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THREE NEW EOCENE MAMMALS FROM RAJAURI DISTRICT, JAMMU AND KASHMIR

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ABSTRACT—Three new mammals, a tapiroid and two primitive bunodont artiodactyls, are described from the Middle to Upper Eocene sequence of Rajauri, Jammu and Kashmir, and are based on upper dentitions. The tapiroid, *Sastrilophus dehmi* gen. et sp.nov., is closely allied to *Indolophus* from the Pondaung Sandstone of Burma. Of the two artiodactyls, *Raoella dograi* gen. et sp.nov., is related to the anthracotheres of Burma, and shares some features in common with *Gobiohyus* from the Upper Eocene of Mongolia. The other artiodactyl *Kunmunella rajauriensis*, gen. et sp. nov., represented by a solitary M^3 is assigned to the Dichobunidae.

The general character of the faunal assemblage is similar to the mammalian fauna described from the Middle Eocene Chharat Series of Northern Pakistan, and the Upper Eocene Pondaung Sandstone of Burma. This would suggest that the mammal-bearing horizon under study, which conformably overlies the mostly marine Subathu shales and limestones of Lower Eocene age, represents a horizon between the Middle and Upper Eocene.

INTRODUCTION

The new mammals described here constitute part of a prolific vertebrate fauna collected from a 4.5 m thick maroon argillaceous sandstone in a road section exposed on the Kalakot-Rajauri road at 6 kms stone from Kalakot (lat. 33°14′: long. 74°25′), some 123 kms northwest of Jammu. The main vertebrate producing horizon is confined to a 5-7 cms thick, dense, compact lens with a heavy concentration of bones probably representing an accumulation in the meander belt of a stream channel. Stray occurrences of bone are recorded upto 1.5 m above the mammal-bearing horizon. The fauna is composed of fragmentary, disarticulated and assorted skeletal elements of fish, turtles and mammals. The bones were obviously transported only a short distance by contemporary streams for the preservation of some fragile and slender limb bones excludes the possibility of extensive displacement. A freshwater gastropod is also associated with the fauna.

Mammals have been known for over three decades from the Middle Eocene (Kirthar) Chharat Series of West Panjab, Pakistan, and occur in two widely separated areas. One is in the Attock district, west of Rawalpindi, covering the fossil localities of Lamindhan, Jhalar and Ganda Kas (Pilgrim, 1940; Dehm and Oettingen, 1958) and the other about 500 kms SSW, near Fort Munro, Dera Ghazi Khan district, a locality on the eastern side of the Indus (Pilgrim, 1940). The fossils from Pakistan represent one of the oldest mammalian faunas on the subcontinent and comprise of at least fifteen genera. The only other mammalian fauna of equivalent age (Lutetian) is found over 1200 kms to the SSW, in western Kutch (Sahni and Mishra *in press*). The Kutch locality is very promising and has produced a large vertebrate fauna which is currently under study. The mammals bear affinities to forms occurring further west in Egypt and Mongolia in the northeast. A slightly younger fauna (Auversian) occurs in the Pondaung Sandstone of Burma and includes two probable Upper Eocene primates besides five genera each of perissodactyls and artiodactyls (Pilgrim and Cotter, 1916; Cotter, 1923; Pilgrim, 1925; 1928; and Colbert, 1937). The presence of similar mammals in the Middle and Upper Eocene beds of Pakistan, India and Burma implies unrestricted migration across what had earlier been regarded as an insuperable barrier, namely, the Tethyan geosynclinal zone which all but encircled the subcontinent at the beginning of the Tertiary.

By the Middle Eocene, the mammalian fauna was well diversified and had apparently become firmly established on the subcontinent. The presence of taeniodonts in the Ganda Kas region (Dehm and Oettingen, 1958) upto now regarded as being restricted to the North American continent, besides other forms, indicates strong affinity between the Eocene mammals of South and Central Asia and those of North America, and reaffirms what has been so categorically stated before—that bilateral migration of early Tertiary land mammals took place across the Bering Straits region.

