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## ECOLOGICAL ADAPTATION IN RHESUS MONKEYS AT THE KUMAON HIMALAYA<sup>1</sup>

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(With a plate and nine text-figures)

In the western Kumaon Himalayas, the distributional range of Rhesus monkeys comprises two major habitat types coniferous forest dominated by *Cedrus deodara*, *Pinus roxburghii* and *Pinus wallichiana*, and terrace fields with potatoes, wheat, maize and peas. In the hill areas the troops always include fields as feeding places in their home ranges. During winter, as food variety decreases, the monkeys take to the seeds of pine tree as staple food. The monkey troops tend to travel to the lower part of the home range to avoid heavy snowfall, and then exploit the terrace fields more frequently than at other seasons. This is due to the scarcity of foods in the forests. It seems likely that in winter the Rhesus monkeys live milder environmental conditions than the Japanese monkeys. When some troops join and separate again at the lower elevation home ranges, there was little antagonistic behaviour. Eight categories of grouping were distinguished in the troop. Females with babies to 3-yr-olds are sociologically the basic group males which occupy the rear of troop procession function as defenders.

### INTRODUCTION

Ecological and Sociological studies on the Rhesus monkey (*Macaca mulatta*) have been actively carried out in the Indian Subcontinent. Two types of ecological studies can be distin-

guished. Southwick, Beg & Siddiqi (1961a & b), Mukherjee & Mukherjee (1972), and Siddiqi & Southwick (1977) concentrated on the population ecology of the troop composition and troop density at the roadside or in streets, while Neville (1968), Lindburg (1971, 1976), Makwana (1978), Teas *et al.* (1980), and Koyama & Shekar (1981) studied the general ecology, focussing on the troop composition, distribution, home range and habits. Neville

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# CONTENTS

	PAGE
ECOLOGICAL ADAPTATION IN RHESUS MONKEYS AT THE KUMAON HIMALAYA. By Kazuo Wada. (With a plate and nine text-figures)	469
THE INDIAN MUGGER, <i>Crocodylus palustris</i> LESSON (REPTILIA, CROCODYLIA): OBSERVATIONS ON THE BEHAVIOUR OF A FEMALE FROM NATURE. By Lala A. K. Singh. (With six plates and a text-figure)	499
AUTHORS' CATALOGUE OF THE BOTANICAL ARTICLES PUBLISHED IN THE JOURNAL OF THE BOMBAY NATURAL HISTORY SOCIETY-II (Vol. 67-76; 1970-1979). Compiled by A. R. Das	507
ONTOGENY OF TEETH ROW STRUCTURE IN <i>Rana tigerina</i> TADPOLES. By S. K. Dutta and P. Mohanty-Hejmadi. (With twelve text-figures)	517
A CONTRIBUTION TO THE WETLAND FLORA OF SITAPUR DISTRICT, UTTAR PRADESH. By J. K. Maheshwari and R. P. S. Tomar	529
STUDIES ON THE SYSTEMATICS AND DISTRIBUTION OF CRABS IN ASSAM. By N. K. Dutta. (With six text-figures)	539
SEASONAL CHANGES IN THE HERD STRUCTURE OF BLACKBUCK. By N. L. N. S. Prasad. (With a plate and a text-figure)	549
THE FORMER DISTRIBUTION OF THE INDIAN RHINOCEROS ( <i>Rhinoceros unicornis</i> ) IN INDIA AND PAKISTAN. By L. C. Rookmaaker	555
SOME NOTES ON THE ECOLOGY AND STATUS OF THE ORANGERUMPED HONEYGUIDE <i>Indicator xanthonotus</i> IN THE HIMALAYAS. By S. A. Hussain and Sâlim Ali. (With a plate)	564
BIRDS OF THE RAJPIPLA FORESTS — SOUTH GUJARAT. By S. G. Monga and Rishad K. Naoroji	575
NEW DESCRIPTIONS:	
A NEW SPECIES OF <i>Lagenandra</i> DALZELL (ARACEAE) FROM KERALA STATE, INDIA. By K. Ramamurthy and R. Rajan. (With eleven text-figures)	613
A NEW SPECIES OF <i>Dimeria</i> R. BR. (POACEAE) FROM KOLLIMALAI, SOUTH INDIA. By M. Mohanan and A. V. N. Rao. (With ten text-figures)	615
TWO NEW SPECIES OF EULOPHIDAE (HYMENOPTERA: CHALCIDOIDEA) FROM ANDAMAN ISLANDS. By S. Adam Shafee, Anis Fatma, M. Younus Khan and Shujauddin. (With four text-figures)	618
A NEW SPECIES OF <i>Psychotria</i> L. (RUBIACEAE) FROM KERALA STATE, INDIA. By K. Ramamurthy and R. Rajan. (With six text-figures)	621
DESCRIPTIONS OF THREE NEW SPECIES OF <i>Gonatocerus</i> NEES (HYMENOPTERA: MYMARIDAE) FROM ALIGARH (INDIA). By S. M. Shamim and S. Adam Shafee. (With ten text-figures)	623
<i>Dimeria keralae</i> (POACEAE) — A NOVELTY FROM KERALA, INDIA. By N. C. Nair, P. V. Sreekumar and V. J. Nair	626
ON THE IDENTITY OF <i>Aspidium finlaysonianum</i> WALL. By S. R. Ghosh. (With a plate)	629

