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An unrecorded specimen of the Javan rhinoceros (*Rhinoceros sondaicus*)

A. J. E. Cave

Zoological Society of London, Regent's Park, London NW1 4RY

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(With 4 plates and 1 figure in the text)

An hitherto unpublicized specimen of the Javan (Sondaic) rhinoceros in the Manchester Museum is briefly described.

Contents

Introduction

Despite the considerable effort currently devoted to rhinoceros conservation, the wild-living stocks of all five extant rhinoceros species continue to decline from habitat destruction occasioned by agricultural and industrial development, intensified poaching on a commercial scale and sporadic outbursts of civil commotion. Already, the Javan rhinoceros (*Rhinoceros sondaicus*) has become the rarest of the large exotic mammals and is threatened with early extinction, inasmuch as its known breeding population is now reduced to some 50 animals, protected within the Udjong Kulon National Park. It is unlikely, therefore, that examples of this vanishing rhinoceros species will appear henceforth in captivity, either to reproduce their kind or to furnish material for morphological investigation. Enhanced value thus attaches, from the taxonomic and anatomical viewpoint, to such Javan rhinoceros osteological material as survives in the world's museums.

The precise tally of this material escapes present quantification. Prior to the Second World War (1939–45), it was estimated to comprise no more than 21 skeletons and 44 (not all perfect) skulls (Barbour & Allen, 1932; Carter & Hill, 1942; Finlayson, 1950) but damage to European museums during that conflict has modified that estimate to an unknown extent, one museum alone (that of the Royal College of Surgeons of England) having thereby lost seven of its eight Javan rhinoceros crania. It is particularly desirable, therefore, that the whereabouts of any previously unpublicized Javan rhinoceros skeletal material preserved in provincial or private museums should be made known to the research-worker and with that end in view attention is herein directed to a Javan rhinoceros skull, long exhibited in the Manchester Museum.

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The skull in question is that of a male animal, as evidenced by its size, rugosity and emphatic secondary markings and by the size of its horn-boss. The animal's longevity is attested by the marked suture obliteration present, by the development of a basicranial exostosis and an extreme degree of crown-wear upon the cheek-teeth. Its life in captivity is reflected in the presence of osteoarthritis of the temporo-mandibular joints and of generalized parodontal disease in the upper and lower jaws.

Description of specimen

General

The Manchester Museum specimen is the complete skull of an old male animal which had lived long in captivity. The (pre)maxillary incisors have suffered post-mortem loss, the nasal horn is not preserved and pathological change is manifest in the skull base, the temporo-mandibular joints and the dentigerous portions of the jaws. A large and prominent horn-boss caps the nasal bones. Local detachment of the outer cranial table exposes the well-pneumatized interior of the lambdoid crest. The specimen's provenance and date of acquisition are not determinable from the Museum records and an accession number is wanting. The skull has, however, been on continuous exhibition since 1914 at least and must therefore have entered the Museum at an earlier date, either during the first decade or so of the present century or (more probably) during the latter part of the last.

Being so patently the skull of a long-captive animal, it almost certainly came from the local Belle Vue Zoological Gardens, an institution which in its heyday exhibited the greatest variety of exotic animals in extra-metropolitan England and proved a continuous source of material both to the Manchester Museum and to the Anatomical Department of the Owen's College, precursor of the present Victoria University of Manchester.

Osteological

The specimen conforms in all particulars to the canon of *R. sondaicus* cranial morphology established by the specific examination of 25 Javan rhinoceros skulls. Thus the lacrimal tubercle is mammilliform and is bridged posteriorly, the pre-orbital tuberosity is well developed, the infra-orbital foramen is large and single, the posterior palatine foramina number two, the pars verticalis of the palatine bone manifests a localized maxillary sinus osteolysis, the pterygoid fossa is shallow, the vomer articulates superiorly with the palatines and the pterygoids, the Eustachian ridge ends in a tubercle on the posterior free margin of the alisphenoid, the foramen ovale is confluent with the foramen lacerum, the coronoid process is directed antero-superiorly and the mental foramen is single. Pneumatization is pronounced in the lambdoid crest and doubtless in other cranial regions also since such cavitation of the crest, as well as of the frontal, nasal and lacrimal bones, is already obtrusive in the infant Javanese rhinoceros skull (Plates I, II).

The orbital and zygomatic arch margins are typically rugose: the attachment markings of the masticatory muscles are vigorously developed: the supra-orbital regions and the temporal fossae are sculpted by vascular channels.

