

Basalina, a Tillodont from the Eocene of Pakistan

By SPENCER G. LUCAS & ROBERT M. SCHOCH^{*)}

With Plate 15

Abstract

Basalina basalensis DEHM and OETTINGEN-SPIELBERG, 1958 from the middle Eocene of Ganda Kas, Pakistan originally was assigned to the Taeniodonta but here is reassigned to the Tillodontia. *Basalina* is a distinct genus of tillodonts diagnosable by its small size, rooted I₂, loss of I₃, relatively large C₁, rudimentary P₁, single-rooted P₂, molariform P₄ and mandibular symphysis extending beneath P₄. The reassignment of *Basalina* extends the geographic range of the tillodonts into the subcontinent and supports previous suggestions of Asian affinities of the Eocene land mammals of India and Pakistan.

Kurzfassung

Basalina basalensis DEHM & OETTINGEN-SPIELBERG, 1958 aus dem Mitteleozän des Ganda Kas, Pakistan, war zuerst zu den Taeniodonta gestellt, wird jedoch hier zu den Tillodontia gerechnet. *Basalina* ist eine Gattung, die durch kleines Format, bewurzelten I₂, fehlenden I₃, relativ großen C₁, rudimentären P₁, einwurzeligen P₂, molariformen P₄ und dadurch gekennzeichnet ist, daß die Symphyse unter den P₄ sich erstreckt. Die neue Zuweisung der Gattung *Basalina* dehnt die geografische Verbreitung der Tillodontia auf den Subkontinent aus, und bekräftigt die früher vertretene Ansicht über eine Verwandtschaft zwischen den eozänen Landtieren Asiens und Indien-Pakistans.

Introduction

Basalina basalensis was one of the most enigmatic forms described by DEHM and OETTINGEN-SPIELBERG (1958) in their classic monograph on the Eocene mammals from the Ganda Kas region, Pakistan. Known from a badly damaged and nearly edentulous left dentary fragment, *Basalina* was assigned to the *Taeniodonta* (DEHM & OETTINGEN-SPIELBERG, 1958, p. 7-10). Another edentulous left dentary fragment similar to the type speci-

^{*)} SPENCER G. LUCAS & ROBERT M. SCHOCH, Peabody Museum of Natural History, Yale University, New Haven, Connecticut 06511 U.S.A.

men of *Basalina* was identified by DEHM & OETTINGEN-SPIELBERG (1958, p. 10) as "Taeniodontum gen. et. spec. indet."

Since its original description, *Basalina* has infrequently been mentioned in the literature. ROMER (1966, p. 381) listed it as a taeniodont, but PATTERSON (in BUTLER et al., 1967) did not. SAHNI & KHARE (1973, p. 48), FLEROV et al. (1974, p. 94, fig. 33) and GINGERICH (1977, p. 192) also considered *Basalina* a taeniodont though later GINGERICH et al. (1979, p. 119) listed it as "Tillodontia(?)." GINGERICH & GUNNELL (1979, p. 150) recently stated that the morphology of *Basalina* "more closely resembles that of tillodonts [than taeniodonts]" and "on biogeographical evidence *Basalina* is also more likely to represent a tillodont than a taeniodont." Most recently WEST (1980, p. 510) listed *Basalina* as a tillodont.

Although it is evident that most recent authors consider *Basalina* to be a tillodont, no one has yet attempted to demonstrate this by restudying the type specimen in the light of new information on taeniodonts, tillodonts and other early Tertiary mammals that has appeared since DEHM & OETTINGEN-SPIELBERG (1958). We here reopen the discussion of the ordinal affinities of *Basalina*, redefine the genus as a tillodont and briefly discuss its implications for the Paleogene biogeography of the subcontinent.

Systematic Paleontology

Order Tillodontia MARSH, 1875

Family Esthonychidae COPE, 1883

Genus *Basalina* DEHM & OETTINGEN-SPIELBERG, 1958

Type species: *Basalina basalensis* DEHM & OETTINGEN-SPIELBERG, 1958, the only known species.

Distribution: Ganda Kas (DEHM & OETTINGEN-SPIELBERG, 1958) and Chorlakkī (WEST, 1980) localities, middle Eocene of Pakistan.

Revised diagnosis: Small tillodonts with rooted I₂, I₃ absent, relatively large C₁, rudimentary P₁, single-rooted P₂, molariform P₄ and mandibular symphysis extending under the P₄ trigonid.

