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NEW CRETACEOUS AND TERTIARY PHOLADIDAE (MOLLUSCA: BIVALVIA) FROM CALIFORNIA

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ABSTRACT—Cretaceous and early Tertiary Pholadidae (Mollusca: Bivalvia) from the Pacific Slope of North America are rare and only poorly known. Three new species, each the earliest known Pacific Slope representative of its respective genus, are described: *Barnea* (*Anchomasa*) *saulae* n. sp. (Pholadinae) from the Upper Cretaceous (Coniacian and Santonian) Redding Formation near Redding, uppermost Sacramento Valley, Shasta County, northern California; *Chaceia fulcherae* n. sp. (Martesiinae) from three widely separated areas of outcrop represented by 1) the middle Miocene ("Temblor") Temblor Formation near Oil City and in Jasper Canyon, western Fresno County, central California, 2) the middle Miocene ("Temblor") Topanga(?) Group in the northern Santa Ana Mountains, Orange County, southern California, and 3) the upper Miocene (Wishkahan) Montesano Formation on the Middle Fork of the Satsop River, Mason County, western Washington; and *Netastoma squiresi* n. sp. (Jouannetiinae) from the lowest Eocene (uppermost "Meganos") part of the Santa Susana Formation north of Simi Valley in the Santa Susana Mountains, Ventura County, southern California.

INTRODUCTION

FOSSIL REPRESENTATIVES of the molluscan bivalve family Pholadidae are rare in Cretaceous and lower Tertiary formations along the Pacific Slope of North America. Although some wood-boring species, such as *Opertochasma clausa* (Gabb, 1864) (subfamily Martesiinae) and *Turnus plenus* Gabb, 1864 (subfamily uncertain), have at least a meager fossil record in some Upper Cretaceous formations in California, soft-sediment or rock borers were previously unknown. The few specimens known from Paleocene and Eocene rocks are generally poorly preserved, and some cannot be unequivocally assigned to existing genera (Kennedy, 1974). *Zirfaea dentata* Gabb, 1866, is relatively common in some shallow marine Miocene formations in California, but most of the extant eastern Pacific genera and species do not have a fossil record older than Pliocene or Pleistocene (Kennedy, 1974).

Described herein are three new species: *Barnea* (*Anchomasa*) *saulae* n. sp. (subfamily Pholadinae) from the Upper Cretaceous of northern California; *Chaceia fulcherae* n. sp. (subfamily Martesiinae) from the middle Miocene of central and southern California, the upper Miocene of western Washington, and, provisionally, the upper Oligocene of southwestern British Columbia; and *Netastoma squiresi* n. sp. (subfamily Jouannetiinae) from the lower Eocene of southern California (Figure 1). Extant West American species of *Barnea* (*Anchomasa*) and *Netastoma* previously had been known as fossils only from the Pliocene and Pleistocene (Kennedy, 1974). The holotype of *Chaceia fulcherae* n. sp. previously had been regarded as Pliocene in age, but otherwise the genus was not known from rocks older than Pleistocene (Kennedy, 1974). The sediment-filled borings from the upper Miocene of the central California coast attributed to "*Chaceia*(?)" by Adegoke (1966) and to "*Nettastomella rostrata*" by Evans (1967) both represent misidentifications (Kennedy, 1974, p. 37). The generic assignments of the new species of *Chaceia* and *Netastoma* are not unequivocal, and arguments could be made for placing them in *Zirfaea* Gray, 1842, and *Pholadopsis* Conrad, 1849, respectively.

Morphological terminology follows that of Kennedy (1974, p. 11–13, fig. 2 [note, however, in the center illustration, "PC" should read "PL" and above left of the pallial sinus, "AMS" should read "PMS"]).

The following institutional acronyms are used: CAS, California Academy of Sciences; CIT, California Institute of Technology (collections at LACMIP); CSUN, California State University, Northridge; LACMIP, Natural History Museum of Los Angeles County; PRI, Paleontological Research Institution, Ithaca, New York; SU, Stanford University (collections at CAS); UCLA, University of California, Los Angeles; UCMP, University of California Museum of Paleontology; UCR, University of California, Riverside; USGS, U.S. Geological Survey; and USNM, U.S. National Museum of Natural History (Smithsonian Institution).