Suture obliteration due to age is pronounced throughout the cranium and affects particularly the maxillo-palatine, pterygo-palatine, vomero-palatine and vomero-pterygoid articulations: the post-choanal undersurface of the basis cranii is rendered flat and featureless from synostosis of the vomerine alae with neighbouring structures (Plate III).

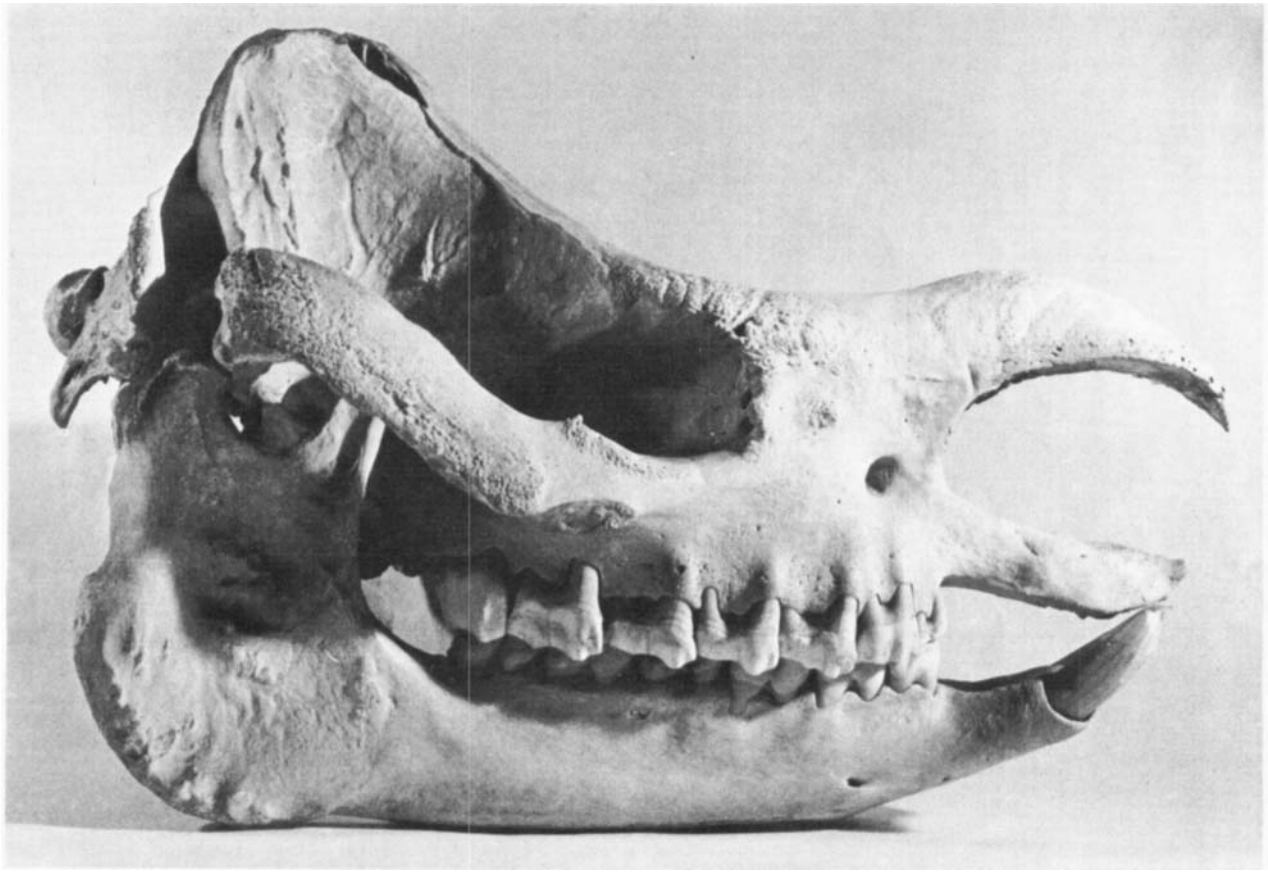

PLATE I. Javan rhinoceros, Manchester Museum. Skull in norma lateralis showing general features, alveolar bone-loss and exposure of tooth-roots.

