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THE UNIVERSITY OF MICHIGAN

VOL. 31, NO. 14, PP. 379-385 December 20, 2007

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A NEW ADAPOID PRIMATE FROM THE EARLY EOCENE OF INDIA

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KENNETH D. ROSE[1], RAJENDRA S. RANA[2], ASHOK SAHNI[3], and THIERRY SMITH[4]

Abstract—A new genus and species of primitive adapoid primate, *Asiadapis cambayensis*, is described based on a dentary from the lower Eocene Cambay Shale exposed in the Vastan lignite mine in Gujarat, western India. *Asiadapis* is most similar to European cercamoniine notharctids and to *Marcgodinotius*, another primitive cercamoniine from Vastan mine. *Asiadapis* and *Marcgodinotius* may belong to a primitive clade of notharctids that reached India around the beginning of the Eocene.

INTRODUCTION

Recent explorations of early Eocene lignites in western India have led to discovery of the oldest local fauna of terrestrial mammals from India, at Vastan Mine in Gujarat (Bajpai et al., 2005a,b, 2006; Rana et al., 2005, in press; Rose et al., 2006; Smith et al., 2007). Vastan is an open-cast lignite mine located about 300 km northeast of Mumbai and 30 km northeast of Surat, near the Gulf of Cambay. The mine is developed in exposures of lower Eocene Cambay Shale, on the western margin of the Deccan Traps. The assemblage includes at least 20 species of mammals in at least eight orders, as well as a diverse ichthyofauna (mainly estuarine; Rana et al., 2004), frogs, lizards, and snakes (Rose et al., 2006; Rage et al., in press), and the oldest avian fossils from India (Mayr et al., 2007). An early Eocene age c. 53 Ma (early Ypresian, early Cuisian) is supported by the presence of the foraminiferan *Nummulites burdigalensis*, an index fossil of Shallow Benthic Zone 10 (Schaub, 1981), in strata about 14 m above the occurrence of the terrestrial mammals (Fig. 1; Sahni et al., 2006).

The Vastan mammalian fauna includes the first early Eocene primates known from India (Bajpai et al., 2005b; Rana et al., 2005). Bajpai et al. (2005b) named two new genera and species of euprimates; however, because of the very fragmentary nature of the fossils, they were unable to allocate the new taxa very precisely. Thus *Marcgodinotius indicus* was assigned to Adapiformes incertae sedis and *Vastanomys gracilis* was assigned to ?Omomyidae. As will be shown elsewhere based on new material, *Marcgodinotius* is a very primitive notharctid adapoid closely related to European cercamoniines. Here we describe a second cercamoniine notharctid from Vastan Mine. Additional teeth probably referable to this new taxon will be described elsewhere. The holotype and

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referred specimens are catalogued in the Department of Geology at H.N.B. Garhwal University, Uttaranchal, India, and carry the prefix GU/RSR/VAS (Garhwal University/R.S. Rana/Vastan). Dental terminology follows Szalay (1969) and Van Valen (1966).

SYSTEMATIC PALEONTOLOGY

Class MAMMALIA Linnaeus, 1758
Order PRIMATES Linnaeus, 1758
Suborder EUPRIMATES Hoffstetter, 1978
Infraorder STREPSIRRHINI É. Geoffroy Saint-Hilaire, 1812
Superfamily ADAPOIDEA Trouessart, 1879
Family NOTHARCTIDAE Trouessart, 1879
Subfamily CERCAMONIINAE Gingerich, 1975

Asiadapis cambayensis, new genus and species
(Figs. 2,3)

Holotype.—GU/RSR/VAS-6, right dentary with P_3-M_2 and alveoli for C, P_2, M_3.

Locality and Horizon.—Vastan Lignite Mine (just above lower lignite: Lignite 2), about 30 km northeast of Surat, Gujarat, India; early Eocene (Ypresian equivalent), Cambay Shale.