Basalina basalensis DEHM & OETTINGEN-SPIELBERG, 1958

Holotype: Bayerische Staatssammlung für Paläontologie und historische Geologie München, Nr. 1956 II 2, a left dentary fragment with I₂ alveolus, C₁ root, P₁ alveolus, roots of P₂₋₃, partial P₄ and anterior roots of M₁ (Pl. 15).

Horizon and locality of the type: Fundstelle 20 (DEHM & OETTINGEN-SPIELBERG, 1958) near Ganda Kas, north of Basal, western Punjab, Pakistan in the lower part of the Kuldana Formation of middle Eocene age (WEST & LUKACS 1979, p. 13).

Referred specimens: WEST (1980) listed undescribed material from Chorlakkī, Pakistan as *B. basalensis*. The edentulous jaw fragment identified by DEHM and OETTINGEN-SPIELBERG (1958) as "Taeniodontum gen. et spec. indet." here is identified as cf. *B. basalensis* (see later discussion).

Diagnosis: Same as for the genus.

Description: DEHM and OETTINGEN-SPIELBERG (1958, p. 8–10) provided a detailed description and measurements of the type specimen of *B. basalensis*. They also illustrated the specimen (DEHM & OETTINGEN-SPIELBERG, 1958, fig. 1; Pl. 2, fig. 1, a–e) and we illustrate it here (Pl. 15). There is little to add to DEHM and OETTINGEN-SPIELBERG's description except to note that our interpretation of the tooth formula of *B.* differs from theirs.

Discussion: DEHM and OETTINGEN-SPIELBERG (1958) identified the large, rooted anteriormost tooth preserved in the type specimen as the C_1 ; the alveolus anterior to it was identified as that of I_3 . The incomplete, but only preserved tooth near the posterior end of the jaw was deemed M_1 . Four single-rooted premolars intervened between the C_1 and M_1 , the first premolar only represented by a shallow alveolus. Behind M_1 were the roots of a larger M_2 .

Considering *Basalina* to be a tillodont, we suggest that the large anteriormost alveolus of the type specimen is that of I_2 , similar to I_2 in *Esthonyx* (GINGERICH & GUNNELL, 1979). In all tillodonts I_2 is enlarged and I_3 is greatly reduced or lost (GAZIN, 1953, p. 67). I_3 appears to have been lost in *Basalina*. The I_2 of *Basalina* is followed by a large C_1 , as in *Esthonyx* (GINGERICH & GUNNELL, 1979, Pl. 1, fig. 4). The small, shallow alveolus behind C_1 could either be for a rudimentary P_1 , or a double-rooted P_2 as in some specimens of *Esthonyx* (GINGERICH & GUNNELL, 1979, p. 132). In the type specimen of *Basalina*, the alveolus directly behind the C_1 is much smaller and shallower than the succeeding alveolus, and therefore we consider these alveoli to pertain to different teeth. Thus, the alveolus immediately following C_1 is for P_1 . It is followed by a single, obliquely-oriented alveolus for P_2 ; the P_2 often is single-rooted and obliquely oriented in tillodonts (GAZIN, 1953, p. 67; GINGERICH & GUNNELL, 1979, text-fig. 2). P_3 is double-rooted in all tillodonts and we consider the next two alveoli to be those of P_3 . That these two roots pertain to one tooth is suggested by the jaw fragment which is broken around them to form a depression, suggesting the breaking off of one piece. These two roots are broken off at different heights and the anterior root clearly is pitched forward whereas the posterior root is vertical, as in *Esthonyx* (GINGERICH & GUNNELL, 1979, text-fig. 2). The only partially preserved tooth in the type specimen of *Basalina* thus is a molariform, two-rooted P_4 as in all tillodonts (GAZIN, 1953). It is followed by an M_1 which, from the partial roots preserved, is slightly wider than P_4 , as in other tillodonts (GAZIN, 1953).

Our interpretation of the tooth formula of *Basalina* also is consistent with the deepening of its mandibular symphysis to under P_4 , a condition intermediate between that of *Esthonyx* and *Trogosus* (GAZIN, 1953). In addition, the mental foramina on the type specimen of *Basalina* are scattered under P_{2-4} according to our interpretation; this is the same position as in other tillodonts (GAZIN, 1953).