# THE FORMER DISTRIBUTION OF THE INDIAN RHINOCEROS (*RHINOCEROS UNICORNIS*) IN INDIA AND PAKISTAN<sup>1</sup>

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The existence of the rhinoceros in prehistoric times is known from different sites in the Indus valley of Pakistan, and in the Indian states of Rajasthan, Gujarat, Uttar Pradesh, Bihar and possibly Karnataka. There are written and pictorial records testifying to the occurrence of the animal in those regions of India and Pakistan at least until the 16th century. The species concerned is the Indian rhinoceros, *Rhinoceros unicornis* Linnaeus, 1758.

## INTRODUCTION

Three recent species of rhinoceros are known to have occurred in parts of the Indian sub-continent. The double-horned Sumatran rhinoceros (*Dicerorhinus sumatrensis*) was reported from Assam and some regions bordering on Burma before 1880. The Javan rhinoceros (*Rhinoceros sondaicus*) was known definitively from the Sunderbans area of Bangladesh and has been said to exist as far north-west as Assam and Sikkim. The Indian rhinoceros (*Rhinoceros unicornis*) has been recorded in Assam, Nasirabad, Sylhet and Cachar (Rookmaaker 1980). It is still present in various reserves in N. E. India and in Nepal. The rhinoceros also once inhabited other parts of India and Pakistan, as described by Shebbeare (1953: 142): "[it] inhabited the sub-Himalayan tract during prehistoric times, the western limits of its range retreating from Peshawar, in the days of Babur (1505-1530), to Rohilkhand (the Bareilly district) in the mid-19th century and the Nepal terai during the present

century." The distribution of the rhinoceros in Pakistan and India outside the N.E. provinces until the 16th century and its retreat — the last record as far west as the Philibit district near the Nepal border dated from 1876 — has been reviewed or mapped by Lydekker (1907: 30), Guggisberg (1966: 135), Seshadri (1969: 92) and Mukherjee (1963: 45-47, 1974: 339-341). Usually, these records have been assumed to pertain to *R. unicornis*, but the animals rarely have been identified as *R. sondaicus*. Recently, there have been proposals to translocate Indian rhinoceroses from Assam to other areas within their former range. The first pair to be translocated arrived in the Lal Sohanra National Park in Pakistan on 23 March 1982 (Nawaz 1982), while other animals are supposed to be sent to Dudwa National Park in U.P. soon (Baidya 1982).

In view of these plans, it is evidently important to establish the former limits of the range of the rhinoceros as accurately as possible. In this paper I shall review all available data concerning the distribution of the rhinoceros in Pakistan and India (west of Assam). These will be divided in the information on the fossil specimens found in this region, and the literary and iconographic sources dating

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from the 14th to the 17th century. The specific identity of this rhinoceros will also be discussed. Many sources have been quoted extensively, because many are only available with great difficulty to zoologists and because it is useful to compare them all in one place.

#### PREHISTORIC RECORDS

Rhinoceros remains have been discovered in prehistoric sites in several Indian states. Pictorial representations possibly dating from the same period add localities in Pakistan and in Bihar. Few of the fragmentary remains have been described in detail and their identification as *R. unicornis* often has been taken for granted. Guérin (1980) presented extensive descriptions with measurements of the post-cranial skeletons of the five living species of rhinoceros. He observed that specific differences, either qualitative or quantitative, could be found in almost all bones. More specifically, *R. sondaicus* resembled *R. unicornis* osteologically, but they could be distinguished by size, proportions and other qualitative criteria (Guérin 1980: 74). It may be insufficient to compare specimens on paper only, and hazardous to presuppose the same size in prehistoric and recent specimens of the rhinoceros. Nevertheless, I shall compare the published descriptions of the fossil bones found in India with the analyses by Guérin (1980). The locations and ages of the different sites were taken from the publications describing the rhinoceros fragments.