Diagnosis.—Approximately 25-30% larger (linear dimensions) than *Marcgodinotius indicus*, 50-60% larger than *Panobius afridi*, and 20% larger than *Donrussellia provincialis*. Lower dental formula 2?-1-3-3. P_1 absent and P_2 single-rooted, unlike *Marcgodinotius*. P_3 same size as P_4 and slightly taller. P_{3-4} with distinct hypoconid and small talonid basin. Differs from most other cercamoniines (*Donrussellia*, *Protoadapis*, *Agerinia*, *Europolemur*, but not *Anchomomys* and *Periconodon*) in lacking a metaconid on P_4. Molars not basally inflated; molar cusps peripherally situated. M_1 with buccally shifted paraconid, in contrast to *Panobius*; M_1 further differs from that of *Panobius* in having weaker ectocingulid and relatively longer and narrower talonid basin. M_2 trigonid anteroposteriorly shorter than in *Marcgodinotius*, paraconid indistinct and paracristid arcuate and continuous from protoconid to metaconid; M_2 postvallid almost transverse, not oblique. Cristid obliqua of M_{1-2} meets trigonid buccally. Hypoconulid closer to hypoconid than to entoconid on M_{1-2}, but hypoconulid and entoconid barely distinct from postcristid of M_2.

Etymology.—The genus name refers to the Asian occurrence of the new taxon and its relationship to adapoids. The species name refers to its specific derivation from the Cambay Shale.

DESCRIPTION

The holotype dentary is moderately shallow, with two mental foramina, below the anterior part of P2 and the posterior root of P3. The jaw is broken through the large canine alveolus. Behind it is a single alveolus for P2, about the same diameter as that housing the anterior root of P3. The antemolar teeth are not mesiodistally compressed. P3 and P4 each have a well-developed lingual cingulid which is complete or nearly so; the ectocingulid is much weaker and less continuous on both teeth. Both are dominated by a tall protoconid. Neither premolar has a distinct paraconid or metaconid, in contrast to many other notharctids, although a faint hint of a paraconid can be seen on P_4. A small hypoconid is present on both P_3 and P_4 and is more distinct on the latter. A crest runs lingually from the hypoconid to join the lingual cingulid, enclosing a small talonid basin, which is somewhat larger on P_4. On P_4 a distinct crest descends from the protoconid, curving medially toward the lingual cingulid, and a shorter crest runs from the hypoconid halfway up the back of the protoconid. These crests bound the talonid basin anteriorly.

The molars are relatively primitive in lacking basal inflation, so that the cusps are on the periphery of the crown. The trigonid of M_1 is as long as it is wide, with the paraconid situated at the most anterior margin of the tooth just lingual to a line drawn midway between the protoco-

