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## New Occurrences of Extinct Meiolaniid Turtles in New Caledonia

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### ABSTRACT

Two posterior cervical vertebrae found in new localities in New Caledonia have derived features of the extinct cryptodiran family Meiolaniidae. One cervical is from Pindai Cave, Nepoui Peninsula,

and is associated with Holocene fossils and charcoal dated at  $1720 \pm 70$  years BP, whereas the other cervical is from Tiga Island with a probable Late Pleistocene date.

### RÉSUMÉ

Deux vertèbres cervicales postérieures trouvées dans des nouvelles localités en Nouvelle Calédonie ont des caractères dérivés de la Famille éteinte des Cryptodères, Meiolaniidae. Une cervicale est de la cave Pindai, Péninsule Nèpoui et est associée

avec des fossiles Holocène et des charbon de bois datés à  $1720 \pm 70$  ans avant ce jour, tandis que l'autre cervicale de l'île Tiga a une date probable dans le Pleistocène supérieur.

### INTRODUCTION

The meiolaniid or horned turtles are an extinct group of cryptodires (Gaffney, 1983) found in the Southern Hemisphere in Cenozoic rocks. In appearance, the meiolaniids are bizarre, having cranial horns and frills, a tail club, and numerous epidermal ossicles

(see Gaffney, 1983, for figures). The best known meiolaniid, *Meiolania platyceps*, is from the Pleistocene of Lord Howe Island, a volcanic remnant about 630 km east of the Australian mainland. Other meiolaniid specimens are known from the Eocene of Argen-

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tina, the Miocene and Pleistocene of mainland Australia, and the Pleistocene of Walpole Island, New Caledonia. The biogeographic significance of this distribution has been speculated on by Simpson (1938, 1943), Darlington (1957), and Mittermeier (1972), but there have been no definitive studies based on original examination of specimens. We report here two new occurrences of meiolaniids from New Caledonia with the intention of providing more information for biogeographic and phylogenetic studies.

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Among the co-authors, Balouet was responsible for geologic and locality data, Gaffney provided the morphologic description and de Broin allowed access to the museum specimens.

#### ABBREVIATIONS

AM F, Australian Museum, Sydney, Australia.  
NCP, NCT, Museum National d'Histoire Naturelle, Paris, France.

#### FAMILY MEIOLANIIDAE

CONSISTS OF: NCP 05, a nearly complete seventh cervical vertebra.

LOCALITY: Main Pindai Cave, Nepoui Peninsula, New Caledonia, 21°20'12"S latitude, 164°57'24"E longitude.

HORIZON: Found in a phosphatic cave deposit containing Holocene fossils, with charcoal dated at 1720 ± 70 years BP.

#### FAMILY MEIOLANIIDAE

CONSISTS OF: NCT 01, a fragmentary centrum of a posterior cervical, probably the seventh.

LOCALITY: "Tiga Island, ossements au fond d'une cavité, a remplissage de sables phosphatés" (label). A small island in the Loyalty group, New Caledonia, 21°8'S latitude, 167°49'E longitude.

HORIZON: Phosphates of unknown age, presumed to be Pleistocene, deposited in

karstified calcarenites. Similar calcarinites in the Loyalty group have been dated at 100,000–120,000 years BP (Bernat, Launay, and Recy, 1976).

#### GEOLOGIC OCCURRENCE

The New Caledonian meiolaniids from all three localities occur in guano-rich sediment deposited in karst. At the first locality, Walpole Island, phosphates were mined in the early part of the twentieth century and the meager geologic information available is in Andrews (1922) and Anderson (1925). They are presumed to be Pleistocene but there have been no dating reports. The second locality, Tiga Island, consists only of uplifted reef with phosphatic infillings in the karst. The uplifted reef has been dated at 100,000–120,000 BP (Bernat et al., 1976), giving a maximum age for the deposit. A large cave and numerous smaller cavities are present on Tiga Island but the exact source of the cervical described here, discovered during a mining survey in 1959, is not known.

