal floodplain or paleosol facies, and Wright et al. (2001) noted that all occurrences of *R. callenderi* are in such facies. Thus it is possible that teeth of dinosaurs such as *Revueltosaurus* will only become more important biostratigraphically as workers continue to examine those facies, and microvertebrate faunas in general, for Late Triassic tetrapods. Consequently, *R. huntii* and *R. callenderi* have great potential as index fossils of the Adamanian and Revueltian lvfs, respectively.

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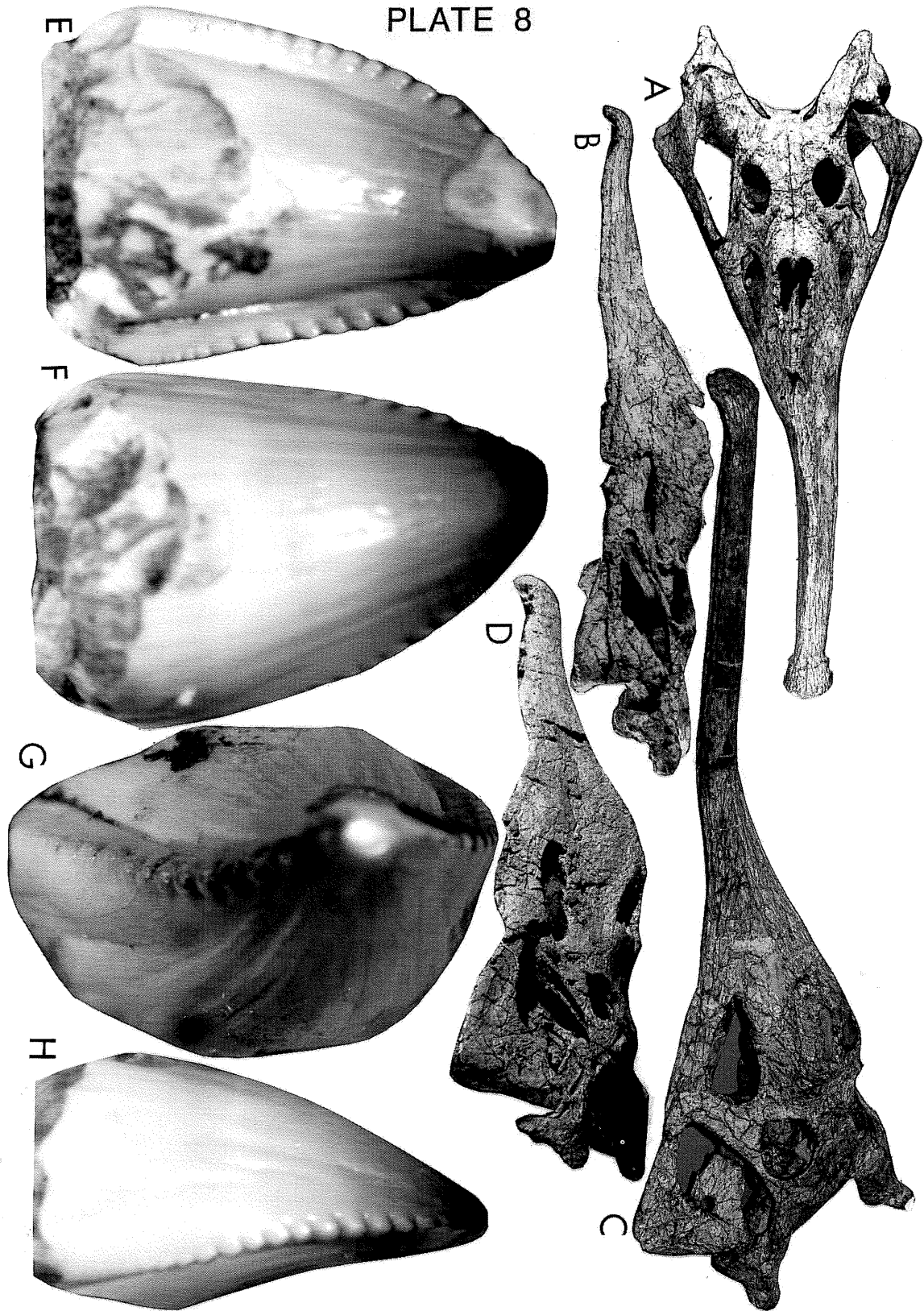


Plate 8 of Hunt (1989). Paratype premaxillary tooth of *Revueltosaurus callenderi* (NMMNH P 4959). E, Internal view, x 8. F, External view, x 8. G, Occlusal view, x 11. H, ?Anterior view, x 7. (Also, from Ballew, 1989): Canjilon quarry (New Mexico) [phytosaur] skulls. A, *Pseudopalatus buceros*, referred specimen, UCMP 34246 [dorsal view]. B, *Pseudopalatus buceros*, referred specimen, UCMP 34250 [lateral view]. C, *Pseudopalatus buceros*, referred specimen, UCMP 34250 [dorso-lateral view]. D, *Pseudopalatus pristinus*, referred specimen, UCMP 34249 [lateral view].