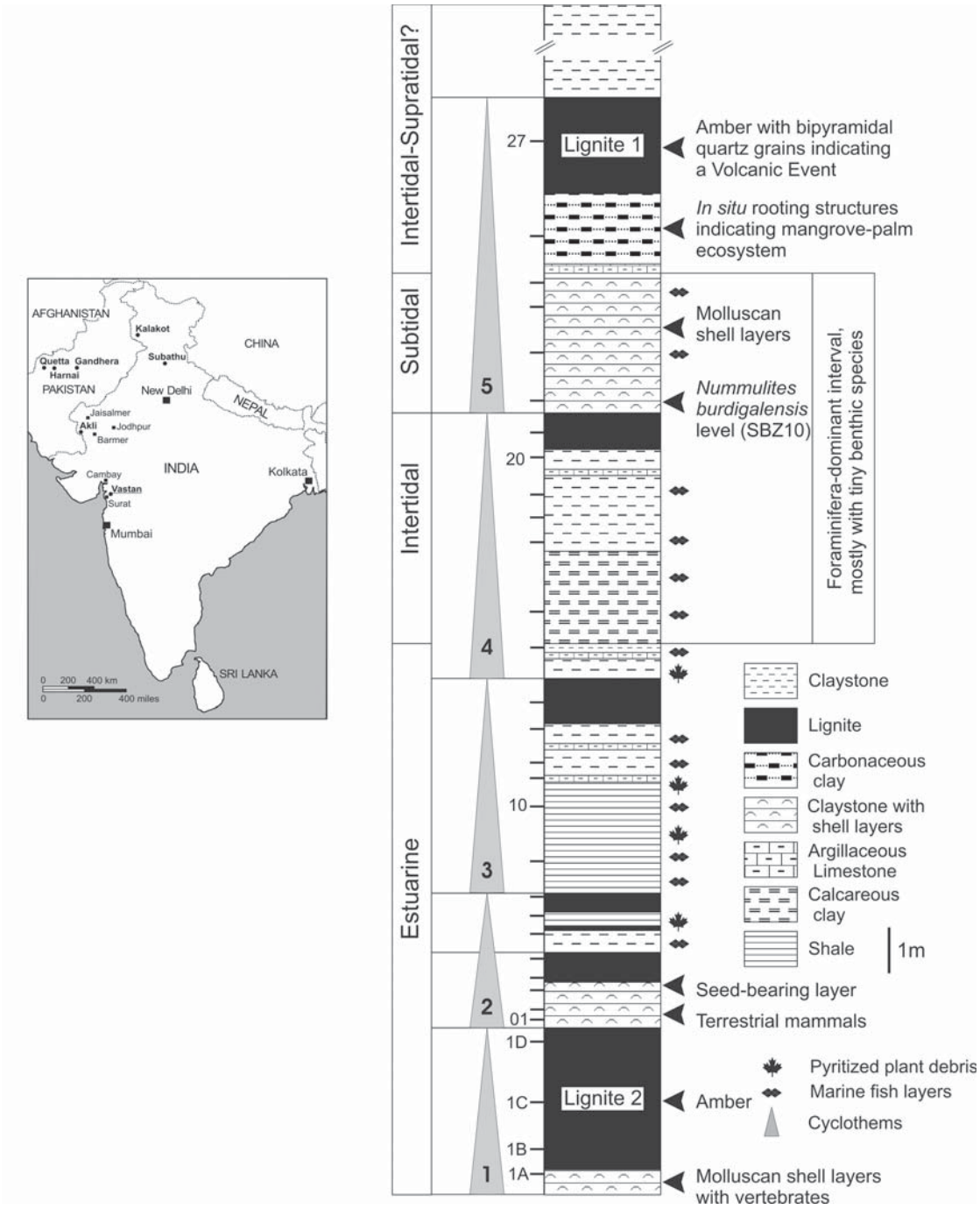

FIG. 1 — Location map and stratigraphic section through part of the Vastan Mine, showing position of the terrestrial mammal-producing layer that yielded *Asiadapis*, just above Lignite 2. Note the occurrence of the early Cuisian index fossil *Nummulites burdigalensis burdigalensis* about 14 m above the mammal-bearing horizon. (Map from Rose et al., 2006; section from Sahni et al., 2006.)

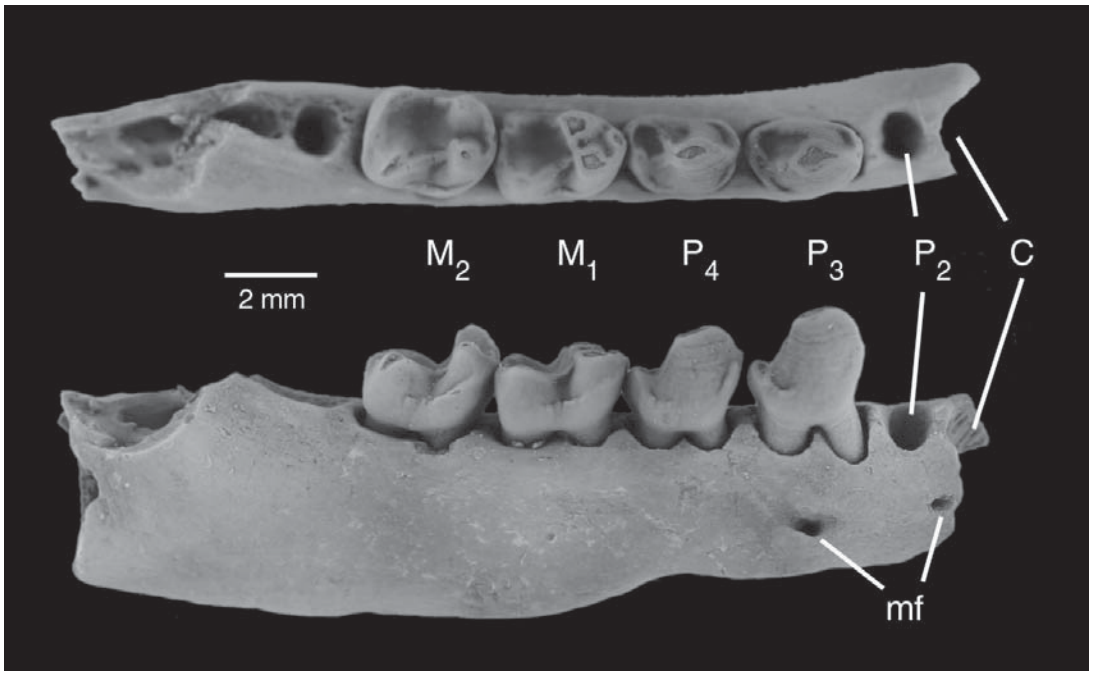

FIG. 2 — Holotype of *Asiadapis cambayensis*, new genus and species, GU/RSR/VAS-6, showing postcanine dental formula (coated with ammonium chloride).