SYSTEMATIC PALEONTOLOGY

Phylum MOLLUSCA Linnaeus, 1758
Class BIVALVIA Linnaeus, 1758
Order MYOIDA Stoliczka, 1870
Superfamily PHOLADACEA Lamarck, 1809
Family PHOLADIDAE Lamarck, 1809
Subfamily PHOLADINAE Lamarck, 1809
Genus BARNEA Risso, 1826

Type species.—*Barnea spinosa* Risso, 1826 (=*Pholas candidus* Linnaeus, 1758), by monotypy (Turner, 1954, p. 19).

Comparison.—Species of *Barnea* differ from those in other genera of the Pholadinae by having only a single lanceolate protoplax (anterior-dorsal accessory plate). The umbonal reflection is not septate, as in *Pholas* Linnaeus, 1758, nor are the valves divided by an umbonal-ventral sulcus, as in *Zirfaea* Gray, 1842. *Cyrtopleura* Tryon, 1862, has a complicated socket arrangement in the umbonal region that is absent in *Barnea*.

Subgenus ANCHOMASA Leach, 1852

Type species.—*Anchomasa pennantiana* Leach, 1852 (=*Pholas parvus* Pennant, 1776), by monotypy (Turner, 1954, p. 23).

Comparison.—*Anchomasa* differs from *Barnea* s.s. in gaping widely anteriorly, and in some cases posteriorly, and by the constriction of its anterior extremity (beak). The shell of *Barnea* s.s. is rounded anteriorly and has slit-like anterior pedal and posterior siphonal gapes.

BARNEA (ANCHOMASA) SAULAE n. sp.
Figure 2.1, 2.2

Diagnosis.—Shells thin, fragile, moderately small for subgenus, reaching 5 cm in length and 2 cm in height, elongate, not truncate; anterior pedal gape approximately one-third of overall

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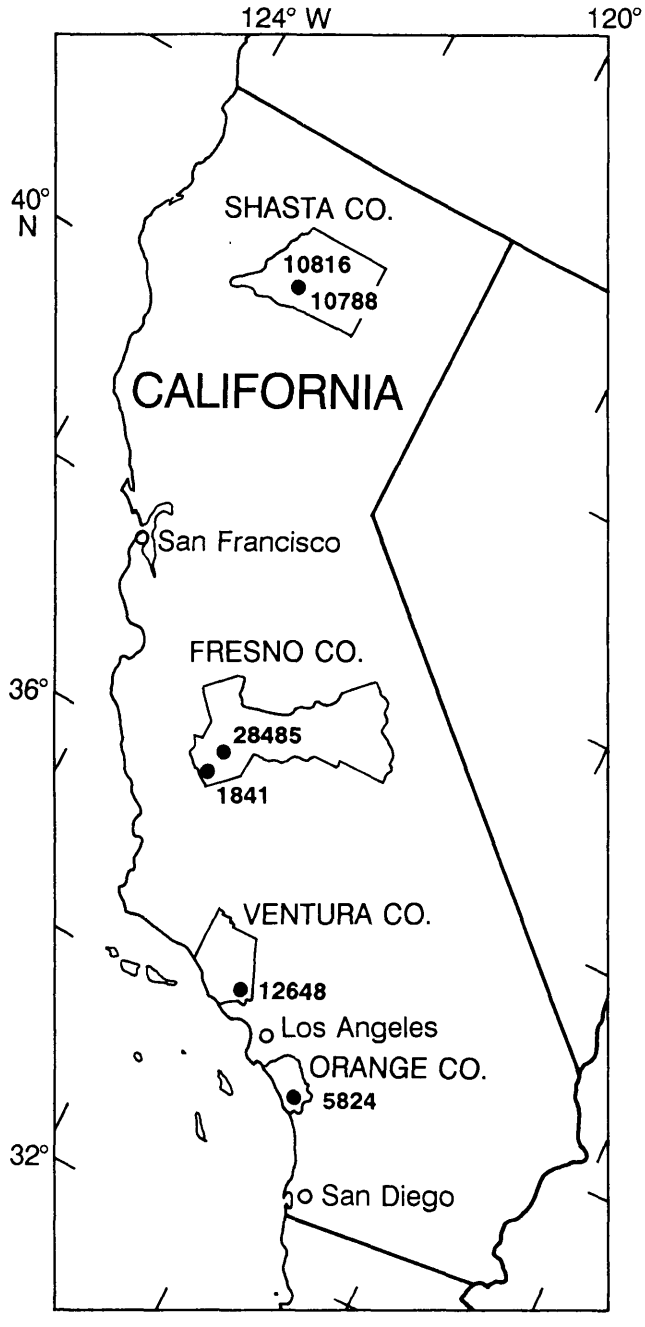