In both *R. sondaicus* and *Rhinoceros unicornis*, the foramina ovale et lacerum, though confluent in the macerated cranium, are separated in life by a (petro-sphenoidal) ligament and the mode of anterior attachment of this ligament distinguishes the crania of the two species. In *R. sondaicus* (as in the present specimen), a minute tubercle (the termination of the Eustachian crest) receives this anterior attachment, whereas in *R. unicornis* no corresponding tubercle is developed and the petro-sphenoidal ligament attaches undetectably to the posterior free margin of the alisphenoid (Fig. 1).

Odontological

The canonical dentition of *R. sondaicus*, illustrated by Gregory (1951), is represented by the dental formula $i\frac{1}{1}$ $c\frac{0}{0}$ $pm\frac{4}{4}$ $m\frac{3}{3}$, but this formula is subject to modification by the variability of incidence of the first premolars, teeth apt to be undeveloped in the upper or the lower dental series, or even in both. Thus in the present specimen, both the mandibular premolars are suppressed as are their counterparts (together with the left maxillary tooth) in the skull of another long-captive Javan rhinoceros preserved in the South Australian Museum (Finlayson, 1950).

The now-lost premaxillary (single) incisors of the Manchester Museum specimen appear from

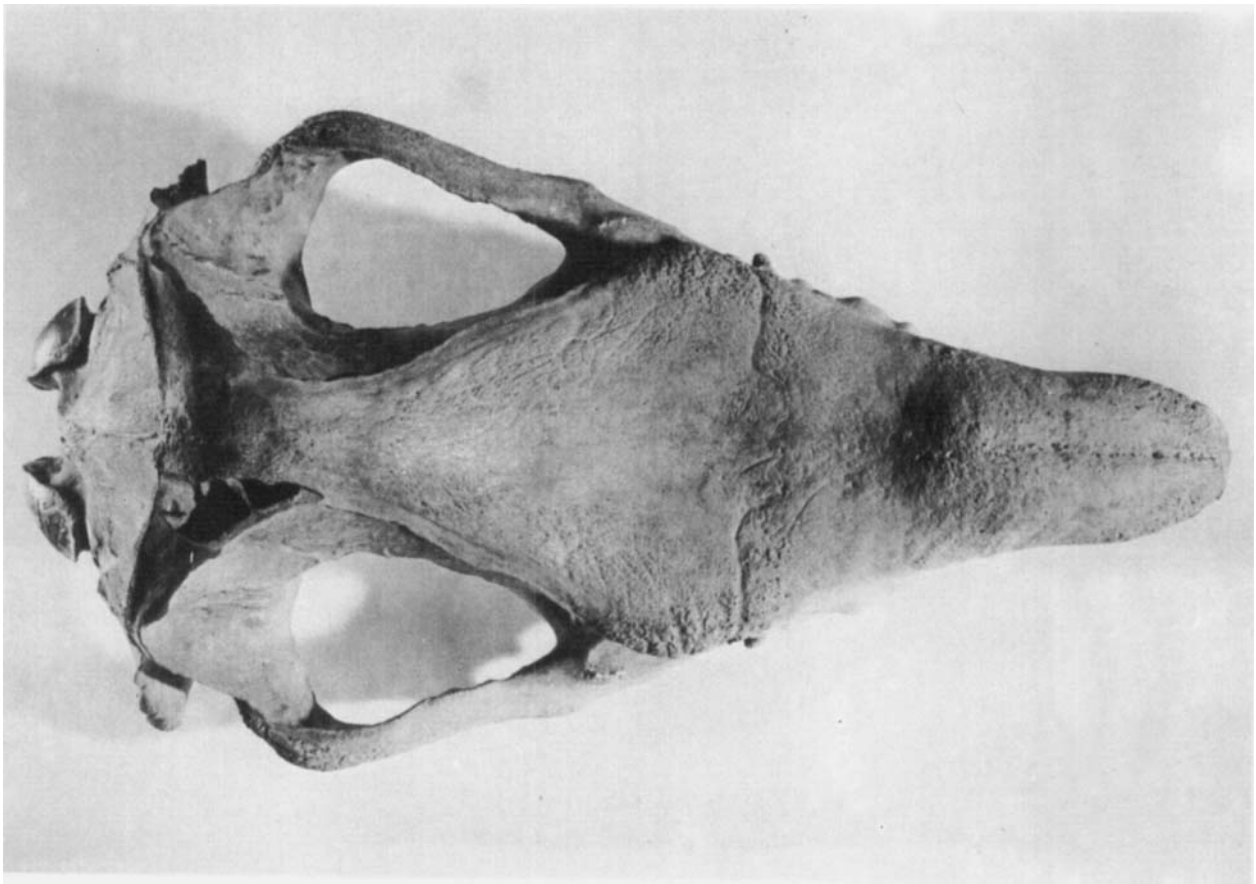

PLATE II. Javan rhinoceros, Manchester Museum. Skull in norma dorsalis showing horn-base and pneumatized occipital crest.