In an earlier report Ranga Rao records the presence of mammals in Kalakot area from beds he believes to be the Murrees ranging in age from the? Upper Eocene to the Lower Miocene from a locality 2 1/2 miles (4 kms) WNW of Kalakot, 100 ft. (30.8 m) above the Kalakot-Rajauri road near Sind. (Ranga Rao 1971, p. 129). He points out the primitive nature of the two species of a ? choeropotamid, *Indohyus*, described by him on lower dentition material. Our locality occurs at a road section 5 m above the 6 kms mark on the Kalakot-Rajauri road. The horizon is probably older than the one described by Ranga Rao (1971). The identification of a tapiroid and two primitive bunodont artiodactyls by the authors of this paper on the basis of upper dentition suggests that the Kashmir mammals are very closely allied to those described from the Lutetian of West Punjab (Pakistan), as well as from the Auversian of Burma and even to those from the Middle and Upper Eocene of Mongolia.

The stratigraphic position of the mammal-bearing Palaeogene rocks in the subcontinent is given in Table 1.

The geology of the Palaeogene sequence at Kalakot and adjoining areas was first described by Medlicott (1876), later by Simson

COUNTRY		PAKISTAN		INDIA		BURMA
AGES	AREA / WORKERS	PANJAB	BALUCHISTAN	KASHMIR	GUJRAT	PAKOKKU AND PROME
		Pilgrim 1912, 1940 Dehm and Oettingen 1958	Pilgrim 1912 Cooper 1924	Ranga Rao 1971 Khare (under investigation	Sahni and Mishra (in press) Mishra (under investigation	Pilgrim and Cotter 1916 Pilgrim 1925, 1928 Colbert 1937, 1938, Cotter 1923
MIOCENE	BURDIGALIAN	FATEHJANG				PADAUKPIN
	AQUITANIAN		BUGTI HILLS		KUTCH	
OLIGOCENE	CHATTIAN					
	RUPELIAN					
	LATTORFIAN					
EOCENE	LUDIAN					
	BARTONIAN					
	AUVERSIAN					PONDAUNG
	LUTETIAN	GANDA KAS		RAJAURI	KUTCH	
		LAMINDHAN				
		JHALAR				
		FORT MUNRO				

Table 1

(1904), Wadia (1928), Middlemiss (1929), Bhandari and Agarwal (1967), Tewari and Singh (1967) and most recently by Singh (1970a). At Kalakot the Tertiary sequence unconformably rests on a chert breccia marking the top of the Sirban Limestone (Great Limestone) with a 2 ft (0.6 m) thick lateritic grit at the contact (Bhandari and Agarwal, 1967). Previously, this limestone was supposed to be questionably Permo-Carboniferous in age, but is now considered by some geologists to be a Precambrian stromatolitic limestone (Singh, *pers. comm.*)

The Subathu Series constitute the base of the Tertiary and represent shallow water marine conditions marked by oscillatory phases of the sea with a gradual conformable transition into the overlying Murrees.

The Subathus have been comprehensively described by Bhandari and Agarwal (1967) who consider that the sequence ranges in time from the Upper Palaeocene to Upper Eocene (Kirthar). At Kalakot, Bhandari and Agarwal (1967) and Singh (1967, 1970b) on the basis of a foraminiferal and ostracode assemblage have determined the age of the Subathu limestones and shales to be Lower Eocene corresponding to the Laki of the type section. Both are agreed that the transition from the Subathu to Murrees is conformable. While discussing the geology of the Kalakot inlier, Bhandari and Agarwal (1967 p.62) state that "There is perfect transition between the Subathus and Murrees, ruling out any possibility of presence of an unconformity". The division between the two series has been hitherto based mainly on colour and lithology and a 6" (15 cms) purple and pale banded marl has been taken as a rather arbitrary boundary between the predominantly greenish Subathu limestones and shales and purplish Murree sandstones and clays (Bhandari and Agarwal 1967). The Subathu Series ,however, do not exclusively consist of olive green and grey limestone and shales ('green facies') but further east at Surajpur and southeast of Bilaspur the Subathu have a 'red facies' unit consisting predominantly of bright red clay and maroon siltstones. It would appear that the red and green—two facies of Subathu occur in an interfingering relationship, with the green facies thickening westwards. This would seem to fit in with the palaeogeographical picture, where the arm of the sea gradually regressed westwards. Non-marine deposits (mainly red facies) further east would thus be contemporaneous with marine deposits (mainly green facies) further west.