FIGURE 1—Index map of California showing approximate locations of fossil localities mentioned in text. Occurrences are: *Barnea* (*Anchomasa*) *saulae* n. sp., Shasta County, LACMIP locs. 10788 and 10816 (type locality); *Chaceia fulcherae* n. sp., Fresno County, CAS locs. 1841 and 28485 (type locality), and Orange County, LACMIP loc. 5824; and *Netastoma squiresi* n. sp., Ventura County, LACMIP loc. 12648 (type locality).

length; external sculpture formed by intersecting concentric ridges and radial ribs, slightly clathrate; radial ribs most prominent on central part of disc, present posteriorly as far as break between disc and posterior slope; sculpture evident on interior of shell due to its thinness.

Description.—Shells thin, fragile, moderately small for subgenus, probably reaching 5 cm in length and 2 cm in height, beaked and widely gaping anteriorly, elongate, rounded posteriorly, not truncate. Valves not divided by umbonal-ventral sulcus. Anterior slope and disc regions sculptured with intersecting radial ribs and concentric ridges that form a clathrate pattern over part of the shell, evident internally as grooves and pits due to thinness of valves. Radial sculpture more prominent than concentric ridges on disc, extending posteriorly to approximate demarcation of disc and posterior slope; apparent on anterior slope only as aligned spinose imbrications. Umbonal reflection flared for most of length, narrowing abruptly, and appressed to inner side of umbo, separated from anterior slope by narrow V-shaped furrow or crease, expressed internally as narrow ridge extending anteriorly to beaks.

Protoplax missing on both the holotype and paratype. Details of the interior aspect of the shell, including the muscle insertion scars, pallial line and sinus, chondrophore, and apophysis, unknown due to the preservation in indurated matrix.

Comparison.—The differences between *Barnea* (*Anchomasa*) *saulae* n. sp. and *B.* (*A.*) *scaphoidea* (Stephenson, 1953) (Figure 2.3), the only other described Cretaceous species of *Barnea,* are subtle ones. *Barnea saulae* n. sp. is larger, has a slightly less prominent sigmoidal curvature of the anterior margin around the pedal gape, and possesses radial sculpture that extends farther posteriorly than in *B. scaphoidea. Barnea scaphoidea* is more elongate, and its radial ridges only extend across the anterior two-thirds of the length of the shell. The protoplax is not known for either species.

Holotype.—LACMIP 8403, the greater part of an isolated right valve in matrix, from LACMIP loc. 10816. Length, 42 mm (incomplete); height, 20 mm.

Paratype.—LACMIP 8404, nearly complete internal mold with some remaining shell of isolated right valve in matrix, from LACMIP loc. 10788. Length, 31 mm (nearly complete); height, 18 mm.

Type locality.—LACMIP loc. 10816 (CIT loc. 1007), Upper Cretaceous, lower Coniacian, Redding Formation, member IV of Popenoe (1943). Hills north of Oak Run, approximately 11 km northeast of Millville, east of Redding, Shasta County, California.

Distribution.—The species is known only from two localities in the Redding Formation east of Redding, Shasta County, California. The type locality above Oak Run (LACMIP loc. 10816) and the paratype locality between Basin Hollow and Clover Creeks (LACMIP loc. 10788) span a stratigraphic interval from lower Coniacian, in member IV of Popenoe (1943), to Santonian, in the lower part of member V (L. R. Saul, personal commun.).