#### PAKISTAN Harappa

(Sihawal district on Ravi river; 2500-1500 B.C.)

Prashad (1936: 31) described a fragment of a right scapula. The stated measurements

(length c. 470 mm, maximum width c. 250 mm) are larger than those of *R. sondaicus* (Guérin 1980: 77). This points at *R. unicornis* (Prashad 1936, Roberts 1977: 159, Nath 1968: 18).

#### Mohenjo Daro

(Indus valley; c. 3000 B.C.)

Several seals and pottery objects representing a rhinoceros were found in Mohenjo Daro (Marshall 1931, I: 72, 205, 348, 353, II: 387). The animal is sometimes depicted "standing over a manger-like object" possibly indicating its keeping in captivity (Marshall 1931, I: 348), while to Conrad (1968: 253) this suggested worship of the rhinoceros. Marshall (1931, I: 348) thought that the species must have been well-known to the people judging "from the frequency with which it is represented, and it was, therefore, likely to have been found in the close vicinity of Mohenjo Daro." Brentjes (1978: 159) identified the animals on the seals as *R. unicornis*.

#### INDIA RAJASTHAN Kalibangan

(Ganganagar district; 3500-400 B.C.)

Banerjee & Chakraborty (1973) reported the discovery in 1965 of four bone fragments referred to *R. unicornis*: a left tibia (distal diameter 125 mm), a right humerus (distal diameter 126 mm), a first phalanx of the 4th metatarsal, and a 3rd metatarsal of the right foot (length 190 mm). In all cases, the measurements are larger than those of living *R. sondaicus* and compare better with those of *R. unicornis* (Guérin 1980: 126, 79, 147; see Nath 1969: 107).

## INDIAN RHINOCEROS IN INDIA AND PAKISTAN

### GUJARAT

#### Langhnaj

(23° 47'N, 72° 25'E; pre-pottery phase)

Zeuner (1952:130-131) gave details about a left scapula (length 430 mm) which showed traces possibly indicating its use as an anvil by a microlith-maker. To Zeuner, "its characters agree with the species *Rhinoceros unicornis*, though the teeth found at Langhnaj suggest the possibility that a sub-species occurred in Gujarat which is not identical with the surviving Nepal and Bengal races." There is no evidence substantiating this suggestion (see Sankalia & Karve 1949).

Clutton-Brock (1965: 9-10) mentioned more remains from Langhnaj: a left scapula (width of the neck 128, 6 mm), a right humerus, a talus, and a fragment of a molar tooth. The scapula and talus were referred to *R. unicornis*, while the other fragments were too damaged to allow proper identification.

#### Kaneval

(20 km N.W. of Cambay or Khambat;  
8000-1200 B.C.)

Momin *et al.* (1973) reported some rhinoceros fragments found in different sites around Lake Kaneval: 3 (partial) cervical vertebrae and the proximal end of a tibia. The vertebrae are illustrated (Momin *et al.* 1973: figs. 2, 3), but these bones do not present specific characteristics (Guérin 1980: 74). Momin *et al.* (1973: fig. 1) figured the tibia, without description although suggesting its use as an anvil.

### SIWALIK HILLS

During the last century, fossilized rhinoceros remains were found in several deposits in the

Siwalik hills and others of similar age (ranging from miocene to lower pleistocene). They were assigned to several (new) taxa:

*Rhinoceros indicus* [= *unicornis*] *fossilis*  
Baker & Durand, 1836: 493;

*Rhinoceros platyrhinus* Falconer & Cautley,  
1847, pls. 73-75;

*Rhinoceros palaeindicus* Falconer & Cautley,  
1847, pls. 73-75;

*Rhinoceros sivalensis* Falconer & Cautley,  
1847, pls. 73-75;

*Rhinoceros perimensis* Falconer & Cautley,  
1847, pls. 73-75;

*Rhinoceros namadicus* Falconer, 1868, I:  
157ff., 513;

*Rhinoceros namadicus* Lydekker, 1876 (not  
of Falconer).

Many of these forms were described in detail by Lydekker (1881, 1884: 82-83, 1885: 61-65, 1886), who synonymized his own *R. namadicus* from the Nerbudda valley with *R. unicornis* in 1886. The relation of these taxa to the recent species of *Rhinoceros* and to each other, whether (near-) identical or not, whether ancestral or not, has to my knowledge not been clarified sufficiently. Heissig (1972) recently described some ancient fragments from the lower and middle Siwalik-deposits as *Rhinoceros* (*Rhinoceros*) aff. *sivalensis*, *R. (Gaidatherium) browni*, *R. (G.) vidali*, *Didemnoceros* aff. *sumatrensis* (one P<sup>2</sup>) and *Eurhinoceros sondaicus* (one P<sup>1</sup> and one P<sup>2</sup>). Guérin (1980: 168, 170) questioned the last two identifications as the material was very old and very limited.