The compact vertebrate bearing maroon argillaceous sandstones representing a part of 'red facies' unit occur 3.4 m above a greyish green compact fossiliferous limestone, which constitutes the upper part of Subathus (Singh, 1970a). The ossiferous zone has been traced up to the coal mines of Jigni and Mhogla. The boundary between the Subathu and Murrees is here considered to be a 1.2 m thick reddish grey sandstone overlying the ossiferous zone. The productive vertebrate horizon would be Middle Eocene possibly ranging upwards into the Upper Eocene and may correspond to the mammal bearing Chharat Series of Pakistan. Thus this horizon would represent the topmost non-marine part of the Subathus.

In the type section of the Murree Series, exposed near Murree 55 kms NE of Rawalpindi, the Middle to Upper Eocene Chharat Series are overlain by Murree sandstones and shales with an apparent unconformity. At the

base of Murrees is found the Fatehjang Mammal Zone of Lower Burdigalian age (Pilgrim 1913) representing a major break in sedimentation. However, this break is not discernible in the corresponding formations of Jammu and the Simla Himalayas. This would suggest that the base of the Murrees is considerably older eastwards than further west near the type section.

SYSTEMATIC DESCRIPTION

Class Mammalia
Order Perissodactyla Owen 1848
Sub-Order Ceratomorpha Wood 1937
Superfamily Tapiroidea
Family Isectolophidae Peterson 1919

Sastrilophus gen. nov.

Etymology. The genus is named after V. V. Sastri, Director, Institute of Petroleum Exploration, O.N.G.C., Dehra Dun, India.

Type species. Sastrilophus dehmi.

Horizon and locality. Middle-Upper Eocene, maroon argillaceous sandstone, exposed in a road section at a road distance of 6 kms from Kalakot towards Rajauri, Subathu Series.

Diagnosis. Molars of *Sastrilophus* lie within the size variation range of *Indolophus*, distinguished from the latter by the inequality of the paracone and metacone (paracone higher by about 15 percent than metacone); also the metacone is flattened, elongated and slightly lingual to paracone. P^3 with paracone and metacone not so well differentiated as in *Indolophus*, more flattened labially than in *Lophiodon*; metastyle rudimentary. Parastyle distinct, conical, well developed as in *Lophiodon* especially in M^3 where it is only slightly lower than the paracone. Labial cingulum continuous, labial border straighter than in *Indolophus*. Upper molars less transverse than in *Homogalax*, *Isectolophus*, *Depertella* and *Colodon*; somewhat similar to *Schlosseria*, but metacone with convex labial slope and not flattened as in the latter form.

Sastrilophus dehmi sp. nov.

Pl. 1, figs. 1-2, Text Figs. 1-2.

Etymology. The species is named after Richard Dehm, Institute of Palaeontology and Geological History, Munich, West Germany.

Type species. Sastrilophus dehmi, based on left maxilla with M^1-M^3, L.U.V.P. 15001.

Repository. Geological Museum, Lucknow University.

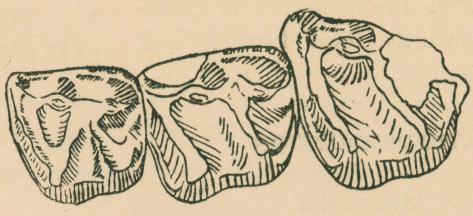
Horizon and locality. Middle-Upper Eocene, maroon argillaceous sandstone, exposed in a road section at a road distance of 6 kms from Kalakot towards Rajauri.