Discussion.—*Barnea* (*Anchomasa*) *saulae* n. sp. is one of the oldest species in the genus. Turner (1954, p. 16) cited a stratigraphic range for *Barnea* from Lower Cretaceous to Holocene, but subsequently (Turner, 1969, p. N708) recorded it only from the Miocene onward. The oldest species appears to be *Pholas*? *scaphoides* Stephenson, 1953, described from the Cenomanian (Upper Cretaceous) Woodbine Formation of Texas. The species (Figure 2.3) lacks any evidence of the septate umbonal reflection that is so diagnostic of *Pholas* and its subgenera, and is placed herein into *Barnea* (*Anchomasa*). Kelly (1988), in his review of Mesozoic pholadids, based his early record of *Pholas,* subgenus *Monothyra* Tryon, 1862, on *P.? scaphoides.*

Etymology.—The species name honors LouElla R. Saul, in recognition of her contributions to our understanding of the Cretaceous molluscan faunas of the Pacific Slope of North America.

Subfamily MARTESIINAE Grant and Gale, 1931
Genus CHACEIA Turner, 1955

Type species.—*Pholas ovoidea* Gould, 1851, by original designation (Turner, 1955, p. 66).

Comparison.—*Chaceia* was proposed as a monotypic genus for the large and distinct *C. ovoidea,* which differs from species in other genera of the Martesiinae, particularly *Penitella* Valenciennes, 1846, by its large size, wide anterior and posterior gapes, large "warty" siphon, broadly U-shaped mesoplax, only partial callum, and lack of a siphonoplax. If *Chaceia fulcherae* n. sp. is to be included in *Chaceia,* and not *Zirfaea,* then the definition of the genus will have to be amended to account for the apparent lack of even a partial callum in ancestral species (Kennedy, 1985). Species of *Zirfaea* have a small V-shaped mesoplax, weakly to moderately developed umbonal-ventral sulcus, and, like all members of the Pholadinae, lack a callum and siphonoplax.

CHACEIA FULCHERAE n. sp.
Figure 2.4–2.8

? *Zirfaea* sp. CLARK AND ARNOLD, 1923, p. 156, Pl. 16, fig. 2.
? *Zirfaea* sp. ADDICOTT, 1966, p. 646 (USGS loc. M1542; specimen(s) not seen, not found by Kennedy, 1974, p. 92).
Chaceia ovoidea (Gould, 1851). KENNEDY, 1974, p. 38, 39, both in part (CAS loc. 28485 only, as "aff." [on errata sheet]); not p. 37–39, figs. 20–27 (=*C. ovoidea* (Gould, 1851)). Not *Pholas ovoidea* Gould, 1851.
Unidentified pholadid. KENNEDY, 1974, p. 126, fig. 102.
Burrow of *Chaceia* sp. aff. *C. ovoidea* (Gould). KENNEDY, 1974, p. 126 (aff. on errata sheet), fig. 103.

Diagnosis.—Relatively large pholadid, reaching 10 cm in length, elongate and subcylindrical, anterior margin with prominent sigmoidal curvature, anterior slope short in relation to combined length of disc and posterior slope, umbonal-ventral sulcus moderately well defined, disc and posterior slope with well-defined low rounded concentric ridges, callum and dorsal extension of callum absent.

Description.—Shell large, reaching 10 cm in length and 5 cm in height, elongate and subcylindrical, anterior slope relatively short, approximately one-third of overall length, widely gaping anteriorly, anterior margin with prominent sigmoidal curvature from beak to ventral margin, posterior margin rounded, posterior-dorsal margin flaring somewhat. Anterior slope sculptured by upright concentric ridges with radially aligned flutes or ruffles that can be knobby appearing rather than sharp or spinose; concentric ridges pass through umbonal-ventral sulcus and continue onto disc and posterior slope as low, rounded concentric ridges. Umbonal-ventral sulcus relatively well defined, impinges upon ventral margin near its juncture with the pedal opening. Umbonal reflection free anteriorly, appressed over umbo, with well-defined muscle scar pad. Mesoplax unknown, perhaps broadly rounded posteriorly (see Discussion). Callum and dorsal extension of callum absent in all known specimens.