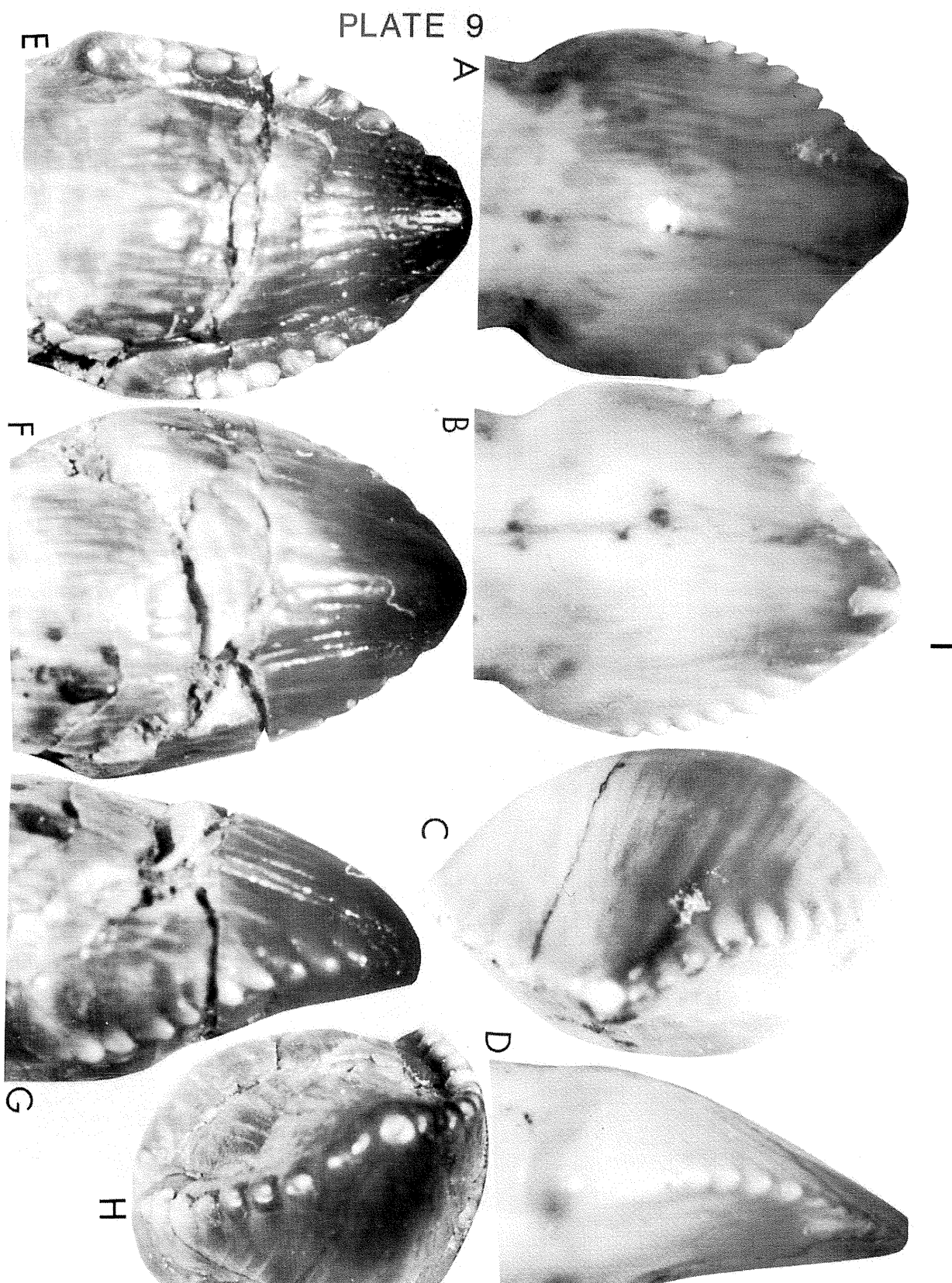


Plate 9 of Hunt (1989). A-D, Paratype dentary/maxillary tooth of *Revueltosaurus callenderi* (NMMNH P 4958). A, External view, x 10. B, Internal view, x 10. C, Occlusal view, x 13. D, ?Anterior view, x 10. E-H, Holotype incisiform tooth of *Revueltosaurus callenderi* (NMMNH P 4957). E, Internal view, x 11. F, External view, x 11. G, Lateral view, x 11. H, Occlusal view, x 10.