Diagnosis. P^3 triangular, with well developed external cusps; parastyle distinct, paracone higher by about 30 percent than metacone, linked to small but distinct posterolabial cusp. Molars with a distinct, separate, conical parastyle, best developed in M^3. Paracone higher than metacone by about 15 percent with steep labial slopes; metacone slightly lingual to paracone, more flattened but still with a convex slope. Labial cingulum continuous, anterior cingulum wide,

shelf like; posterior cingulum extends from the metacone to the hypocone.

Description. P^3. There is only one specimen, L.U.V.P. 15002, found in close association with the type and is possibly a part of the same maxilla. The posterior part of the triangular crown is slightly broken and the lingual side somewhat bluntly rounded. Parastyle, though damaged in the specimen, distinct and connected to a high paracone by a ridge. The paracone is a somewhat compressed conical cusp, higher by about 30 percent than the metacone which is lingual in position to it. The labial slope of the paracone is steep but the circular outline of base of the cusp can be easily made out. The metacone is also a conical cusp, linked anteriorly to the paracone by a high ridge and posteriorly to what appears to be a small metastyle. The metacone is more flattened than the paracone and more elongated. A protocone with steep convex lingual slopes and gentler external slopes is present on the anterolingual border. An anterior transverse crest intersects the ridge linking the parastyle to the paracone. As the posterior portion of the crown is broken it is not possible to ascertain the presence and position of the posterior crest. But there is some evidence, particularly in the existence of a small ridge between the paracone and metacone, that such a crest did exist, probably in the form of a V as in *Indolophus*. A strong anterior cingulum runs from the protocone to the parastyle along the anterior margin of tooth while a labial cingulum extends from the parastyle to the metastyle. The reasons for designating the tooth as P^3 and not P^4 are its size relating to the molar series, and the shape of the crown.

1



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Text Fig. 1. *Sastrilophus dehmi* gen. et sp. nov., Isolated left p^3 (L.U.V.P. 15002), occlusal view x2.
Text Fig. 2. *Sastrilophus dehmi* gen. et sp. nov., Left maxilla with M^1-M^3 (L.U.V.P. 15001), occlusal view x2.

M^1.—The tooth has a squarish outline. A well developed parastyle is present at the anterior edge of the paracone and is connected to it by a ridge. This ridge is continuous and links the metacone as well, extending to the posterolabial border where it ends in a slight swelling situated on the labial cingulum. The paracone is a steeply conical cusp, distinctly higher than the metacone, after allowing for wear on both cusps. The circular outline of the base of the paracone can be made out on the labial side where it slopes steeply. The metacone is lower, more elongated, flattened and slightly lingual to paracone with a similar slope. Protocone with convex lingual slope, flattened and ex-

ternally joined by a transverse oblique crest to the one linking the parastyle and protocone. Hypocone, slightly labial to the protocone and similarly connected to the anterior border of the metacone by another transverse crest. A wide cingulum runs along the anterior margin of the crown but is not continuous on the lingual side, where a distinct ledge is present between the protocone and the hypocone. A prominent labial cingulum extends from the outer margin of the parastyle to the posterior part of the metacone along the entire labial side. A posterior cingulum, narrower than the anterior cingulum, continues from the posterior edge of the metacone to the posterior edge of the hypocone. The valley between the protoloph and metaloph is relatively shallow.

M^2—The tooth is morphologically similar to M^1 but slightly larger. The labial margin of the paracone and parastyle is partially broken. Hypocone is more conical than that of M^1 and the metaloph slightly smaller than protoloph with a deep median valley. All cingula are better developed than in M^1.

M^3—This is the largest tooth in the molar series. Parastyle very well developed, distinct, conical and well separated from the paracone and only slightly lower in height. Metacone is broken in the specimen. Median valley is deeper than in other molars, cingula prominent, particularly the anterior cingulum which is shelf-like.