Details of interior aspect of shell, including muscle insertion scars, pallial line and sinus, and apophysis, unknown due to mode of preservation of existing specimens.

Comparison.—From *Chaceia ovoidea, C. fulcherae* n. sp. differs in its greater length to height ratio, proportionately smaller anterior slope in relation to disc and posterior slope lengths, less distinct umbonal-ventral sulcus, and apparent lack of even a partial callum or dorsal extension thereof. *Zirfaea dentata* from the Miocene of California is also elongate and subcylindrical, but its umbonal-ventral sulcus is only weakly defined and passes across the shell far posterior of the highly sculptured anterior slope that is comarginal with the pedal gape (see Kennedy, 1974, figs. 13–15). From *Zirfaea pilsbryi* Lowe, 1931, a Pliocene to Recent species, *C. fulcherae* n. sp. differs by its elongate subcylindrical shape, more prominent umbonal-ventral sulcus, more prominent sigmoidal curvature of the anterior margin, and lack of spinose projections on the concentric ridges.

Holotype.—CAS 54825.01, paired valves in posteriorly truncated sediment-filled boring, from CAS loc. 28485. Length, 80 mm (incomplete, projected length about 10 cm); height, 50 mm.

Paratypes.—CAS 54826.01, from CAS loc. 1841; LACMIP 11444 (juvenile pair), and 11445 (adult pair in sediment-filled boring), from LACMIP loc. 5824. All other specimens are excluded from consideration as type material.

Type locality.—CAS loc. 28485, Miocene, "Temblor"(?) Stage, Temblor(?) Formation, "one mile" (1–2 km) south of Oil City, north of Coalinga, Fresno County, California (see locality descriptions).

Distribution.—Despite possible questions about the exact locality and stratigraphic position for the holotype (see below), the species is widely distributed in the middle Miocene ("Temblor" Stage) of California, including the Temblor Formation near Oil City (the type locality) and in Jasper Canyon (CAS loc. 1841), both Fresno County, to Orange County, in the Topanga(?) Group at Upper Oso Reservoir (LACMIP loc. 5824) in the northern Santa Ana Mountains. In the upper Miocene (Wishkahan Stage) of western Washington, a pholadid boring from the basal Montesano Formation at USGS loc. M3073 yielded an external mold of a partial specimen that is probably *C. fulcherae* n. sp. (Figure 2.7, 2.8). The record of *Zirfaea* sp. by Addicott (1966, p. 646) from the Montesano Formation at USGS loc. M1542 may also represent *C. fulcherae* n. sp., but the specimens could not be located for comparison (Kennedy, 1974, p. 92). *Zirfaea* sp. of Clark and Arnold (1923, p. 156, Pl. 16, fig. 2; CAS 66602.01, ex SU 295, not UCMP 30065 as cited) from the upper Oligocene (Juanian Stage) Sooke Formation west of Sooke (CAS loc. 66602) on the southern end of Vancouver Island, British Columbia, is represented by a single partial specimen and is only provisionally assigned to *C. fulcherae* n. sp.

Discussion.—The description of *Chaceia fulcherae* n. sp. now allows for the identification of a number of previously enigmatic *Zirfaea*- and *Chaceia*-like pholadid specimens that did not compare favorably with any previously described species. These specimens were too derived, particularly in the development and placement of the umbonal-ventral sulcus, to be assigned to the only Miocene *Zirfaea, Z. dentata* Gabb, or to its Pliocene and younger descendant, *Z. pilsbryi* Lowe. The oldest of these specimens may be the small, partial specimen of "*Zirfaea* sp." of Clark and Arnold (1923) from the upper Oligocene (Juanian Stage) Sooke Formation on Vancouver Island, British Columbia. Unequivocal identification as *C. fulcherae* n. sp., however, should await additional, better preserved material. The apparent similarity to juvenile *Z. pilsbryi* noted by Kennedy (1974, p. 74, 81) was based on the strength and position of its umbonal-ventral sulcus, which is commonly better defined in juvenile specimens of *Z. pilsbryi* than in adults.