their socket-evidence to have been typically short, broad, subtriangular teeth of rhomboidal crown-contour. The retained mandibular incisors are large, procumbent, trihedral teeth, possessing sharp, rounded apices and extremely sharp lateral margins, enabling them to function in life as weapons of offence and defence in lieu of the absent canines. The cheek-teeth in each maxilla and mandible moiety form a continuous series of very similar and extremely crown-worn units, the maxillary first premolars being distinctly smaller than the second. The molar teeth exhibit the complicated crown-pattern characteristic of *R. sondaicus* and so well described by Owen (1840–5), Flower & Lydekker (1891) and others as not to require present detailed consideration.

Dental disease is conspicuously absent, but paradontal disease is widespread throughout the upper and lower jaws (Plates I, III). Therein, extensive destruction of the dental alveolar walls has brought about considerable bone-loss and has exposed the roots of the cheek-teeth. The disease was clearly of long duration and a direct consequence of the unnatural diet provided in captivity, since it never occurs in the wild-living rhinoceros, nor in wild-living herbivores in general (Colyer, 1936). The exposed tooth-roots, particularly those of the maxillary cheek-teeth (Plate I), manifest

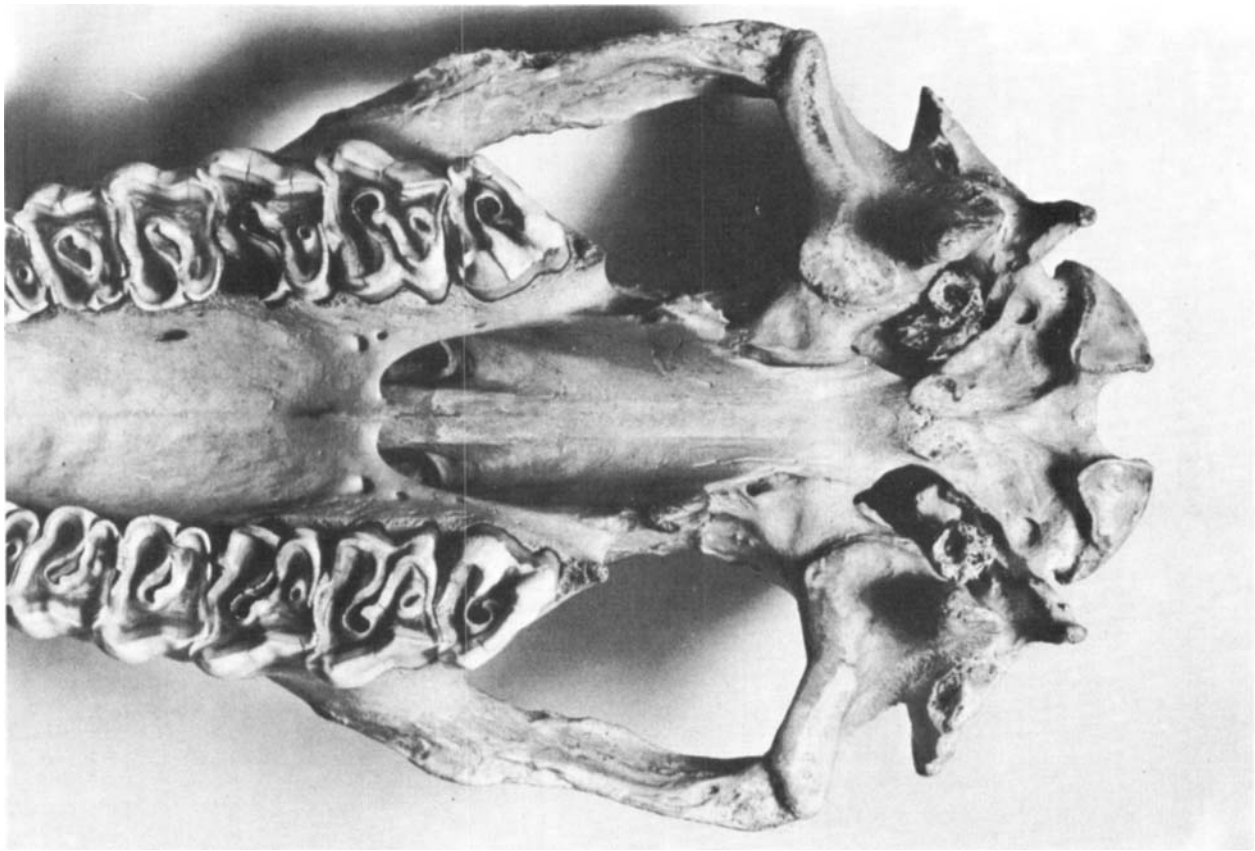

PLATE III. Javan rhinoceros, Manchester Museum. Skull in norma basalis showing spheno-occipital exostosis, resorption of alveolar bone, suture obliteration and foramen lacerum.

an annular grooving reminiscent of the transverse striation of the enamel seen in examples of dental hypoplasia, a disease usually attributed to calcium deficiency or imbalance in the diet. The 'root ringing', which marks the teeth of the present specimen and has clearly affected the root cementum, may well have resulted from similar imbalance. (A corresponding 'ringing' of the tooth roots (including those of the unerupted canine and incisors) has been illustrated by Colyer (1936) in a young baboon living in captivity.)

Pathological

In addition to the advanced parodontal disease in the upper and lower jaws (doubtless responsible for the post-mortem loss of the upper incisors), the specimen exhibits pathological change on the cranium undersurface and in each temporo-mandibular joint.

The ventral aspect of the long-consolidated spheno-occipital synchondrosis is obscured by an exostosis of long standing (Plate III) similar to those encountered in aged rhinoceros crania of any species, whether of wild-living or of captive animals.