Accepting our interpretation of the tooth formula of *Basalina*, it resembles tillodonts in the following characters: deepening of the mandibular symphysis, under P_4 in *Basalina* (Pl. 15, fig. 4), intermediate between *Esthonyx* (usually under P_3 ; GAZIN, 1953, p. 61) and *Trogosus* (under M_1 ; GAZIN, 1953, p. 61); possession of four mental foramina scattered between P_{2-4} (cf. GAZIN, 1953, p. 62); reduction of the number of roots of the anterior premolars, P_{1-2} ; possession of a molariform, bunoselenodont P_4 ; and possession of a large tooth anterior to the canine, typically I_2 in tillodonts and so interpreted here for *Basalina*. The reduction of the anterior premolars (i. e., either their loss or reduction of the number of roots) is a synapomorphy of the Tillodontia separating them from the

closely related pantodonts (cf. GAZIN, 1953; CHOW & WANG, 1979) in which there typically are four, double-rooted lower premolars.

Basalina can be excluded from the Taeniodonta for the following reasons: 1. The lower cheek teeth of all taeniodonts are hypsodont, with enamel extending much further down the labial aspects of the teeth than the lingual aspects (PATTERSON, 1949). The enamel on the only preserved cheek tooth of *Basalina* is only slightly higher on the labial aspect than the lingual (Pl. 15, figs. 3, 4), as in *Esthonyx* (GINGERICH & GUNNELL, 1979). 2. The molariform cheek teeth of conoryctine taeniodonts (cf. WORTMAN, 1897; MATTHEW, 1937) possess trigonids with three distinct cusps (although in some forms the paracoid is much reduced) and talonids bearing subequal hypoconids, entoconids and hypococonulids. The trigonids and talonids are subcircular, of subequal height and no trace of a selenoid crest is present, as in *Basalina*. In the stylinodontine taeniodonts, to which *Basalina* originally was referred, the cheek teeth are either conoryctine-like in primitive forms, or are bilophodont in derived forms with the trigonids and talonids anteroposteriorly compressed and transversely broadened (PATTERSON, 1949). The cheek tooth preserved in the type specimen of *Basalina* thus bears little resemblance to the cheek teeth of any taeniodont.

cf. *Basalina basalensis*: The specimen referred by DEHM and OETTINGEN-SPIELBERG (1958) to "Taeniodontum gen. et. spec. indet." resembles the type specimen of *Basalina* in size and all discernible morphological details. It appears to be a left dentary fragment (Pl. 15, fig. 5-6) bearing the root of P₂, the two alveoli for P₃ and part of the anterior root of P₄. Two foramina are present below the posterior alveolus of P₃ and the leading edge of P₄. Although we are reasonably confident the specimen pertains to *Basalina* it is so incomplete that we only identify it as cf. *B. basalensis*.

Paleobiogeographical Implications

SAHNI and KUMAR (1974) recently reviewed the Paleogene biogeography of the Indo-Pakistani subcontinent. They concluded (p. 223-224) that "migration of large terrestrial mammals from Central Asia to the Indian subcontinent was only possible at the beginning of the middle Eocene when the Indian Plate abutted against the Sino-Siberian Platform establishing a stable land route for dispersal." They qualified this conclusion by stating (p. 221) that the smaller mammals "may have crossed over from the Asiatic landmass in a sweepstake fashion by island hopping across the Tethys in advance of the larger mammals, by the late lower Eocene." The affinities of most of the Eocene land mammals of the subcontinent are with Asian forms (e. g., DEHM & OETTINGEN-SPIELBERG, 1958; SAHNI & KHARE, 1973; WEST, 1980), clearly supporting their conclusions.

The affinities of the marine and shoreline mammals (cetaceans, sirenians, moeritheres) of the Indo-Pakistani Eocene, as WEST (1980) has pointed out, are with those of the late Eocene-early Oligocene faunas of the Fayum, Egypt in the Tethyan region. WEST (1980, p. 531) thus suggested that "perhaps, during its northward drift, the South Asian subcontinent passed near enough to the eastern coast of Africa for a quasi-continental connection to have existed". WEST (1980, p. 531) justified this conclusion by claiming that "the moeritheres, if they were terrestrial or amphibious, required continental connections for the African-South Asian distribution". We believe, however, that the moeritheres, generally

agreed to have been amphibious (COPPENS & BEDEN, 1978), may readily have swam across shallow marine barriers much as hippos evidently swam to Madagascar. We thus see little evidence to support WEST's suggestion. The fact that few land mammals other than moeritheres are shared between the Fayum and Eocene faunas of Indo-Pakistan suggests that no land connection existed between these areas prior to the middle Eocene.