The holotype of *Chaceia fulcherae* n. sp. (Figure 2.6) was originally associated in the CAS collection with several specimens of *Zirfaea dentata,* although the lithologies and styles of preservation differed enough to question a single provenance. On that basis, I considered the present holotype specimen to be geologically younger (Pliocene?) and identified it as *Chaceia* sp. aff. *C. ovoidea,* believing it to be ancestral to *C. ovoidea* (Kennedy, 1974, p. 38, 39 [errata sheet]). It would seem now that the original Miocene age was probably correct, although the collection from CAS loc. 28485 may be a mixture of specimens from the Temblor Formation and the upper Miocene ("Margaritan") Santa Margarita Formation as suggested by the CAS locality records. The oldest examples of representative *C. ovoidea* are from the lower Pliocene ("Etchegoin" Stage) Etchegoin Formation, San Emigdio Mountain, Kern County, southern California (UCR loc. 1446).

The specimen of *Chaceia fulcherae* n. sp. from the Montesano Formation of western Washington (USGS loc. M3073) illus-

trated in Figure 2.7 and 2.8 was also questionably identified as a *Zirfaea* and thought to represent a form ancestral to *C. ovoidea* (Kennedy, 1974, p. 36, 93).

The greatest documented abundance of *Chaceia fulcherae* n. sp. is in the middle Miocene ("Temblor" Stage) Topanga(?) Group in the northern Santa Ana Mountains, where over 300 sediment-filled borings were collected from an area being prepared for the Upper Oso Reservoir (LACMIP loc. 5824; Figure 1). Most are 10–12 cm in length and comparable in size to the holotype boring (CAS 54825.01), although only a few have revealed impressions of the original pholadid shells, which have been leached away. Many of the filled borings preserve an ornate pattern of "chatter marks" on their basal end as a result of the rasping action of the beak and anterior margin during the boring process. Similar ornamented borings have been given the ichnofossil name *Gastrochaenolites ornatus* Kelly and Bromley (1984, p. 801, fig. 7A–D). The holotype of *G. ornatus* was created by a specimen of *Zirfaea crispata* (Linnaeus, 1758).

Although the mesoplax of *Chaceia fulcherae* n. sp. is unknown, one sediment-filled borehole from the Upper Oso Reservoir locality (LACMIP loc. 5824) still preserves an impression near the umbonal region that suggests *C. fulcherae* n. sp. may have had a mesoplax that was broadly rounded posteriorly, possibly similar to the adult mesoplax of *C. ovoidea,* which is also broadly rounded posteriorly (cf. Kennedy, 1974, figs. 25, 26). The mesoplax of *Zirfaea dentata* is unknown. The mesoplax of *Z. pilsbryi* is V-shaped and similar in aspect to the juvenile mesoplax of *C. ovoidea.*

Although description of *Chaceia fulcherae* n. sp. resolves identification of various Miocene and Oligocene(?) specimens at the species level, determination of the "correct" generic and subfamilial assignment is not as straightforward. The Pholadinae are borers of firm to indurated sediments, and may possess shells that are either closed anteriorly or have a pedal gape that remains open throughout life. Of the Pholadinae, only *Zirfaea* has a weakly to moderately developed umbonal-ventral sulcus, and all genera lack a callum and siphonoplax. Members of the Martesiinae, which are predominantly rock and wood borers, have a prominent, well-defined umbonal-ventral sulcus that separates the highly ornamented anterior slope from the relatively smooth disc and posterior slope, a wide open pedal gape that is closed by a callum in the adult stage, and various accessory plates around the margins of the shell. *Chaceia ovoidea* has the well-developed sulcus and sculpturally differentiated anterior and posterior regions, but has only a partial (incomplete) callum. The apparent lack of a callum in *C. fulcherae* n. sp. suggests that it should be placed in *Zirfaea* in the Pholadinae, but the moderately well developed umbonal-ventral sulcus, sculpturally differentiated anterior and posterior regions, and a mesoplax possibly similar to that of *C. ovoidea* indicate placement with *Chaceia* in the Martesiinae. Placement in *Chaceia* and the Martesiinae is warranted on the grounds that it best elucidates the ancestral (evolutionary) relationship of *C. fulcherae* n. sp. to *C. ovoidea,* and the definition of *Chaceia* is thus amended to account for the apparent lack of even a partial callum in the ancestral condition.