MEASUREMETNS

	P^3	M^1	M^2	M^3
Length	8.0 mm	9.0 mm	10.0 mm	11.5 mm
Width	8.5 mm	9.5 mm	10.0 mm	11.0 mm

Order Artiodactyla Owen 1848
Suborder Suina Gray 1868
Superfamily Hippopotamoidea Gray 1821
Family Anthracotheriidae Gill 1872

Raoella gen. nov.

Etymology. The genus is named after A. Ranga Rao, Institute of Petroleum Exploration, O.N.G.C., Dehra Dun.

Type species. Raoella dograi.

Horizon and locality. Middle-Upper Eocene, maroon argillaceous sandstone, exposed at a road distance of 6 kms from Kalakot towards Rajauri, Subathu Series.

Diagnosis. Small anthracotherid, P^4 triangular, external cusp (paracone) robust, high, elongated with prominent ridges running anterolabially and posterolabially and differing in this respect from *Anthracohyus* and *Anthracothema*, close to the condition in *Anthracokeryx ulnifer*. It differs from the latter in the development of a feeble protoconule, and a small cingulum internal to the anterolabial margin. Molars with typical five cusps, paracone higher than metacone, both conical, hypocone slightly labial to protocone, protoconule V-shaped, at about the same position as in *Anthracokeryx*, differs from *Anthracokeryx* in its less developed labial cingulum, absence of mesostyle, feebly developed parastyle; and also more bunodont paracone and metacone. It can be distinguished from *Anthracohyus* in being less transverse, in possessing a parastyle, also length of the tooth on labial side is not less than the length of the lingual side. It resembles *Anthracohyus* in the absence of a mesostyle, represented in both genera by a slight swelling on the labial cingulum; separable from *Anthracothema* in the

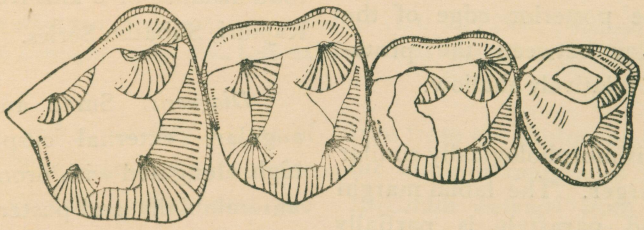
presence of a parastyle, absence of mesostyle, less transverse; also the cusps are bunodont, not crescentric. It is similar to *Gobiohyus*, particularly in the structure of P^4 but differs from it in the absence of a distinct parastyle, separate from paracone; molars less transverse, anterior border more rounded.

Raoella dograi sp. nov.

Pl. 1, figs. 3-4, Text Fig. 3.

Type species. *Raoella dograi*, based on right upper maxilla with P^4-M^3, L.U.V.P. 15003, sostyle absent, cingulum thickened, external to paracone. Hypocone somewhat labial to protocone. Protoconule quite distinct, V-shaped but not raised or as well developed as in the Burmese anthracotheres. M^3 is the largest molar, protocone bigger than in other molars. Basal anterior cingulum with a slight swelling anterior to the protocone, in the same position, but far less developed than in *Anthracothema pangan*, *Anthracokeryx moriturus* and *Anthracohyus choeroides*.

Description. *P.*^{4}—P^4 is triangular in shape with two unequal, conical cusps protocone and paracone. The protocone is situated near the lingual side, slightly anterior to the paracone, and has a steep convex slope towards the internal margin. It is linked to the paracone by a high ridge; another ridge originating from the protocone extends in the anterolabial direction upto the base of anterior cingulum. At the point where this ridge originates is a slight elevation which suggests the presence of a feebly developed protoconule. The paracone is broken in the specimen, but judging from its oval and elongated outline it is obvious that this was a large cusp much higher than the protocone. It is linked to a small and ill developed parastyle by a faint ridge. A similar ridge probably connected this cusp to the posterolabial side of the tooth.