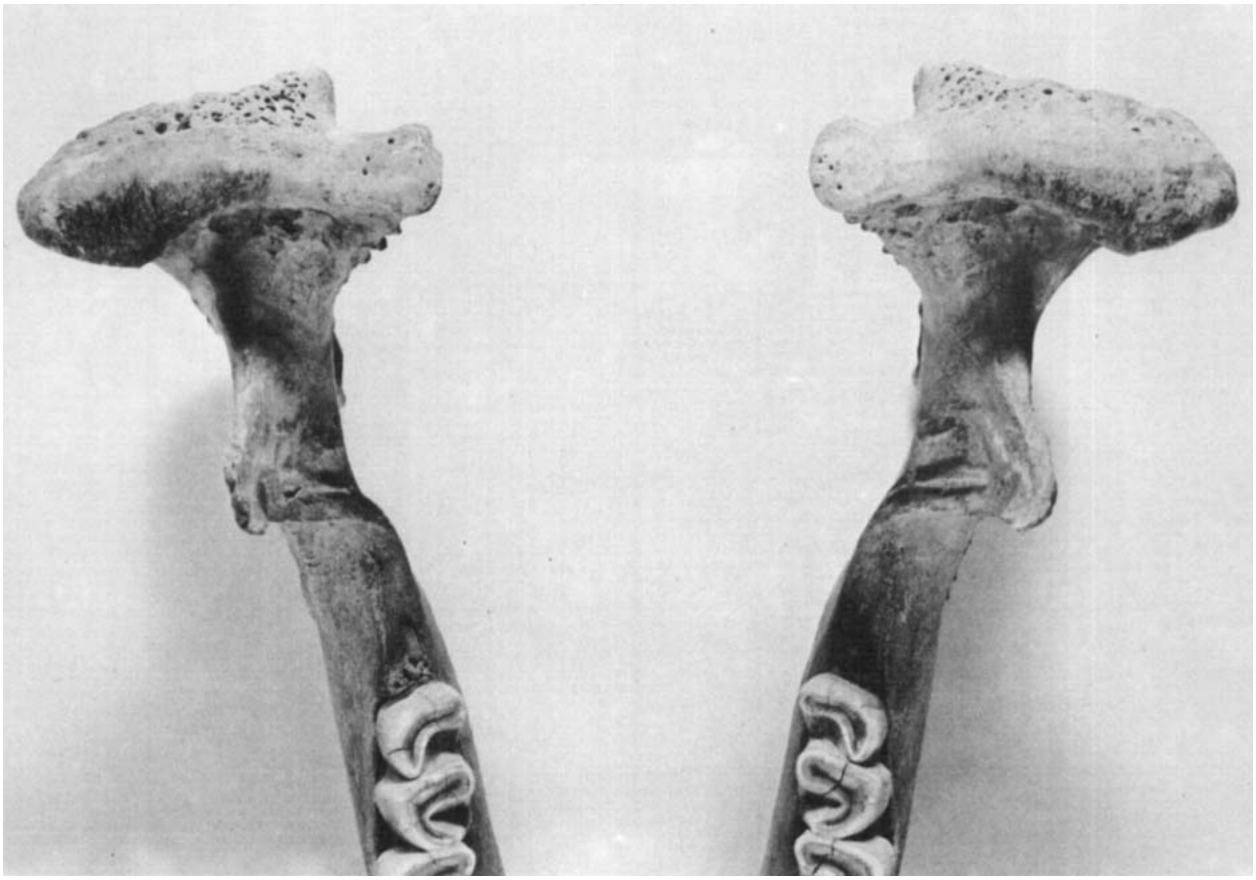

PLATE IV. Javan rhinoceros, Manchester Museum. Mandibular condyles showing pathological change.

Each temporo-mandibular joint is the seat of a chronic osteoarthritis. Each mandibular condyle is somewhat eburnated and sparsely pitted following destruction of its clothing cartilage and the left condyle is slightly deformed. A corresponding eburnation and distortion of contour marks the articular eminence of the left glenoid fossa. The precondylar region (fovea colli mandibulae) is coarsely pitted while the postcondylar region is obtrusively cribriform from multipunctate loss of the outer compactum (Plate IV). The osteoporotic condition of the mandible neck is the result of a localized rarifying osteitis associated in some manner with life in captivity and is unknown in the cranium of the wild-living rhinoceros. The severity of the temporo-mandibular arthritis would appear not to have been sufficient to have impaired masticatory movement of the mandible.

Commentary

The total cranial morphology of the Manchester Museum specimen proclaims it to be that of a Javan rhinoceros and thus a welcome addition to the more generally-known corpus of