Etymology.—The species name honors the memory of my sister-in-law, Janet Krantz Fulcher (1930–1984).

Subfamily JOUANNETIINAE Tryon, 1862
Genus NETASTOMA Carpenter, 1864
[Conserved, ICZN Opinion 1296, 1985]

Type species.—*Netastoma Darwinii* Sby [*Pholas darwinii* G. B. Sowerby II, 1849], by monotypy (see comments in Turner, 1955, p. 141, and Coan and Kennedy, 1980, p. 114).

Comparison.—*Netastoma* differs from the larger and more bulbous *Pholadopsis* Conrad, 1849, to which it is most closely related, by the absence of a mesoplax, the very large, unequal callum, and the pectinate siphonoplax of the right valve. Juvenile shells are not easily distinguishable, but the umbonal reflection of *Netastoma* has a straighter dorsal margin and extends posteriorly over the umbo, whereas in *Pholadopsis* it is shorter, dorsally convex, and usually terminates on the anterior side of the umbo. In addition, the angle at which the anterior concentric ridges impinge on the umbonal-ventral sulcus is similar to the angle of departure in *Pholadopsis,* whereas in *Netastoma* the angle of departure is approximately 90° to the sulcus. In *Netastoma* the callum is a peripheral band of calcareous material that borders a large central periostracal region, and the siphonoplax is developed on both valves, usually equally. *Jouannetia* DesMoulins, 1828, is a distinct genus that is not closely related to either *Netastoma* or *Pholadopsis,* although the latter has been treated as a subgenus of *Jouannetia* by earlier workers, mainly because of the apparent similarity of their globose forms in the adult stage.

NETASTOMA SQUIRESI n. sp.
Figure 2.9, 2.10

Diagnosis.—Shell average-sized for genus, reaching 12 mm in length and 8 mm in height in juvenile stage, anterior and disc-posterior slopes about equally developed. Anterior slope sculptured by sharp, well-defined concentric ridges and prominently intersecting radial ribs forming pointed projections; radial ribs absent close to umbonal-ventral sulcus; concentric ridges pass through umbonal-ventral sulcus as sharp, well-defined ridges and continue posteriorly onto the disc at about a 90° angle with sulcus. Umbonal reflection flaring, not overturned (but missing over umbo on holotype), smooth, lacking continuation of concentric sculpture of anterior slope.

Description.—Shell reaching about 12 mm in length and 8 mm in height in juvenile stage, beaked, widely gaping anteriorly, rounded posteriorly. Anterior slope sculptured with moderately spaced, thin, sharply defined concentric ridges and intersecting radial ribs, intersections forming pointed (spinose?) projections; radial ribs weakening posteriorly, absent close to umbonal-ventral sulcus. Concentric ridges impinge on umbonal-ventral sul-

