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**A Record of the Inarticulate Brachiopod *Glottidia?* from the Ancestral
Gulf of California (Miocene to Pliocene Imperial Formation),
Southern California**

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ABSTRACT

A single specimen on an inarticulate brachiopod questionably referred to the genus *Glottidia* is the first fossil brachiopod from the ancestral Gulf of California. The specimen is from the Whitewater outcrop of the Imperial Formation in Riverside County, California which is considered late Miocene in age. It also documents a part of the non-molluscan fauna of the Imperial Formation.

INTRODUCTION

One of the unexpected discoveries in the Neogene Imperial Formation (upper Miocene to upper Pliocene) in Riverside County, southern California, is a double-valved, crushed specimen of an inarticulate brachiopod questionably identified as *Glottidia?* species (fig. 1). Although *Glottidia* has been found as a fossil in Eocene to Pleistocene marine deposits in California (Hertlein and Grant, 1944), this specimen is the first record of its occurrence as a fossil in the ancestral Gulf of California.

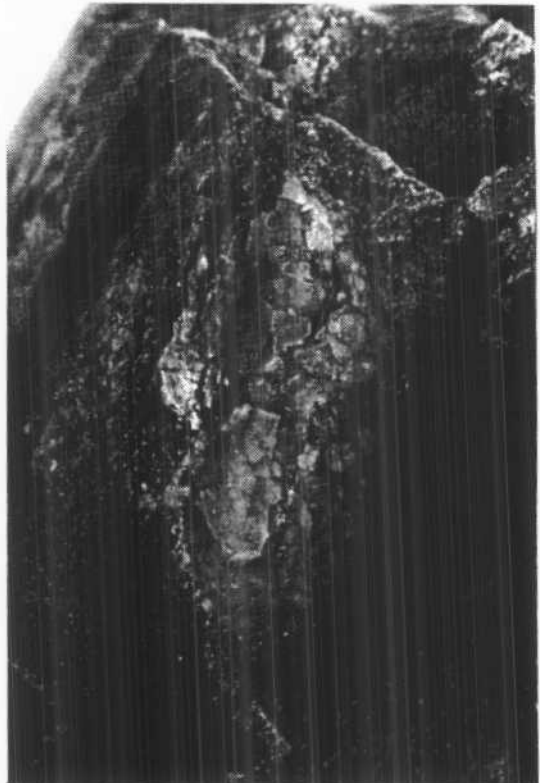
The genus *Glottidia* most closely resembles *Lingula* from which it is distinguished wholly on the basis of internal features (Dall, 1870). Because of poor preservation the present specimen cannot be definitively distinguished from the genus *Lingula*, but *Lingula* is not known from the northeastern Pacific (Hertlein and Grant, 1944). The genus *Glottidia* occurs in the modern eastern Pacific marine fauna from Monterey Bay, California to Peru, including the Gulf of California (Hertlein and Grant, 1944).

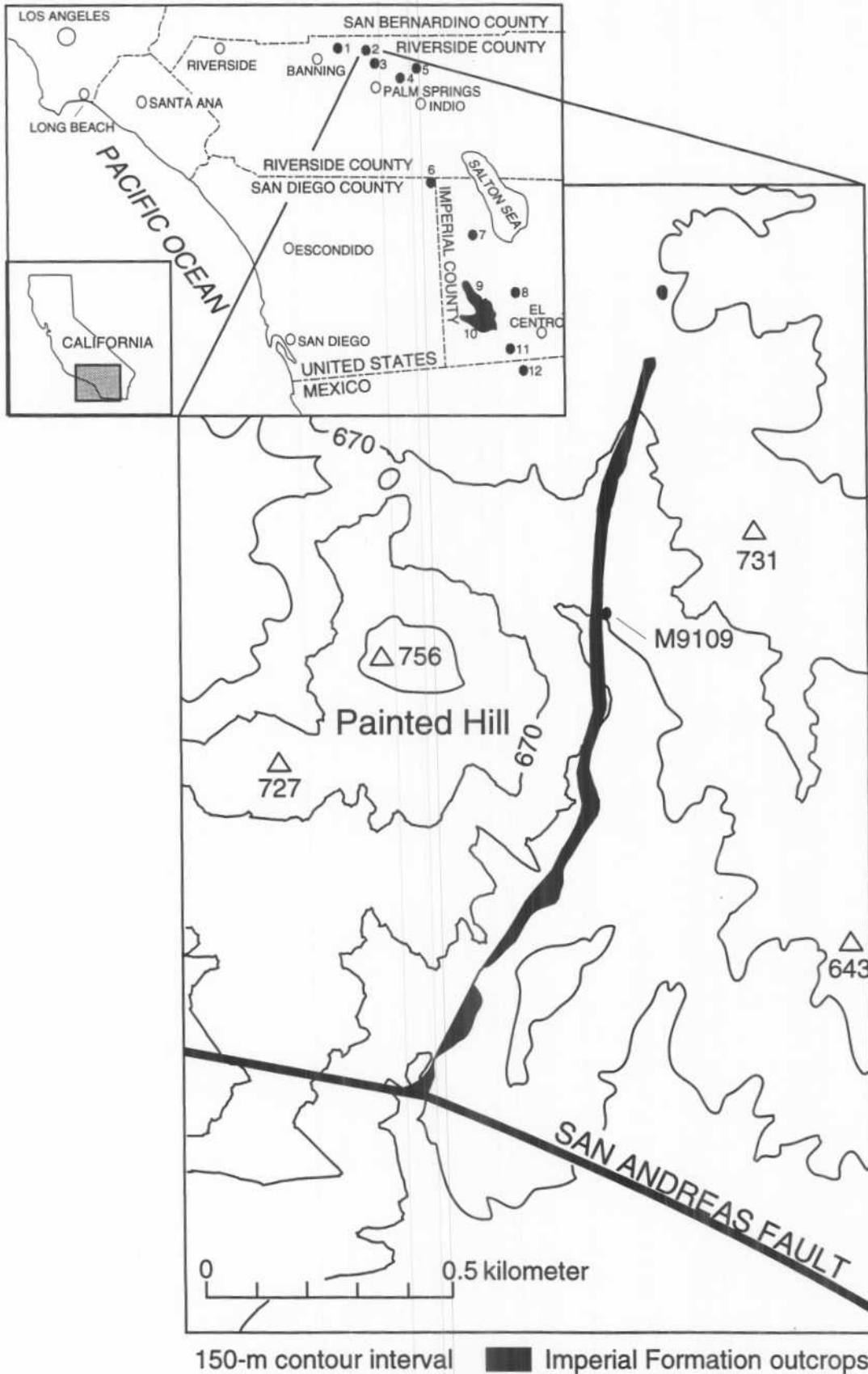
Three species of *Glottidia* are known from the northeastern Pacific (Hertlein and Grant, 1944): *G. albida* Hinds, 1844, which is reported to occur from Monterey Bay, California to Oaxaca, Mexico, in Eocene to Holocene deposits; *G. audebarti* Broderip, 1834, known only in the Holocene, from San Diego, California to Guayaquil, Ecuador, including the Gulf of California; and *G. palmeri* Dall, 1871, also known only in the Holocene, which reportedly ranges from San Pedro, California to the Gulf of California (Dall, 1871; 1920), but is present only in collections from the Gulf of California (Hertlein and Grant, 1944).