As a neontologist and taxonomist, I was surprised at Heissig's use of *Eurhinoceros* as a full genus with the species *sondaicus*. *R. unicornis* is said to be the type-species of *Rhinoceros* Linnaeus, 1758 and *R. sondaicus* that of *Eurhinoceros* Gray, 1867 [=1868]. Gray (1868) divided the genus *Rhinoceros* into two

subgenera: typical *Rhinoceros* with *R. stenocephalus*, and *Eurhinoceros* with *R. javanicus* [=sondaicus], *R. unicornis*, *R. nasalis* and *R. floweri*. This too is a rather curious classification which, however, does not concern us at present. It would seem that Heissig's interpretation of *Eurhinoceros* would need further clarification.

#### UTTAR PRADESH

##### Mirzapur petroglyph

A rock drawing in the "Ghormangur rock-shelter near the fortress of Bidyergurh in the Mirzapur district" is described and illustrated by Cockburn (1883). It shows a single-horned rhinoceros surrounded by hunters, but its identity is not clear (Bhaduri *et al.* 1972: 404, Rookmaaker 1980: 258).

##### Banda

Cockburn (1883) found some fragmentary rhinoceros bones "in the ravines of the Ken river, 2 miles due south of the town of Banda" which he tentatively assigned to *R. unicornis*.

#### BIHAR

##### Chirand

(Saran district; c. 1700 B.C., neolithic)

Nath (1976) reported 4 fragments: a left humerus, upper molar tooth, left tibia and ulna. The bones are not described, but referred to *R. unicornis*.

#### MADHYA PRADESH

No material has been discovered in this state. Sagreiya (1969: 718) concluded that if the rhinoceros ever "did occur in parts of Madhya Pradesh, [it] disappeared before the Aryans arrived."

#### SOUTH INDIA

Lydekker (1880) described a single M<sup>3</sup> from the alluvium of Madras as *R. unicornis* (see Hooijer 1946: 84). Another specimen found 3½ miles N. E. of Gokak, Belgaum district (Karnataka) was described as *Rhinoceros deccanensis* by Foote (1874). It appears premature to state on the basis of this meagre evidence, that *R. unicornis* used to occur in this part of India, which would allow future re-introduction (Krishne Gowda 1975-309).

#### HISTORICAL RECORDS

Several medieval Muslim authors wrote about encounters with the rhinoceros in Pakistan or India (Ettinghausen 1950). The majority seems to be based on second-hand information, but those by al-Beruni and Ibn Battuta deserve further consideration. Several Indian authors of the 16th and 17th century claimed to have observed these animals. This evidence was partly reviewed by Yule & Burnell (1903: 363, 762), Ali (1927) and Rao (1957: 269).

al-Beruni, one of the Muslim authors who wrote a book about India (c. 1030), gave the following details:

"The ganda exists in large numbers in India, more particularly about the Ganges. It is of the build of a buffalo, has a black scaly skin, and dewlaps hanging down under the chin. It has three yellow hoofs on each foot, the biggest one forward, the others on both sides. The tail is not long, the eyes lie low, further down the cheek than is the case with all other animals. On the top of the nose there is a single horn which is bent upwards. The Brahmins have the privilege of eating the flesh of the ganda. I have myself witnessed how an elephant coming across a young ganda was attacked by it

The ganda wounded with its horn a fore-foot of the elephant, and threw it down on its face" (Sachau 1910: 203-204).

The author continued about his uncertainty whether the ganda was in fact the rhinoceros.

**Ibn Battuta**, an Arab traveller, saw rhinoceroses near the Indus river in 1334 as follows:

"After crossing the river of Sind called Banj Ab, we entered a forest of reeds, following the tracks which led through the midst of it, when we were confronted by a rhinoceros. In appearance it is a black animal with a huge body and a disproportionately large head. For this reason it has become the subject of a proverb, as the saying goes *Al-karkaddan ras bila badan* (rhinoceros, head and no torso). It is smaller than an elephant, but its head is many times larger than an elephant's. It has a single horn between its eyes, about three cubits in length and about a span in breadth. When it came out against us one of the horsemen got in its way; it struck the horse which he was riding with its horn, pierced his thigh and knocked him down, then went back into the thicket and we could not get at it. I saw a rhinoceros a second time on this road after the hour of afternoon prayer. It was feeding on plants but when we approached it, it ran away. I saw a rhinoceros yet another time when in the company of the king of India we had entered a jungle of reeds. The sultan was mounted on an elephant and we too were mounted on elephants along with him. The foot-soldiers and horsemen went in and beat it up, killed it and conveyed its head to the camp" (Gibb 1971: 596).