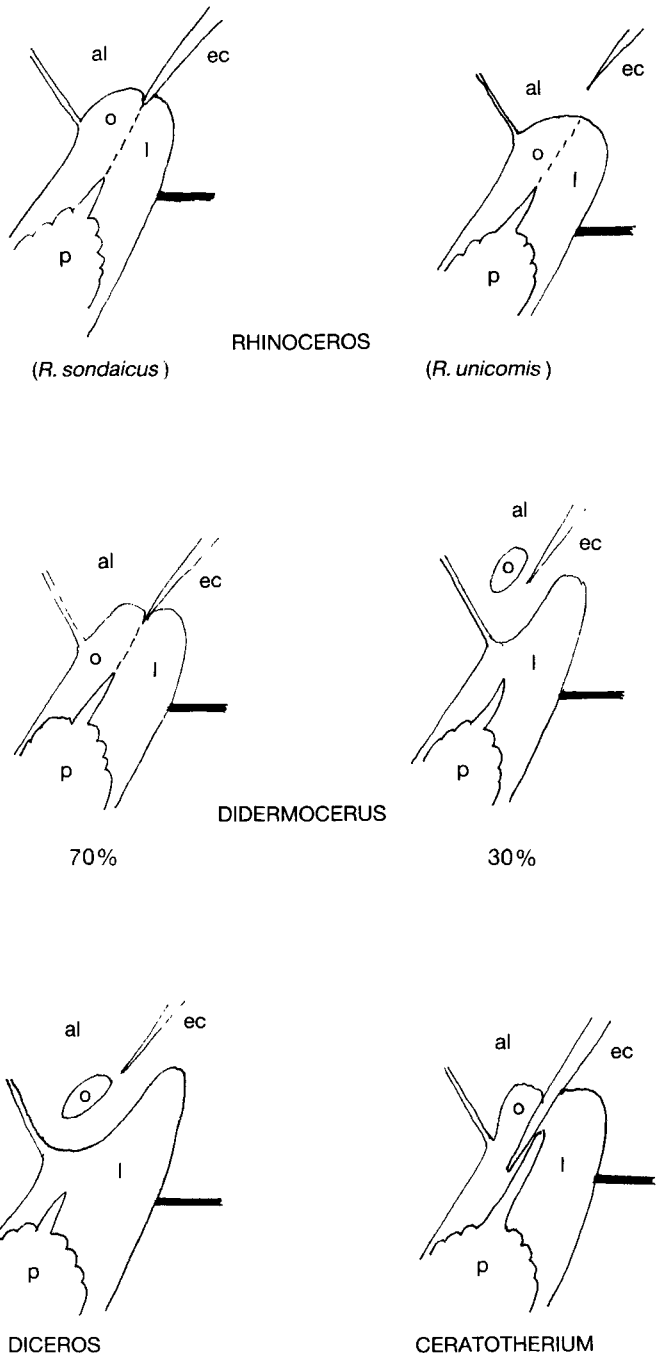

FIG. 1. Diagrammatic representation of the relationship of foramina ovale et lacerum in the Rhinocerotidae. al = alisphenoid, ec = Eustachian crest, l = foramen lacerum, o = foramen ovale, p = petrous temporal, - - - - - = petro-sphenoidal ligament.

R. sondaicus research material. Its value is undiminished by its manifestation of the sequelae of life in captivity, viz. temporo-mandibular arthritis, defective tooth-root formation and generalized parodontal disease.

Its lack of mandibular first premolars merely exemplifies the known propensity for variation manifested by the *R. sondaicus* first premolars in both the upper and the lower jaws. Its manifestation of a single incisor in each premaxilla and mandible moiety prompts brief consideration of the number and morphological placement of the Javan rhinoceros incisors. Largely on the basis of arrangements obtaining in the closely allied Indian rhinoceros (*R. unicornis*), the premaxillary incisor of *R. sondaicus* is generally considered to be a medial incisor and the mandibular incisor a lateral incisor, i.e. to be, respectively, the developed medial and lateral members of the paired embryonal anlagen. Flower, however, on palaeontological grounds, regarded *Rhinoceros* incisors as true canine teeth.

Rhinoceros phylogeny attests a progressive reduction in incisor-number (which attains its apogee in the virtual or actual loss of such teeth in the extant African genera, *Diceros* and *Ceratotherium*), and specimens of the Asian genus *Rhinoceros* are not wanting wherein phylogenetically lost incisors reappear. Thus supernumerary incisors occurred in two Indian rhinoceros crania and one (still extant) Javan rhinoceros cranium in the Royal College of Surgeons Museum. In the first *R. unicornis* specimen (Osteol. Series 2124), three small supernumerary incisors were present in the mandible between the large canonical incisors: in the second *R. unicornis* specimen (Osteol. Series 2125), an additional incisor lay medial to the canonical right maxillary incisor. The extant *R. sondaicus* specimen (Osteol. Series 2133) lacks the premaxillae and has the milk dentition *in situ*: three milk incisors are present in each mandible moiety, viz. a small first (medial) incisor, a large second (lateral) incisor and another incisor situated between, or rather medial to, these two. Such specimens suggest that, in *Rhinoceros*, the incisor teeth are potentially two in each premaxilla and three in each mandible moiety.

All extant rhinoceros forms have the foramen ovale separated in life from the foramen lacerum, whether these foramina be discrete or confluent in the macerated cranium. The mode of foramen separation may be ligamentous or osseous, a matter of no functional importance and one uninfluenced by internal or external environmental factors: it becomes, therefore, a character of some taxonomic value. As already indicated, the two foramina in *Rhinoceros* are separated by a (petro-sphenoidal) ligament, the mode of anterior attachment of which distinguishes *R. sondaicus* from *R. unicornis*. In the African rhinoceros genera *Diceros* and *Ceratotherium*, the foramina in question are permanently separated by bone, but in widely different fashion. In *Diceros*, the intervening bony barrier is formed by a uniform strip of alisphenoid, so that the foramen ovale is wholly intrasphenoidal: in *Ceratotherium*, however, the barrier is a bridge compounded of overlapping processes from the alisphenoid and the petrous temporal. Curiously, the primitive Asian rhinoceros genus *Didermocerus* does not conform to this schema of taxonomic assessment: some two thirds of Sumatran rhinoceros crania manifesting the type of foramen relationship typical of *Rhinoceros*, the remainder that typical of *Diceros* (Fig. 1). The implications of this variation in the pattern of foramen separation lie outside present consideration.

The photographs illustrating this notice have been generously provided by the Manchester Museum courtesy of Dr M. V. Hounsome, Keeper of Zoology, to whom the writer's gratitude is hereby tendered.

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