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Figure 1 Slab containing *Glottidia?* sp. x4.
LACMIP 7628; length 12.7 mm, width 6.4 mm. U.S. Geological Survey Cenozoic loc. M9109.





SYSTEMATIC PALEONTOLOGY

Phylum Brachiopoda Duméril, 1806

Class Inarticulata Huxley, 1869

Family Lingulidae Menke, 1828

Genus *Glottidia* Dall, 1870

Type species.—*Glottidia albida* (Hinds, 1844), by original designation by Dall (1870).

Glottidia? sp.

Figure 1

Description.—The crushed specimen figured here has an elongated-oval shape with subparallel lateral margins, a pointed posterior end, and a slightly rounded anterior end. It measures 12.7 mm long and 6.4 mm wide at its widest point. It is very pale yellow and ornamented only with very fine incremental growth lines. No internal features of the shell are visible because of its crushed nature.

Discussion.—This specimen is most similar in outline and coloration to an immature *G. albida*, but, because it is crushed, it cannot be referred with confidence to this species. *Glottidia palmeri* differs from the present specimen by its thinner and more pointed anterior end, more evenly rounded posterior end, and larger size. *Glottidia audebarti* can easily be distinguished by its nearly straight posterior margin, larger size, and thinner and more sharply pointed anterior end.

Occurrence.—The Imperial Formation crops out discontinuously in Riverside County along the San Andreas-Banning fault zone, with exposures occurring at Cabazon, Whitewater, Garnet Hill, Mt. Edom, and Willis Palm (fig. 2). Sediments from these beds attain a maximum thickness of 105 m, are composed of sandstone and siltstone, with minor conglomeratic and shelly beds, and are divided into two members (Murphy, 1986; Powell, 1986). The lower member in Super Creek consists of about 30 m of sandstone and conglomerate topped by a reworked "worm tube" bed and contains a molluscan fauna characterized by taxa that live in a euhaline, moderate- to high-energy, subtidal to inner shelf, rocky to sandy habitat. The upper member (=Lion Sandstone of Vaughan, 1922), where the brachiopod was collected, is composed of sandstone and siltstone and attains a maximum thickness of 75 m. It represents a low- to moderate-energy, inner to outer shelf environments that shallows upsection.

The specimen of *Glottidia?* was collected about 9 m above the base of the upper member of the Imperial Formation exposed along part of Super Creek (Whitewater

Figure 2.—Idealized geologic map of the Cabazon outcrop area. The brachiopod described in this paper was collected from U.S. Geological Survey locality M9109. Insert shows study area (gray pattern) and outcrops of the Imperial Formation in southern California (shaded area and solid dots): 1, Cabazon; 2, Whitewater; 3, Garnet Hill; 4, Mt. Edom; 5, Willis Palm; 6, Travertine Point; 7, Ocotillo Wells State Vehicle Recreation area; 8, Superstition Mountain; 9, Fish Creek Mountains; 10, Coyote Mountains; 11, Yuha Buttes; 12, northern Cucupa Mountains, east of Mexicali, Baja California Norte, Mexico (Ingle, 1974).

outcrop area), Riverside County, California (USGS Cenozoic locality M9109) (fig. 2). At this locality the Imperial Formation is of latest Miocene age (Peterson, 1975; Matti and others, 1985; Powell, 1986; McDougall and others, 1994; Rymer and others, 1994) and consists of continental shelf sediments influenced by only minor current activity (Powell, 1986).

Repository.—The specimen discussed here is deposited in the Invertebrate Paleontology section of the Natural History Museum of Los Angeles County (LACMIP), California.

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