**Babur**, the Moghul emperor reigning from 1505 to 1530, hunted the rhinoceros several times. His accounts are quite extensive and

unfortunately too long to reproduce in full. In February 1519 he wrote:

"I went to hunt rhinoceros on the Sawati side [Suabi, west of the Indus river] which place people call also Karg-khana (Rhino-home). A few were discovered but the jungle was dense and they did not come out of it" (Beveridge 1970: 378).

One calf came out and escaped, another died when the jungle was set on fire. In December 1526, Babur had another encounter with the animal:

"There was a rhino in a bit of jungle near Bigram [Peshawar]. ... It took its way across the plain. Humayun and those come with him from that side (Tramontana), who had never seen one before, were much entertained. It was pursued for two miles; many arrows were shot at it; it was brought down without having made a good set at man or horse. Two others were killed" (Beveridge 1970: 451).

When it came face to face with an elephant, it did not attack but turned in another direction. A few years later, in March 1529, near Benares no rhinoceros was discovered (Beveridge 1970: 657). Babur gave a comprehensive description of the rhinoceros in his list of the animals of Hindustan:

"This also is a large animal, equal in bulk to perhaps three buffaloes. ... It has a single horn on its nose more than 9 inches (qarisch) long; one of two qarisch is not seen.... The rhinoceros' hide is very thick; an arrow shot from a stiff bow, drawn with full strength right up to the arm-pit, if it pierces at all, might penetrate 4 inches (ailik, hands). From the sides (qash) of its fore and hind legs, folds hang which from a distance look like housings thrown upon it. ... There are masses of it in the Parashawar and Hash-nagar jungles, so too between the Sind river

and the jungles of the Bhira country. Masses there are also on the banks of the Saru river in Hindustan" (Beveridge 1970: 489-490).

**Sidi Ali**, a Turkish admiral of Suleiman the Great, saw rhinoceroses in northern Pakistan in 1556 (Yule & Burnell 1903: 762). The passage is here translated from the French published by Moris (1826: 201-202):

"We left the city of Pourschewer [Peshawar], and having happily passed the Koutel [Kotak], we came to the city of Djouschayeh. At the Koutel, we saw rhinoceroses approaching in size the elephant. Those rhinoceroses had a horn of two hands length on the forehead; but it is a fact that those living in Abyssinia have longer horns."

**Akbar**, the 3rd Moghul emperor (1542-1605), had his memoirs written about 1590. The rhinoceros was found in the "Sarkar of Sambal", near Sambhal in Utter Pradesh (Jarratt 1949, II: 285). It is described as follows:

"The rhinoceros is a stupendous creature. He is twice the size of a buffalo and much resembles a horse in armour. His feet and hoofs are like those of an elephant, and his tail similar to a buffalo's, and he has a pastern-joint like a horse. On the point of his snout he carries a single horn and his hide is so thick that an arrow will not pierce it. Of this, breast-plates and shields and the like are made, and he is bold enough to charge a man on horse back" (Jarrett 1949, III: 134).

**Jehangir**, another Moghul emperor who wrote his memoirs. In the passage given here translated by Beveridge, "wolf" is given instead of "rhinoceros" because the latter was unlikely to live in the region mentioned. This is questioned by Ali (1927: 861) and Kühnel (1941).

"One day I was on an elephant, and was hunting wolves in Aligarh in the Nuh forest.

A wolf appeared, and I struck it with a bullet on its face (mana) near the lobe of the ear. The bullet penetrated for about a span. From that bullet it fell and gave up its life. It has often happened in my presence that powerful (jawan) men, good shots with the bow, have shot twenty or thirty arrows at them, and not killed" (Beveridge 1968, II: 270). = 4162.

**A Portuguese embassy** to Muzafar II, King of Cambaia, was presented with a living rhinoceros in May 1514. Its place of capture is not recorded. It had been kept in Champanel and was transported to Lisbon via Goa by the Portuguese. It lived in Lisbon from 20 May 1515 until December 1515, when it was sent to Pope Leo X in Rome. It drowned on its way at the Italian coast near Porto Venere in February 1516 (Da Costa 1937, Rookmaaker 1973: 39-40).