nid and metaconid. The paraconid is much smaller than the other two trigonid cusps. The M_1 protocristid is obliquely oriented with almost no evidence of a trigonid notch, although the apparent lack of a notch may be an artifact of moderately heavy trigonid wear. Nevertheless, the protocristid separates the trigonid basin from the talonid basin. The cristid obliqua is buccally situated, joining the back of the trigonid at the base of the protoconid, rather than extending to the metaconid as in many other primitive primates. Consequently, the posterior trigonid wall (postvallid) is smooth and wear surfaces 1 and 5 (e.g., Crompton, 1971; Kay and Hiiemae, 1974) are in the same plane, not offset ("stepped") as is characteristic of M_1 of *Donrussellia*, *Cantius*, and many other early primates. The hypoconid of M_1 is the tallest talonid cusp. The entoconid is distinct and is situated on the lingual margin of the crown, slightly posterior to the hypoconid and anterior to the hypoconulid. The hypoconulid is shifted buccally on both M_1 and M_2. The talonid basin is moderately broad and deep and is not foreshortened. The buccal cingulid is most distinct in the hypoflexid, extending weakly onto the trigonid but inconspicuous on the talonid.

M_2 is slightly larger (mainly wider) than M_1. Its trigonid is very short; the paraconid is indistinct, and the paracristid is arcuate and extends from the protoconid to the metaconid without interruption. The protoconid and metaconid are separated by a deep longitudinal valley that is continuous with the the trigonid notch. The notch is so deep that the valley opens directly into the talonid basin. The postvallid is almost transversely oriented, in contrast to the more oblique postvallid of most other adapoids. The cristid obliqua meets the postvallid slightly more buccally than on M_1. The talonid basin is similar to that on M_1 except for being slightly broader and having less distinct entoconid and hypoconulid cusps.

Measurements (mm) of the holotype are: P_3 length = 2.60, P_3 width = 1.70; P_4 length = 2.60, P_4 width = 1.70; M_1 length = 2.85, M_1 trigonid width = 1.80; M_1 talonid width = 2.00; M_2 length = 2.90, M_2 trigonid width = 2.15; M_2 talonid width = 2.15; dentary depth (buccally below the center of M_1) = 4.30.