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Text Fig.—3. *Raoella dograi* gen. et sp. nov., right maxilla with P^4-M^3 (L.U.V.P. 15003). occlusal view x2.

Repository. Geological Museum, Lucknow University.

Horizon and locality. Middle-Upper Eocene maroon argillaceous sandstone, exposed at a road distance of 6 kms from Kalakot towards Rajauri.

Diagnosis. P^4 triangular with a robust, elongated cusp, strongly developed anterolabial and posterolabial borders. Internal cusp conical, connected to anterior border of paracone by a high ridge, slightly elevated at the position of protoconule. Molars with conical, bunodont cusps, metacone smaller than paracone and not lingually situated. Labial cingulum continuous, parastyle small but distinct, me-

A strong cingulum runs continuously from the anterolabial side upto the posterolingual margin. An interesting feature is the wrinkling of the enamel just above the lingual cingulum.

M.^{1}—M^1 is quadrilateral in shape with five prominent cusps of which the paracone is the highest. The protocone is the third highest cusp and shows some signs of wear. It is situated on the anterolingual margin of the crown-slightly anterior to the paracone. The paracone, is a steep-sided conical cusp, slightly higher than the second highest cusp, the metacone. The paracone has a convex slope on its lingual border and is connected to the protoconule and protocone by a prominent ridge. The protoconule, though the smallest of the cusps, is itself quite well developed, V-shaped in outline with a ridge extending to the base anteriorly. A slight swelling in the cingulum at the anterolabial border represents a feeble parastyle, linked to the paracone by a faint ridge. The metastyle, is broken and if present, would probably have been poorly developed like all the other stylar cusps. The metacone is connected to the paracone by a ridge which descends to a prominent median valley; hypocone damaged, incomplete and appears to be connected to the metacone by a ridge. A thin stylar cingulum encircles the labial sides of the crown. There are two other prominent cingula, the anterior cingulum extends from the base of the parastyle to the anterolingual side of the tooth, while the posterior cingulum which is less developed is continuous from the posterolingual side to the base of the metacone.

M.^{2}—M^2 is quadrilateral in shape, slightly more transverse than M^1 and in general, morphologically similar to it, except for a few minor differences. The protocone is a slightly crescentric cusp with a steep convex slope towards the lingual side. It is connected by a high ridge to a V-shaped protoconule which is more prominent than that of M^1. The protoconule has two ridges arising from its lingual side, one linking the base of the paracone and the other extending towards the anterior side of the paracone, though not upto the anterolabial border of the tooth. The parastyle, though feeble, is better developed than that of M^1 and is also connected to the high, conical paracone by a more pronounced ridge which also links the metacone. At the posterolabial border the labial cingulum becomes thickened and gives the appearance of a feebly developed metastyle. The metacone like the paracone has a convex slope towards the labial border and is steep towards the lingual side, where it is connected to a somewhat flattened hypocone. In M^2 as in M^1, protocone is the third highest cusp, and metacone is lower in height by about 20 percent than paracone. Hypocone and protocone are linked by a ledge at base. There is a deep valley between the ridges linking the protocone-paracone, and hypocone-metacone. Anterior and posterior cingula are present as in M.^{1}

M^3.—M^3 is trapezoidal in shape, slightly larger in size than M^1 and M^2. All the cusps are well developed, the protocone is a prominent cusp with steeper lingual slope than labial. It is connected to a protoconule by a high ridge, situated anteriorly to both the paracone and protocone which bifurcates, one ridge extending to the base of the paracone and the other extending to the anterior side of the paracone and linking up with a feebly developed parastyle. The paracone is a massive cusp with a round-

ed labial border encircled by a labial cingulum. The labial border slopes posterolingually and is damaged. The hypocone is a small, flattened cusp situated slightly labial to the protocone. Hypocone and protocone are linked by a ledge at base. The anterior cingulum is better developed than the posterior as in the other molars.