#### ICONOGRAPHY

There are rather a large number of miniatures and other representations depicting "naturalistic" rhinoceroses made in India between 1500 and 1650. Some have recently been figured, e.g. by Ettinghausen (1950: pls. 21, 30, 32, 33), Brentjes (1969), Lewis *et al.* (1966: pl. 23) and Kühnel (1941: fig. 2). These animals are undeniably rhinoceroses, but few would appear to allow further identification. One such miniature may be mentioned especially. It shows Jehangir hunting rhinoceroses and it is dated c. 1600 (kept in O. Sohn-Rethel collection, Düsseldorf — reproduced by Kühnel 1941, Ettinghausen 1950: pl. 33 and Brentjes 1969). The identity of this animal is discussed below.

#### DISCUSSION

The records of rhinoceroses in India and Nepal were generally attributed to the Indian



rhinoceros (*R. unicornis*). Blyth (1872: 3107), however, considered that the length of the horn and the possibility to penetrate the hide with arrows mentioned by Babur appeared "tolerably sufficient" to indicate *R. sondaicus* rather than *R. unicornis*. Brentjes (1969) identified an animal in one of the miniatures showing Jehangir's hunt as *R. sondaicus inermis*. The animals in this figure look enough like a single-horned rhinoceros that the appearance of the animal must have been known. These representations, however, were not intended to show characteristics which would allow us to separate the two species of *Rhinoceros*. The miniature discussed by Brentjes probably is one of the few which shows the folds naturalistically, at least at first sight. I believe that this is accidental. There are important differences between the two specimens in the picture and some

folds (anterior shoulder fold and scapular fold) are missing entirely.

All evidence presented above suggests that it was indeed *R. unicornis* which inhabited the northern part of the Indian peninsula until relatively recently. In prehistoric times, this species occurred in parts of Pakistan (Indus valley) and India (Rajasthan, Gujarat, Uttar Pradesh and Bihar). In the 16th century the animal was still rather common in appropriate habitats in N.W. India. There is no reason to suspect that the Moghul emperors hunted captive or imported specimens. There are no records at all for the 17th and 18th centuries. The rhinoceroses must have disappeared from many areas during that period. In the 19th century it was occasionally reported from eastern Uttar Pradesh and Bihar, and it must have been quite rare then.

#### REFERENCES

- ALI, S. A. (1927): The Moghul emperors of India as naturalists and sportsmen, part I. *J. Bombay nat. Hist. Soc.*, 31(4): 833-861, 3 pls.
- BAIDYA, K. N. (1982): Alarm call for Great Indian rhino (*Rhinoceros unicornis*). *Tigerpaper*, 9(2): 6-7, 1 fig.
- BAKER, W. E. & DURAND, H. M. (1836): Sub-Himalayan fossil remains of the Dádapur collection. *J. Asiat. Soc. Bengal*, 5: 486-504, pls. 15-19.
- BANERJEE, S. & CHAKRABORTY, S. (1973): Remains of the great one-horned rhinoceros, *Rhinoceros unicornis* Linnaeus from Rajasthan. *Sci. & Cult.*, 39(10): 430-431, tab. 1.
- BEVERIDGE, A. S., editor (1970): Babur-nama (memoirs of Babur), translated from the original Turki text of Zahiru'd-din Muhammad Babur Padshah Ghazi, 2 vols. New Delhi, Oriental books reprint Co. (original 1922).
- BHADURI, J. L., TIWARI, K. K. & BISWAS, BISWAMOY (1972): Zoology. In: D. M. Bose, S. N. Sen & B. V. Subbarayappa, editors: A concise history of science of India: 401-444, pls. 7-9, figs. 8-12. New Delhi, Indian National Science Academy.
- BLYTH, E. (1872): Asiatic rhinoceroses. *Zoologist*, (2) 7: 3104-3108.
- BRENTJES, B. (1969): Eine Darstellung des bengalischen Javanashorns *Rhinoceros sondaicus inermis* Lesson, 1840. *Säugetierk. Mitt.*, 17: 209-211, figs. 1-2.
- (1978): Die Nashörner in den alten orientalischen und afrikanischen Kulturen. *Säugetierk. Mitt.*, 26: 150-160, figs. 1-14.
- CLUTTON-BROCK, J. (1965): Excavations at Langhnaj: 1944-63. Part II: The fauna. Poona, Deccan College.
- COCKBURN, J. (1883): On the recent existence of *Rhinoceros indicus* in the North Western provinces; and a description of a tracing of an archaic rock painting from Mirzapore representing the hunting of this animal. *J. Asiat. Soc. Bengal*, 52: 56-64, pls. 7-8.
- CONRAD, R. (1968): Die Haustiere in den frühen Kulturen Indiens. *Säugetierk. Mitt.*, 16: 189-258, figs. 1-16.
- COSTA, A. F. DA (1937): Deambulations of the rhinoceros (Ganda) of Muzafar, king of Cambaia, from 1514 to 1516. Lisboa.
- ETTINGHAUSEN, R. (1950): Studies in Muslim iconography, I: The Unicorn. *Occ. Papers Freer Gallery of Art*, 1(3): i-xii, 1-209, pls. 1-48, figs. 1-5.