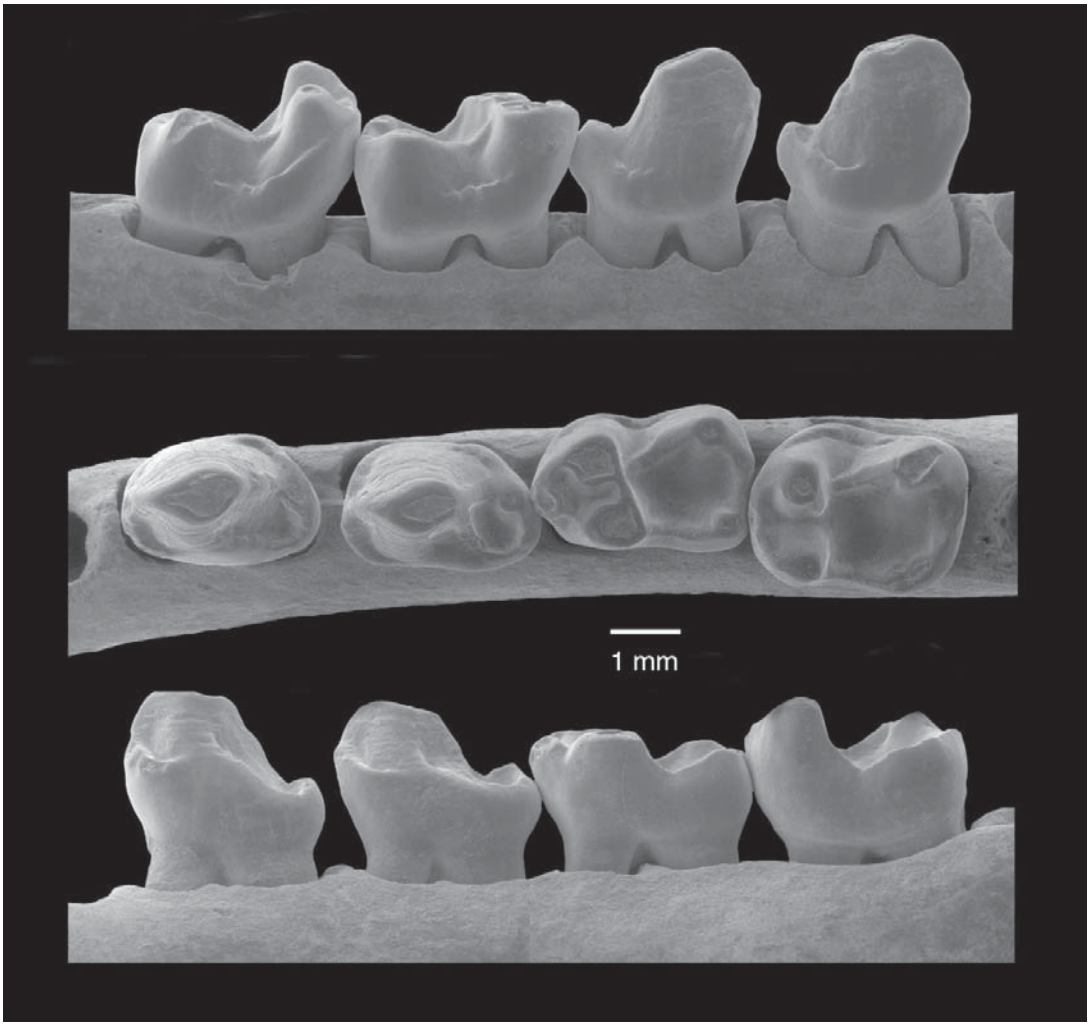

FIG. 3 — Holotype of *Asiadapis cambayensis*, new genus and species, GU/RSR/VAS-6 (SEM images). Top to bottom: lateral, occlusal, and lingual views of P_3-M_2.

DISCUSSION

Asiadapis cambayensis is a small, relatively primitive adapoid, slightly larger than *Donrussellia* and *Marcgodinotius* and substantially larger than *Panobius*, smaller than *Protoadapis, Agerinia*, and *Cantius*, and about the size of *Buxella prisca*. Despite the loss of P_1 and the presence of a single-rooted P2, the unreduced and uncompressed P3-4 together with the molar structure confirm its adapoid affinities. The trigonid structure more closely resembles that of notharctids than that of adapids. Among notharctids, the closest comparisons appear to be to European Cercamoniinae (see Godinot, 1998) such as *Donrussellia, Protoadapis, Buxella*, and *Agerinia*, and to Asian *Marcgodinotius. Asiadapis* differs from the European genera (except perhaps *Buxella*, whose P4 is unknown), however, in having very simple premolars lacking both paraconid and metaconid. This could be a derived condition (loss of paraconid and metaconid) or might be plesiomorphic (in which case it would be even more primitive than *Donrussellia*, the most primitive adapoid, which retains a metaconid on P4). Judging from the unreduced P3-4, it is tempting to interpret the absence

of conids on the premolars as a primitive state, but certain features of the molars (buccal cristid obliqua, and the arcuate paracristid and transverse postvallid of M2), in which it differs from most other notharctids, are more likely derived. *Asiadapis* shares two of these traits (transverse postvallid and buccal cristid oblique) with the sympatric *Marcgodinotius*, also present in the Vastan local fauna, and additional material of the latter (to be described elsewhere) provides evidence of a close relationship between these two genera. The probable derived features superimposed on otherwise very primitive dentitions suggest that *Asiadapis* and *Marcgodinotius* represent a primitive clade of notharctids that reached India much earlier, close to the Paleocene-Eocene boundary.

ACKNOWLEDGMENTS

We thank the other members of our research team, who have been involved with the field work at Vastan and other aspects of the research on the fauna: Annelise Folie, Kishor Kumar, Gina McKusick, Pieter Missiaen, Pratul Saraswati, Hukam Singh, and Lachham Singh. We also thank Mr. Amarnath (Manager), S. Sharma and H. Sukla (geologists), Mr. B.S. Chaudhary (Mine Manager), and other personnel of Gujarat Industrial Power Corporation Ltd. for facilitating our excavations at Vastan Mine. We are grateful to Philip Gingerich, Marc Godinot, and Gregg Gunnell for access to comparative specimens and casts, and to Gregg Gunnell for constructive comments on the manuscript. Valerie Burke DeLeon assisted with the figures. Support for the field work and research from the National Geographic Society (grants 6868-00 and 7938-05 to KDR and AS), the Department of Science and Technology, Government of India (ESS/23/Ves092/2000 to RSR), Council for Scientific and Industrial Research of India (ES grant 560, 21/EMR-II to AS), and the Belgian Federal Science Policy Office (MO/36/011 to TS) is gratefully acknowledged.

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