Assignment of *Basalina* to the Tillodontia establishes the presence of this order in the subcontinent. Tillodonts are otherwise known from the latest Paleocene-middle Eocene of North America (GAZIN, 1953; GINGERICH & GUNNELL, 1979), Paleocene and Eocene of China (e. g., CHOW, 1963; WANG, 1975; ZHOU et. al., 1977) and early (?) Eocene of Europe (TEILHARD DE CHARDIN, 1922; GINGERICH & GUNNELL, 1979); they are thus one of the most widely distributed orders of early Tertiary mammals. The three teeth of *Esthonyx* from Europe are of a form larger than *Basalina* (GINGERICH & GUNNELL, 1979). They might be used as slight evidence of European affinities of *Basalina* were it not for the fact that western Europe during the early Eocene and Paleocene was evidently separated from Asia by the north-south Turgai Straits, a barrier probably impervious to land mammal migration between the two continents (MCKENNA, 1975).

It is more likely that *Basalina*'s closest relatives lie among the Chinese tillodont genera *Lofochaius*, *Adapidium* and *Meiostylodon* (*Kuanchanius* is a derived form close to *Trogosus*). However, our incomplete knowledge of *Basalina* and these Chinese forms (the lower dentitions of *Lofochaius* and *Meiostylodon*, for example, are virtually unknown) render assessment of close relationships speculative at best. *Lofochaius* is so primitive a tillodont that it would be easy to imagine it as the ancestor of all other tillodonts, including *Basalina*.

The fact that neither *Basalina* nor a tillodont very similar to *Basalina* in its degree of anterior dental reduction and molarization of P_4 is known from Asia might be construed as evidence that *Basalina* reflects in situ evolution in the subcontinent of a more primitive tillodont that migrated there before the middle Eocene. This would support SAHNI and KUMAR's notion, cited earlier, that small mammals, like *Basalina* or its ancestor, may have reached the subcontinent before the middle Eocene. Such a conclusion, however, is based primarily on negative evidence and cannot be strongly defended. That no tillodonts are yet known from the Fayum or the rest of the Tethyan region is also negative evidence, but fits in well with the argument that the closest affinities of *Basalina* and the other land mammals of the Indo-Pakistani Eocene are with Asian land mammals.

Acknowledgments

The senior author thanks Drs. RICHARD DEHM, KURT HEISSIG and PETER WELLNHOFER for their help during his visit to Munich and for allowing him to study the specimens of *Basalina* and cf. *Basalina*. RUTH YANAI provided artistic assistance in the preparation of the plate. This research was in part supported by NSF Grant DEB-7919681 to the senior author and an NSF Fellowship to the junior author.