The third locality, Pindai Caves, is on the Nepoui Peninsula of the main island and was discovered in 1983 by the junior author. Five caves are developed in lower Miocene limestones (Lillie and Brothers, 1970), and are situated about 400 m from Pindai beach at an elevation of about 30 m. Two of the caves have yielded bones, mainly birds, including *Sylviornis neocaledoniae* (Poplin, 1980; Poplin, Mourer-Chauvire, and Evin, 1983), but also a varanid, a primitive crocodile (Buffetaut, 1983), as well as the meiolaniid cervical. More than 5000 bones were collected in four days in 1983, making the Pindai Caves the richest and most diverse fossil locality in New Caledonia. More than 20 species of vertebrates have been recovered, half of them extinct. Underground lakes filled the caves, one cave still have a one meter deep lake in it. The sediment, about one meter in thickness, appears to have been deposited by water and contains phosphates, magnesium-rich clay, and gypsum.

Charcoal, rat bones, a human rib, and marine shells (*Arca* and *Nautilus*, presumably transported by man) occur in the sediment. Oldest archaeological sites in New Caledonia have been dated at 3000 BP (Frimigacci, 1980). Carbon 14 dating of the charcoal from

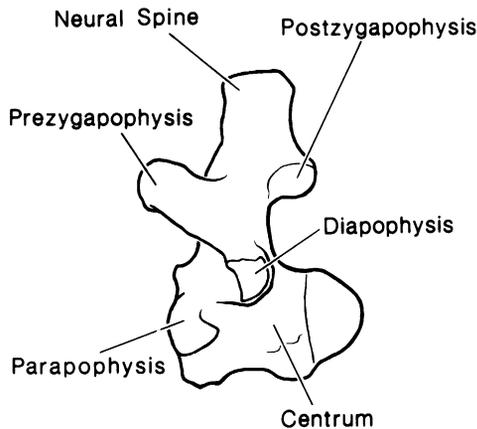


FIG. 1. Lateral view of seventh cervical vertebra of *Meiolania platyceps* labeled to show positions of features discussed in text. Anterior to the left.

the paleontological deposit gives an age of  $1720 \pm 70$  years BP, demonstrating the contemporaneity of man and at least some of the faunal elements. The caves may contain older faunal elements as well, but the association supports the hypothesis of terrestrial vertebrate extinction by man.

### DESCRIPTION

The most complete and best-preserved cervical vertebrae of meiolaniids are those of *Meiolania platyceps* from the Pleistocene of Lord Howe Island. Although a number of disarticulated cervicals are known of this species, most of our knowledge is based on two series of cervicals, AM F:57984 and AM F:49141. Each of these specimens contains nearly complete cervical series; AM F:49141 is preserved in articulation. If the Lord Howe Island material is used as a basis of comparison, certain characteristics of meiolaniid cervicals can be determined. As the New Caledonian specimens consist of posterior cervicals, only features seen in that part of the vertebral column will be discussed.

The posterior cervicals of *Meiolania platyceps* are characterized by a high neural spine, zygapophyses placed above the level of the neural canal, a procoelus central articulation, a well-developed transverse process bearing the diapophysis for the articulation of the cervical rib, and a small parapophysis for the

articulation of the capitulum of the cervical rib. The *Meiolania* cervicals differ from pleurodires in having a much shorter centrum, a lower neural spine, and articulations for a cervical rib. The cervicals of living cryptodires may also be distinguished from *Meiolania* by their possession of a broad centrum, transverse processes small or absent, neural spine low or absent, zygapophyses placed below and separated widely from each other, and the absence of cervical ribs. *Meiolania* posterior cervicals most closely resemble those of baenids but baenids lack cervical ribs and have a narrower centrum. The central articulations, although formed in most baenids, have a greater degree of curvature on the concave and convex surfaces in *Meiolania*.