MEASUREMENTS

	P^4	M^1	M^2	M^3
Length	8.0 mm	9.0 mm	10.0 mm	12.05 mm
Width	9.5 mm	9.5 mm	12.0 mm	14.00 mm

Suborder Palaeodonta Matthew 1929

Super Family Dichobunoidea Weber 1904

Family Dichobunidae Gill 1872

Kunmunella gen. nov.

Type species. Kunmunella rajauriensis

Horizon and locality. Middle-Upper Eocene maroon argillaceous sandstone, exposed in a road section at road distance of 6 kms from Kalakot towards Rajauri, (Subathu Series).

Diagnosis. The genus is represented by an isolated upper right last molar. Small dichobunid close to *Dichobune*. M^3 subtriangular with a voluminous conical paracone connected to a small conical metacone by a ridge. Protocone large, occupying an anterolingual position and hypocone much reduced as in *Dichobune*. It can be distinguished from *Dichobune* on the basis of the V-shaped protoconule situated in an intermediate position on a ridge connecting protocone and paracone, with another ridge extending towards the anterolabial cingulum where a parastyle is feebly developed. Hypocone connected to the metacone by a ridge. A strong cingulum encircles the crown on the anterior and particularly the lingual side. Labial cingulum better developed than posterior cingulum. It can be distinguished by its shape and orientation of ridges from M^3 of *Mouillacitherium*, *Metriotherium* and *Homacodon*.

Kunmunella rajauriensis sp. nov.
Pl. 1, fig. 5, Text Fig. 4.

Type species. Kunmunella rajauriensis, based on isolated upper right last molar, L. U. V. P. 15004.

Repository. Geological Museum, Lucknow University.

Horizon and locality. Middle-Upper Eocene maroon argillaceous sandstone, exposed in a road section at a road distance of 6 kms from Kalakot towards Rajauri.

Diagnosis. M^3 subtriangular in shape, main cusps conical, bunodont. Paracone is the highest cusp, parastyle feeble. Metacone

EXPLANATION OF PLATE—1

1-2 : *Sastrilophus dehmi* gen. et sp. nov. L.U.V.P. 15001, Left maxilla with M^1-M^3, 1-Occlusal view x2; 2-Labial view x2.

3-4 : *Raoella dograi* gen. et sp. nov. L.U.V.P. 15003, Right maxilla with P^4-M^3, 3-Occlusal view x2; 4-Labial view x2.

5. : *Kunmunella rajauriensis* gen. et sp. nov. L.U.V.P. 15004, Isolated right M^3, Occlusal view x3.

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slightly lingual to paracone, and linked by a ridge. Hypocone is somewhat flattened and is slightly labial to the protocone. V-shaped protoconule. Prominent cingulum encircles the whole tooth.

Description. M^3—M^3 is subtriangular in shape, with four prominent bunodont cusps of which the paracone is the highest. Paracone is conical, steeply sloped towards labial side and higher by about 25 percent than the second highest cusp, the protocone. Metacone is slightly lingual to paracone, and lower by about 40 percent. At the anterolabial and posterolabial sides of the crown, the cingulum is thickened and gives the appearance of rudimentary parastyle and metastyle respectively. Occupying the anterolingual side is a voluminous protocone with convex lingual slope. A distinct V-shaped protoconule is present on the ridge connecting the protocone and paracone, another ridge extends towards anterolabial cingulum. Hypocone is somewhat flattened, about 30 percent smaller than protocone and labial to it. Hypocone and metacone are also linked by a ridge. Labial cingulum is well developed. From the base of parastyle another cingulum encircles the internal side of the tooth, becoming prominent between the hypocone and protocone. The tooth is quite transverse, length about 25 percent smaller than width.

Length 10.50 mm. *Width* 14.00 mm.