References

- BUTLER, P. M. et al. (1967): Mammalia. – In, The fossil record, a symposium with documentation, Geological Society of London: 763–787, 3 figs.; London.
- CHOW, M. (1963): Tillodont materials from Eocene of Shantung and Honan. – Vert. PalAsiatica, 7: 97–104, 2 figs., 1 pl.; Peking.
- CHOW, M. & WANG, B. (1979): Relationships between the pantodonts and tillodonts and classification of the order Pantodonta. – Vert. PalAsiatica, 17: 37–48, 5 figs.; Peking.
- COPPENS, Y. & BEDEN, M. (1978): Moeritherioidea. – In, Evolution of African mammals, eds. MAGLIO, V. J. & COOKE, H. B. S., Harvard Univ. Press: 333–335; Cambridge.
- DEHM, R. & OETTINGEN-SPIELBERG, T. (1958): Paläontologische und geologische Untersuchungen im Tertiär von Pakistan 2. Die mitteleocänen Säugetiere von Ganda Kas bei Basal in Nordwest-Pakistan. – Abh. Bayer. Akad. Wiss., Math.-Nat. Abt., N. F., 91: 54 pp., 9 figs., 3 pls.; Munich.
- FILFROV, K. K. et al. (1974): Zoogeografiya Paleogena Azii. – Trudy Paleontol. Inst. Akad. Nauk SSSR, 146: 300 pp., 163 figs., 3 pls.; Moscow.
- GAZIN, C. L. (1953): The Tillodontia: an early Tertiary order of mammals. – Smithson. Misc. Coll., 121 (10): 110 pp., 38 figs., 16 pls.; Washington.
- GINGERICH, P. D. (1977): A small collection of fossil vertebrates from the middle Eocene Kuldana and Kohat Formations of Punjab (Pakistan). – Contr. Mus. Paleontol., Univ. Michigan, 24: 190–203, 5 figs., 2 pls.; Ann Arbor.
- GINGERICH, P. D. & GUNNELL, G. F. (1979): Systematics and evolution of the genus *Esthonyx* (Mammalia, Tillodontia) in the early Eocene of North America. – Contr. Mus. Paleontol., Univ. Michigan, 25: 125–153, 3 figs., 3 pls.; Ann Arbor.
- GINGERICH, P. D., RUSSELL, D. E., SIGOGNEAU-RUSSELI, D. & HARTENBERGER, J.-L. (1979): *Chorlakkia hassani*, a new middle Eocene dichobunid (Mammalia, Artiodactyla) from the Kuldana Formation of Kohat (Pakistan). – Contr. Mus. Paleontol., Univ. Michigan, 25: 117–124, 2 figs., 1 pl.; Ann Arbor.
- MATTHEW, W. D. (1937): Paleocene faunas of the San Juan Basin, New Mexico. – Trans. Am. Phil. Soc., N. S., 30: 510 pp., 85 figs., 65 pls.; Philadelphia.
- MCKENNA, M. C. (1975): Fossil mammals and early Eocene North Atlantic land continuity. – Ann. Missouri Bot. Gard., 62: 335–353, 2 figs.; St. Louis.
- PATTERSON, B. (1949): Rates of evolution in taeniodonts. – In, Genetics, paleontology and evolution, eds. JEPSEN, G. L., SIMPSON, G. G., MAYR, E., Princeton Univ. Press: 243–278, 7 figs.; Princeton.
- ROMER, A. S. (1966): Vertebrate paleontology. – Univ. Chicago Press: 468 pp., 443 figs.; Chicago.
- SAHNI, A. & KHARE, S. K. (1973): Additional Eocene mammals from the Subathu Formation of Jammu and Kashmir. – J. Paleontol. Soc. India: 31–49, 15 figs., 7 pls.; Lucknow.
- SAHNI, A. & KUMAR, V. (1974): Palaeogene palaeobiogeography of the Indian subcontinent. – Palaeogeog., Palaeoclimat., Palaeoecol., 15: 209–226, 11 figs.; Amsterdam.
- TEILHARD DE CHARDIN, P. (1922): Les mammifères de l'éocène inférieur français et leurs gisements. – Ann. Paléontol., 11: 9–116, 42 figs., 8 pls.; Paris.
- WANG, B. (1975): Paleocene mammals of Chaling Basin, Hunan. – Vert. PalAsiatica, 13: 154–162, 2 figs., 2 pls.; Peking.
- WEST, R. M. (1980): Middle Eocene large mammal assemblage with Tethyan affinities, Ganda Kas region, Pakistan. – J. Paleontol., 54: 508–533, 1 fig., 5 pls.; Lawrence.
- WEST, R. M. & LUKACS, J. R. (1979): Geology and vertebrate fossil localities, Tertiary continental rocks, Kala Chitta Hills, Attock District, Pakistan. – Contrib. Biol. Geol., Milwaukee Publ. Mus., 26: 20 pp., 2 figs.; Milwaukee.
- WORTMAN, J. L. (1897): The Ganodontia and their relationship to the Edentata. – Bull. Am. Mus. Nat. Hist., 9: 59–110. 36 figs.; New York.