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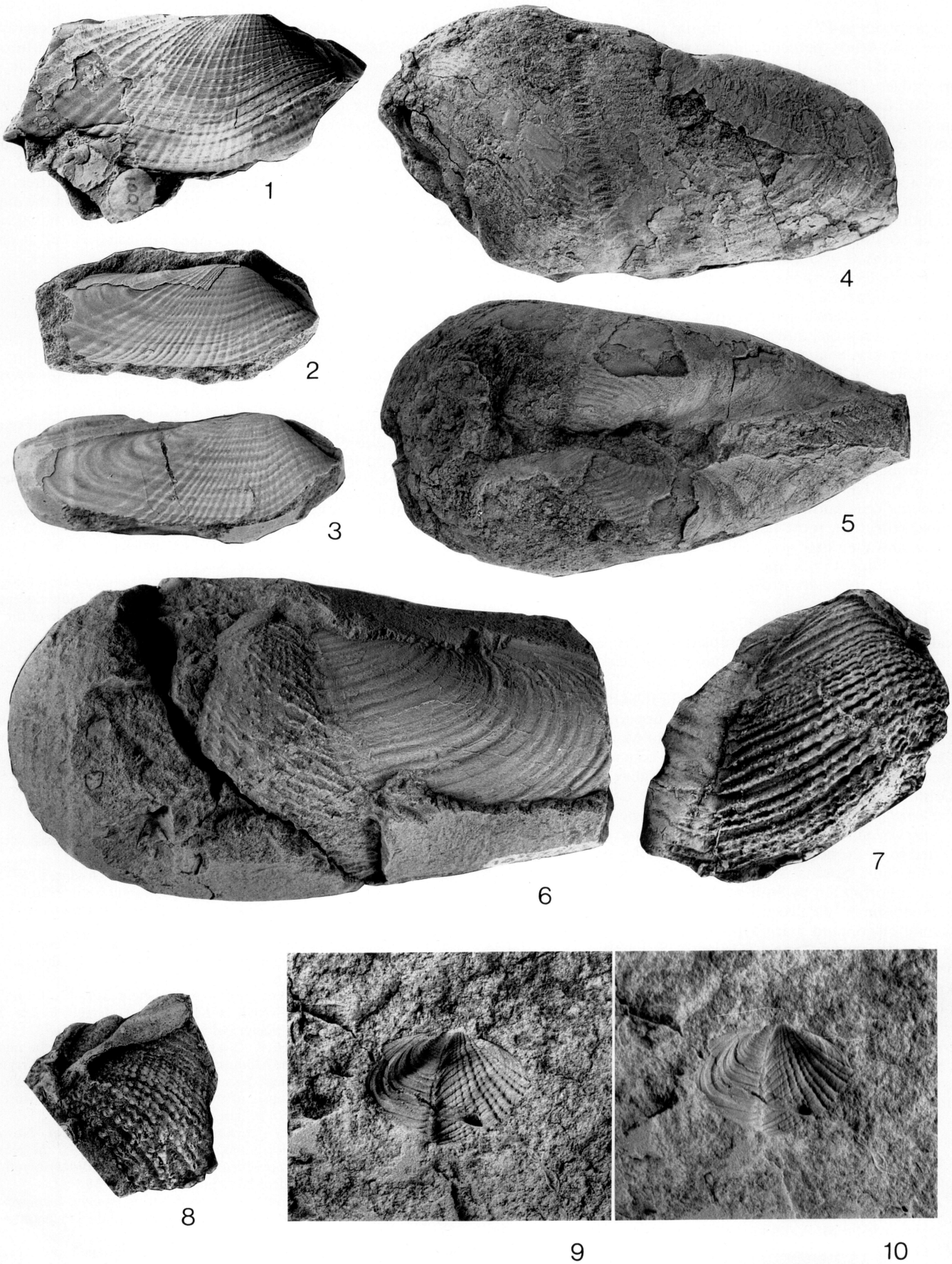
FIGURE 2—*1, 2, Barnea (Anchomasa) saulae* n. sp., ×1.5. *1,* holotype, LACMIP 8403 from LACMIP loc. 10816, incomplete right valve, length 42 mm; *2,* paratype, LACMIP 8404 from LACMIP loc. 10788, nearly complete internal mold of right valve with some remaining shell, length 31 mm. *3, Barnea (Anchomasa) scaphoidea* Stephenson, 1953, ×1.5; holotype, USNM 105591 from USGS Mesozoic loc. 19105 (Woodbine Formation, near Denison, Grayson County, Texas), internal mold with little remaining shell of isolated right valve, length 41 mm. *4–8, Chaceia fulcherae* n. sp., ×1.0. *4, 5,* paratype, CAS 54826.01 from CAS loc. 1841, left valve (*4*), and dorsal view of paired valves (*5*), length 98 mm; *6,* holotype, CAS 54825.01 from CAS loc. 28485, left valve of pair in sediment-filled borehole, length of boring 112 mm; *7, 8,* hypotype, LACMIP 11490, latex casts taken from external mold in sediment-filled borehole from USGS Cenozoic loc. M3073, anterior part of right valve (*7*), and anterior slope and umbonal reflection of left valve (*8*). *9, 10, Netastoma squiresi* n. sp., ×3.0. *9,* holotype, LACMIP 8405 from LACMIP loc. 12648, external (concave) mold of left valve, length 10 mm (incomplete); *10,* same specimen lighted to give the effect of being a convex right valve.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