GENERAL CHARACTER OF THE FAUNA

Studies on the Subathu ossiferous horizon by the present authors indicate that the vertebrate fauna from Rajauri comprises of at least three genera and four species and manifestly represents only a part of the mammalian assemblage that thrived during the latter half of the Eocene in India. Further work will certainly record the presence of other mammalian genera. The composition of the fauna suggests that artiodactyls were more common than perissodactyls. Among the lower vertebrates, fish are represented by vertebrae and well preserved scales. Turtles are mostly trionychids, while crocodiles have been reported by Ranga Rao (1971). The relative abundance of the great mammalian orders, Artiodactyla and Perissodactyla is true not only of the Eocene localities of Burma where primates are found as well but also of the Middle Eocene of Pakistan where mesonychids are recorded. In the latter context, it is interesting to note the find of a moderately large primitive carnivore probably a mesonychid from the Lutetian of Kutch currently under study by V. P. Mishra.

In the early Tertiary, perissodactyls such

4

Text Fig.—4. *Kunmunella rajauriensis* gen. et sp. nov., isolated right M^3 (L.U.V.P. 15004), occlusal view x 1.5.

as tapirs were fairly common, quite diversified and widespread in central and south Asia. They are known from the Eocene of of Mongolia, Burma, Pakistan and now, India. In Mongolia, a number of tapirs were described by Matthew and Granger(1925*a*, 1925*b*) and include the forms *Desmatotherium*, *Depertella*, *Teleolophus*, *Lophialetes* and *Schlosseria*. The list was later revised by Radinsky (1965) who erected two new families, the Lophialetidae and Deperetellidae. A moderately large tapir tentatively described by Pilgrim (1925) as *Chasmotherium* was later considered to be *Depertella* (Colbert, 1938). *Indolophus* appears to be related to the American form *Homogalax* and *Isectolophus* and to a lesser degree to the European *Lophiodon*, (Pilgrim, 1925). *Teleolophus* has been reported from Pakistan (Dehm and Oettingen, 1958). The Rajauri tapir is somewhat similar to *Schlosseria* particularly in the structure of P^3, the prominence of the parastyle in the molars, the outline of the crown and the disposition of lophs and cingula. The mongolian tapirs were no doubt closely related to those from south Asia.

The Artiodactyls are equally diversified and represented by the Anthracotheriidae and forms close to Dichobunidae. In fact, anthracotheres constitute a dominant part in the Palaeogene faunas of south Asia, particularly in the Auversian of Burma and the Aquitanian of Pakistan. In the Middle Eocene of Pakistan, the only anthracothere so far described—*Anthracobune* (Pilgrim, 1940) is related to the genera reported from Burma. Another form *Pilgrimella* based on an isolated M^1, is moderately large and there is at present no evidence to suggest that *Kunmunella* is congeneric with it although both share some morphological similarities. *Kirtharia* and *Indomeryx* from Pakistan and Burma respectively are also primitive artiodactyls.

Ranga Rao (1971) described two species of *Indohyus*, *I. indirae* and *I. kalakotensis*, on the basis of lower dentition and compared them to *Gobiohyus*, *Anthrackeryx lahirii* and other European and American forms. On the basis of size, morphology and frequency of occurence, there is a possibility that *Raoella dograi* may represent the upper molars of *I. indirae*. But this can only be determined at a later date when more material is forthcoming showing the association of upper and lower jaws. *Haqueina* is another closely related genus.

CONCLUSIONS

(1) The vertebrate fauna, on the basis of mammals suggests a Middle to Upper Eocene age.

(2) Three new mammals, *viz. Sastrilophus dehmi*, *Raoella dograi* and *Kunmunella rajauriensis* described are related to, but generically distinguishable from others known from the subcontinent.

(3) Artiodactyls constitute a major part of the fauna.

(4) By the Eocene, mammals were diversified and widespread on the subcontinent and are known by at least 30 genera and 40 species from northern and southern West Panjab (Pakistan), Kashmir and western Kutch (India); and from Central Burma. This generic list gives the current estimate of taxonomic diversity, but future work is likely to show that some of these name are synonyms.

(5) The presence of terrestrial vertebrates in the Middle-Upper Eocene suggests

that fluvial sedimentation, has been continuous since that time to the present in the northern part of India.

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