Washington, Smithsonian Institution.

FALCONER, H. (1868): Palaeontological memoirs and notes, 2 vols. London, Robert Hardwicke.

——— & CAUTLEY, P. T. (1847): Fauna Antiqua Sivalensis, being the fossil zoology of the Siwalik hills in the north of India. Illustrations, part VIII: Suidae and Rhinocerotidae, pls. 69-80. London, Smith, Elder & Co.

FOOTE, F. B. (1874): *Rhinoceros deccanensis*, a new species discovered near Gokak, Belgaum district. *Mem. geol. Surv. India (Palaeont. India)*, series X, 1(1): 1-17.

GIBB, H. A. R., editor (1971): The travels of Ibn Battuta A.D. 1325-1354. Translated with revisions and notes from the Arabic text edited by C. Deffrémery and B. R. Sanguinetti, III. Cambridge, Hakluyt Society (Works, second series, vol. 141).

GRAY, J. E. (1868): Observations on the preserved specimens and skeletons of the Rhinocerotidae in the collection of the British Museum and Royal College of Surgeons, including the descriptions of three new species. *Proc. Zool. Soc. London*, 1867: 1003-1032, figs. 1-6.

GUERIN, C. (1980): Les rhinocéros (Mammalia, Perissodactyla) du Miocène terminal au Pleistocène supérieur en Europe occidentale. Comparaison avec les espèces actuelles. *Docum. Lab. Géol. Lyon* 79: 3-1185, pls. 1-21, figs. 1-115, tabs. 1-161.

GUGGISBERG, C. A. W. (1966): S. O. S. Rhino. London, Andre Deutsch.

HEISSIG, K. (1972): Paläontologische und geologische Untersuchungen im Tertiär von Pakistan, 5: Rhinocerotidae (Mamm.) aus den unteren und mittleren Siwalik-Schichten. *Abh. bayer. Akad. Wiss. (Math-Naturwiss. Kl.)*, 152: 1-112, pls. 1-25, figs. 1-3, tabs. 1-41.

HOOIJER, D. A. (1946): Prehistoric and fossil rhinoceroses from the Malay archipelago and India. *Zool. Meded. Leiden*, 56: 1-138, pls. 1-10, tabs. 1-8.

JARRETT, H. S. (1949): 'Ain-I-Akbari of Abdul Fazl-I-'Allami, II: A gazetteer and administrative manual of Akbar's empire and past history of India. Second ed., corrected and further annotated by Sir Jadu-Nath Sarkar. Calcutta, Royal Asiatic Society of Bengal (Bibliotheca Indica, 271).

KRISHNE GOWDA, C. D. (1975): Plans for breeding colonies of large mammals in India. In: R. D. Martin, editor: Breeding endangered species in captivity: 309-313, figs. 1-2. London etc., Academic Press.

KUHNEL, E. (1941): Jagdbilder aus Indien. *Atlan-*

*tis*, 13(10): 417-424, 9 figs.

LEWIS, B., PELLAT, C. & SCHACHT, J. (1966): Encyclopédie de l'Islam, nouvelle édition établie avec le concours des principaux orientalistes, II. Leiden, E. J. Brill.

LYDEKKER, R. (1876): Descriptions of the molar teeth and other remains of Mammalia. *Mem. geol. Surv. India (Palaeont. India)*, series X, 1(2): 19-87, pls. 4-10.

——— (1880): A sketch of the history of the fossil vertebrata of India. *J. Asiat. Soc. Bengal*, 49: 8-40.

——— (1881): Indian tertiary and post-tertiary vertebrata: Siwalik Rhinocerotidae. *Mem. geol. Surv. India (Palaeont. India)*, series X, 2: 1-62, pls. 1-10.