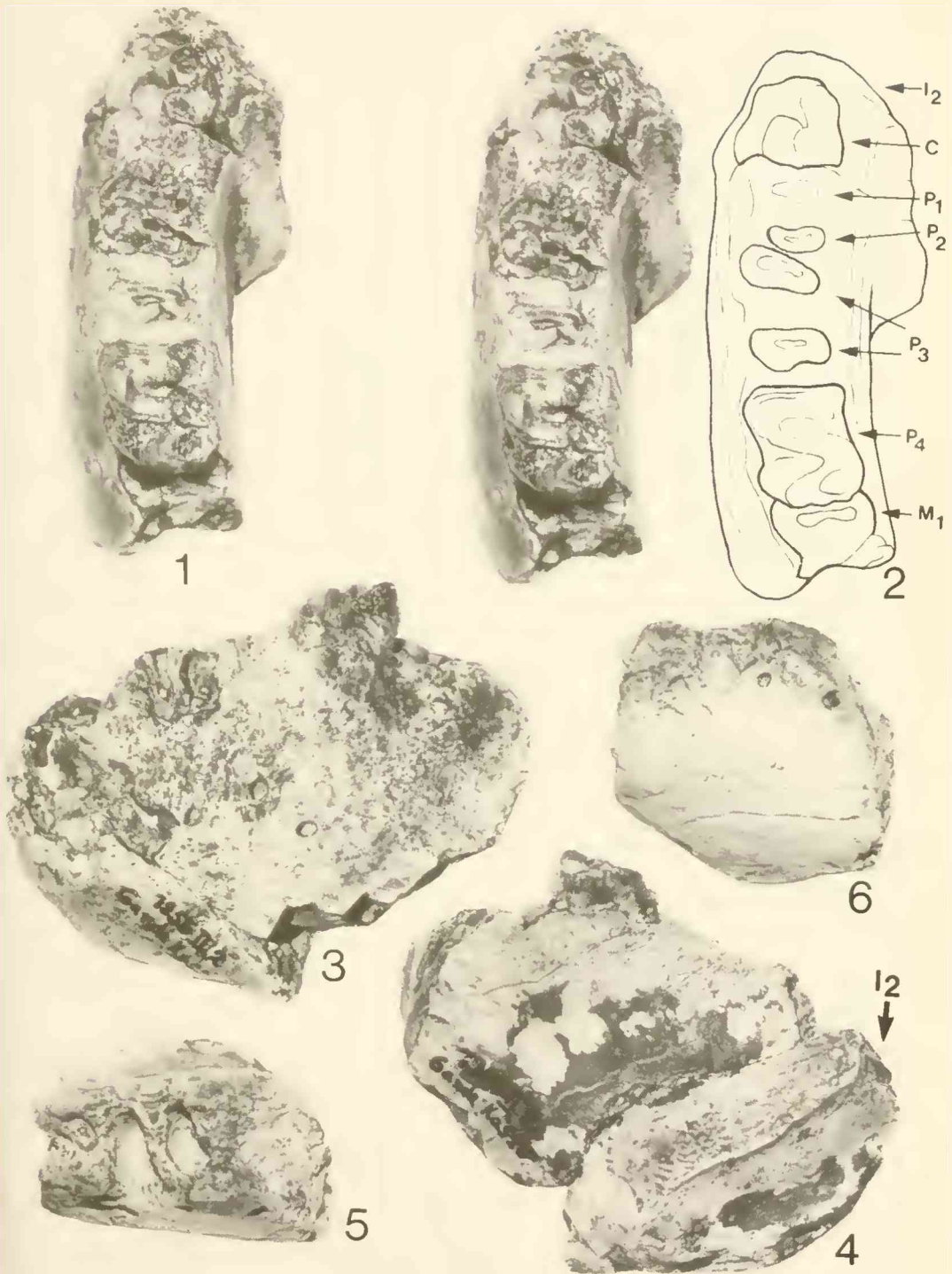
ZHOU, M., ZHANG, Y., WANG, B. & DING, S. (1977): Mammalian fauna from the Paleocene of Nanxiong Basin, Guangdong. – *Palaeontol. Sinica*, 153, N. S. (C), 20: 100 pp., 36 figs., 28 pls.; Peking.

Plate 15

1–4: Holotype of *Basalina basalensis* DEHM and OETTINGEN-SPIELBERG, 1958, a left dentary fragment with I₂ alveolus, C₁ root, P₁ alveolus, P_{2–3} roots, partial P₄ and partial M₁ root; occlusal stereophotograph (1), interpretation of tooth formula (2), labial view (3) and lingual view (4); BSP 1956 II 2.

5–6: cf. *Basalina basalensis*, a left dentary fragment with P₂ root, P₃ alveoli and partial anterior P₄ root, occlusal (5) and labial (6) views; BSP 1956 II 3.

All figures ×2.



ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Histor. Geologie](#)

Jahr/Year: 1981

Band/Volume: [21](#)

Autor(en)/Author(s): Lucas Spencer G., Schoch Robert M.

Artikel/Article: [Basalina, a Tillodont from the Eocene of Pakistan 89-95](#)