The cervical vertebrae of *Meiolania platyceps* conform to the common cryptodiran central pattern of opisthocoelous cervicals two and three, biconvex cervical four, and procoelous cervicals five through eight. The neural spines of cervicals five and six are strongly curved posteriorly and can be differentiated from cervical seven which has a straight neural spine. Cervical eight is quite distinctive with fused cervical ribs, an elongate centrum, and closely apposed prezygapophyses. The most complete New Caledonian cervical is the specimen from Pindai Cave and its procoelus centrum and straight neural spine allow identification as a seventh cervical. The Tiga Island specimen, however, lacks everything above the level of the floor of the neural canal and its position cannot be determined with certainty. The size of the parapophyses and general proportions of the Tiga Island cervical are most similar to the seventh cervical of *Meiolania platyceps*, but the centrum fragment could be five or six. Coincidentally, the only two identifiable chelonian cervicals from New Caledonia are both best identified as seventh cervicals.

The Tiga Island centrum fragment agrees in detail with the seventh cervical of AM F:57984 but the more complete Pindai Cave cervical has some differences from both the Tiga Island centrum and the Lord Howe Island specimens (table 1). The centrum articulation surfaces in the Lord Howe and Tiga cervicals are wider than long while the Pindai centrum is equidimensional. A low ventral ridge is present in the Pindai cervical which is absent in the Lord Howe and Tiga speci-