——— (1884): Catalogue of vertebrate fossils from the Siwaliks of India in the Science and Art museum, Dublin. *Scient. Trans. R. Dubl. Soc.*, (2) 3(4): 69-86, pl. 3, figs. 1-4.

——— (1885): Catalogue of the remains of Siwalik vertebrata contained in the geological department of the Indian Museum, Calcutta. Part I: Mammalia. Calcutta, Government Printing.

——— (1886): Catalogue of the fossil Mammalia in the British Museum, (Natural History), part III: containing the order Ungulata, suborders Perissodactyla, Toxodontia, Condylarthra, and Amblypoda. London, British Museum.

——— (1907): The game animals of India, Burma, Malaya, and Tibet being a new and revised edition of 'The great and small game of India, Burma and Tibet.' London, Rowland Ward.

MARSHALL, J. (1931): Mohenjo-Daro and the Indus-civilisation, 3 vols. London, Arthur Probsthain.

MOMIN, K. N., SHAH, D. R. & OZA, G. M. (1973): Great Indian rhinoceros inhabited Gujarat. *Current Science*, 42: 801-802, figs. 1-3.

MORIS, M., editor (1826): Miroir des pays ou relation des voyages de Sidi Aly fils d'Housain, nommé ordinairement Katibi Roumis amiral de Soliman II, traduite sur la version allemande de M. de Diez (suite). *Journal asiatiques*, 9: 193-217.

MUKHERJEE, A. K. (1963): The extinct, rare and threatened game of the Himalayas and the Siwalik ranges. *J. Bengal nat. Hist. Soc.*, 32(1): 36-67, pls. 1-8.

——— (1974): Some examples of recent faunal impoverishment and regression. In: M. S. Mani, editor: Ecology and biogeography in India:

# INDIAN RHINOCEROS IN INDIA AND PAKISTAN

330-368, figs. 26-41, 1 tab. The Hague, W. Junk (Monographiae biologiae, 23).

NATH, B. (1968-dated 1963): Advances in the study of prehistoric and ancient animal remains: a review. *Rec. Zool. Surv. India*, 61(1/2): 1-63, pls. 1-4, tabs. 1-3.

——— (1969): The role of animal remains in the early prehistoric cultures of India. *Indian Mus. Bull.*, 4: 102-110, pls. 1-11, fig. 1.

——— (1976): On the occurrence of Great Indian rhinoceros — *Rhinoceros unicornis* Linn., from the prehistoric site at Chirand, Saran district, Bihar. *Newsl. Zool. Surv. India*, 2(3): 86-87.

NAWAZ, M. (1982): Re-introduction of wild fauna in Pakistan. *Tigerpaper*, 9(2): 5.

PRASHAD, B. (1936): Animal remains from Harappa. *Mem. Archaeol. Surv. India*, 51: i-iii, 1-76, pls. 1-7.

RAO, H. S. (1957): History of our knowledge of the Indian fauna through the ages. *J. Bombay nat. Hist. Soc.*, 54: 251-280, pls. 1-2.

ROBERTS, T. J. (1977): The mammals of Pakistan. London and Tonbridge, Ernest Benn.

ROOKMAKER, L. C. (1973): Captive rhinoceroses in Europe from 1500 until 1919. *Bijdr. Dierk.*, 43: 39-63, figs. 1-13.

——— (1980): The distribution of the rhinoceros in Eastern India, Bangladesh, China, and the Indo-Chinese region. *Zool. Anz.*, 205:253-268, figs. 1-2.

SACHAU, E. C., editor (1910): Alberuni's India: an account of the religion, philosophy, literature, geography, chronology, astronomy, customs, laws and astrology of India about A.D. 1030, I. London, Kegan Paul, Trench, Trübner & Co.

SAGREIYA, K. P. (1969): Wild life of Madhya Pradesh through ages. *Indian Forester*, 95: 715-718.

SANKALIA, H. D. & KARVE, I. (1949): Early primitive microlithic culture and people of Gujarat. *Am. Anthropol.*, 51: 28-34, pls. 1-4.

SESHADRI, B. (1969): The twilight of India's wild life. London, Baker.

SHEBBEARE, E. O. (1953): Status of the three Asiatic rhinoceros. *Oryx*, 2: 141-149, 1 fig., 1 tab.

YULE, H. & BURNELL, A. C. (1903): Hobson-Jobson: a glossary of colloquial Anglo-Indian words and phrases and of kindred terms, etymological, historical, geographical and discursive, new edition edited by William Crooks. London, John Murray.

ZEUNER, F. E. (1952): The microlith industry of Langhnaj, Gujarat. *Man*, 52: 129-131, pl. 1, figs. 1-2.