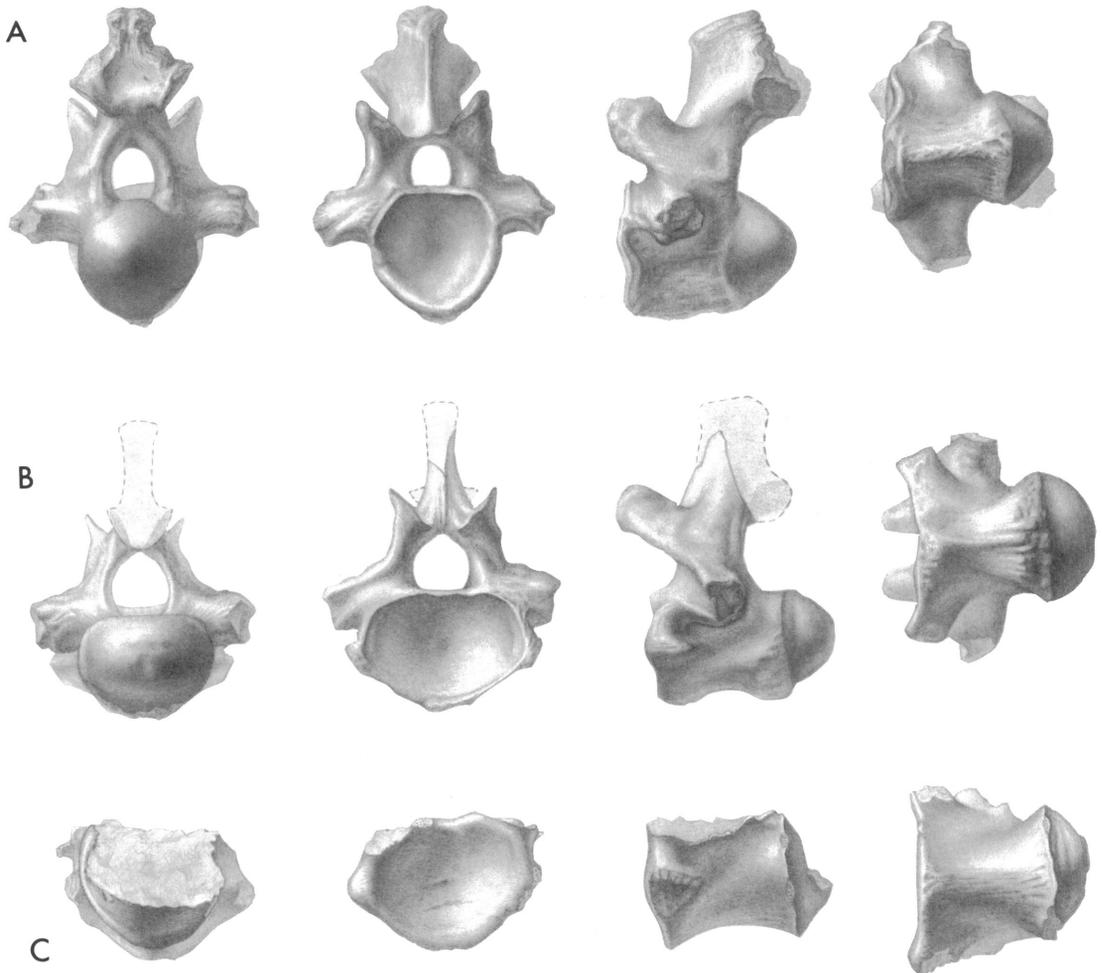


FIG. 2. Posterior cervical vertebrae of meiolaniid turtles. A. Pindai Cave, New Caledonia, NCP 05, probably a seventh cervical. B. Lord Howe Island, Australia, AM F:57984, a seventh cervical. C. Tiga Island, New Caledonia, NCT 01, probably a seventh cervical. Views from left to right are: posterior, anterior, left lateral, ventral (anterior to left). Not to scale, for measurements see table 1.

mens. The most extreme difference among the meiolaniid cervicals involves the ventral rib articulation, the parapophysis. In *Meiolania platyceps* the cervicals bear bicapital ribs and the capitulum, the lower rib head, articulates with a pronounced parapophysis that projects laterally from the anterior portion of the centrum. In *Meiolania platyceps* specimens AM F:57984 and AM F:49141 some parapophyses are separated from the centrum by a suture, indicating that they are intercentra, a conclusion consistent with the parapophyseal elements of other amniotes

(Romer, 1956). In the Pindai cervical the parapophyses are absent, in marked contrast to the Lord Howe species and the Tiga Island centrum. However, the Pindai cervical does have narrow articular facets along the anteroventral margin that appear to be for parapophyseal cartilages or ossifications. There is no indication of a broad sutural contact as in *Meiolania platyceps*. The Tiga Island centrum has well-developed parapophyses, comparable in size to *Meiolania platyceps*.

The significance of the differences between the Pindai cervical and the other meiolaniid

TABLE 1  
Comparison of Posterior Cervicals of Meiolaniids

	<i>Meiolania platyceps</i> (AM F:57984)	Tiga Island meiolaniid (NCT 01)	Pindai Cave meiolaniid (NCP 05)
Areas preserved	complete	centrum	complete
Maximum centrum length	41 mm	35 mm	29 mm
Width at base of transverse process	32 mm	25 mm	19 mm
Central articulations	wider than high	wider than high	equidimensional
Ventral ridge	absent	absent	present
Parapophysis	well developed	well developed	absent
Cervical	seventh	probably seventh, but possibly fifth or sixth	probably seventh

cervicals is difficult to judge without more material. The collections of *Meiolania platyceps* from Lord Howe Island demonstrate the high degree of individual variation present in that species. The Tiga Island centrum shows no differences from the Lord Howe specimens but the Pindai cervical, although clearly a meiolaniid, could very well be a distinct taxon. In view of the variability shown by the Lord Howe *Meiolania* collection, such a conclusion would be premature, however.

Similarly, identifying either the Pindai or Tiga Island cervicals as *Meiolania mackayi*, a meiolaniid described from Walpole Island, is also impossible at present. *Meiolania mackayi* was described in 1925 by Anderson on the basis of fragments excavated during phosphate mining on Walpole Island. Unfortunately, *Meiolania mackayi* consists only of a series of horn cores and appendicular elements, with no vertebrae to compare with the cervicals described here. There is a nearly complete humerus from Tiga and a partial humerus from Walpole Island that can be compared. They are quite similar to each other and to the humerus of *Meiolania platyceps*, differing primarily in size. Nonetheless, the humeri of meiolaniids are generalized cryptodiran humeri and do not have diagnostic features allowing precise identification. From Tiga Island there are also disarticulated elements of dubious identity. Two fragments, the proximal portion of a coracoid and the medial section of a long bone (?femur) are consistent with other meiolaniid specimens. There are also phalanges and caudal fragments that appear to be chelonian but also lack diagnostic features.

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