

REVIEW

Review of the European perception of the African rhinoceros

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Abstract

From 1515, the rhinoceros was well known in Europe through a woodcut by Albrecht Dürer, showing an armoured animal from India with one horn on the nose and a spurious 'Dürer-hornlet' on the shoulders. When the first reports of the rhinoceros from Africa spread in the 17th century, it was not differentiated from the prototype, although it had a smooth skin and two nasal horns. Parsons in 1739 recognized differences between rhinos in Asia and Africa, but could not clearly separate them as two forms. Linnaeus based *Rhinoceros bicornis* on a skull from India with a second horn added by a trader. Camper in 1780 provided first anatomical proof for the existence of two species of rhinoceros distinguished by the number of teeth and horns. In the 19th century, travellers exploring the interior of southern Africa named rhino species according to the shape and size of the two horns, known as the *Rhinoceros simus* of Burchell, the unicorn of Campbell, the keitloa of Andrew Smith and the Mohoohoo of Oswell. Around 1900, with an increase of observations from the entire African continent, only two species were recognized, known as black rhino *Diceros bicornis* and white rhino *Ceratotherium simum*. The black rhino was first seen in captivity in the 1870s, the white rhino in 1944. Their status in the wild is precarious primarily because of illegal hunting for the horn. Continuous protection and management in the field together with research and documentation of their biology can still achieve their long-term preservation.

Key words: Rhinocerotidae, taxonomic history, distribution, captive management, conservation, Africa

Powerful in proportions, pachydermatous, armoured and horned. These and other characteristics of the rhinoceros are immediately apparent in a woodcut designed by Albrecht Dürer of Nuremberg as early as 1515. The artist never travelled to the banks of the Brahmaputra in India or the Limpopo in South Africa, nor did he have a chance to see the animal in a zoo or menagerie. Instead, he relied on an eye-witness account received from Portugal where the first rhino to be brought alive to Europe in 12 centuries arrived on 20 May 1515. Dürer never doubted his informant, read the letters with great care, looked at a sketch made on the spot, and produced an image of the rhinoceros which has retained its appeal for nearly half a millennium. The animal that arrived in the harbour of Lisbon was a present from Sultan Muzafar II, of the kingdom of Gujarat on the west coast of India, to the Portuguese King, Manuel I (Bedini, 1997; Monson, 2004). Within a year, it was decided to send the rhino to Rome as a present to Pope Leo X, possibly to emulate the successful exhibition of Hanno, the Indian elephant donated by Manuel, which for 2 years was 'a source of constant delight to the populace' until its death on 16 June 1516

(Lach, 1970). The rhino, however, never reached Rome as it drowned after a shipwreck off the Italian coast in January 1516. Rumours that some remains were washed ashore, perhaps the hide, bones or horn, provoked occasional searches, as yet inconclusive, in collections of the Vatican and around Italy.

In ancient Rome, 12 examples of the rhinoceros were shown alive in the arenas and menageries, from Augustus in 29 BC to Philippus Arabicus in 248 AD (Störk, 1977; Rookmaaker, 1998a). While a few of these animals may have been single-horned, originating from India, the majority were African, probably imported from areas bordering lower Egypt. Coins dating from the reign of Emperor Domitian in the first century clearly show the animal with two horns (Fig. 1). Gowers (1950) argued that these were white rhino *Ceratotherium simum*, but the recent discovery of a statuette dating from the second century (Colls *et al.*, 1985) suggests that they may just as well have been black rhino *Diceros bicornis*. In an epigram celebrating the dedication of the Colosseum in the time of Titus in 80 AD, Martial wrote that the rhinoceros threw a bear into the air with its double horn: 'namque gravem gemino cornu sic extulit ursum.' The commentators who rediscovered the classics in the Renaissance only knew a one-horned rhino and invented some extremely innovative

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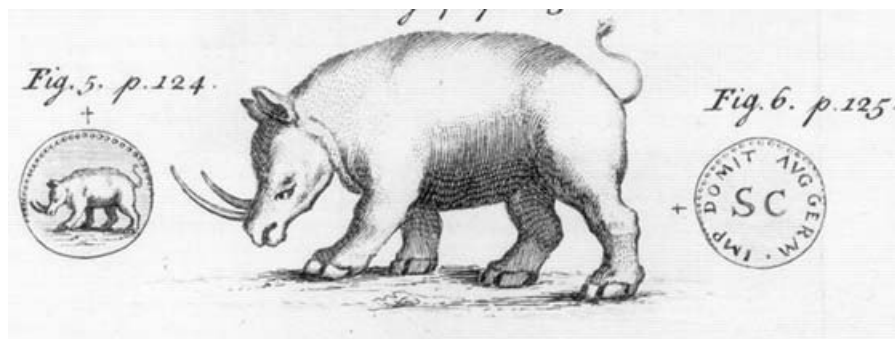


Fig. 1. A double-horned rhinoceros on a coin from the times of Domitian, in the collection of Hans Sloane in London and figured in the *Philosophical Transactions of the Royal Society*, 46: pl. 2 (1749).



Fig. 2. The rhinoceros depicted in a woodcut by Albrecht Dürer in 1515, with heavy body-armor and a spurious horn on the shoulders, was often copied in books and artworks. This example is found among the plates with animal figures collected by Aldrovandi in Bologna around 1600 (*Tavole di Animali* 1, chapter 91, ©Biblioteca Universitaria, Bologna).

explanations to accommodate the anomaly. There was an erudite game of words, in a world where unicorns and rhinos met, but consequently it made naturalists cautious whenever the two horns of the rhino were mentioned.

Dürer's woodcut exhibited the quintessence of the rhinoceros, naturalistic enough to identify the animal as one of the Indian species (single-horned with prominent folds in the skin) rather than African (double-horned with smooth skin). The woodcut shows a feature that contributed to the rhino's fame, generated many pages of speculation and for a long time hindered progress in understanding the classification of the five recent species of rhinoceros: a small spiral horn situated on the shoulders, aptly called the 'Dürer-hornlet'. The image created by

Dürer was consistently used to illustrate the rhinoceros, being copied with greater or lesser modifications not only in all zoological texts, but also in an almost inexhaustible array of arts and crafts produced well into the 18th century (Cole, 1953; Clarke, 1986; Walter, 1989). It was soon so well-known and universally accepted, that there could be no question in anybody's mind, be they learned scholars or members of the public, that the rhinoceros had heavy armour on its body, a prominent ribcage, tubercles on the skin, three hooves on each foot, a single horn on the nose complemented by a second horn on the shoulder (Fig. 2). This was the type against which all future references to animals provided with nasal horns were going to be measured.

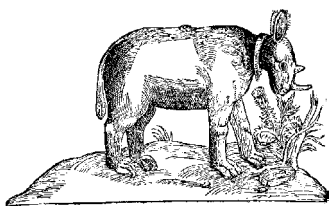


Fig. 3. The 'asinus cornutus' or horned ass first illustrated in Aldrovandi's *De quadrupedibus solidipedibus* (1616).

Early scientists such as Gesner (1551) and Aldrovandi (1616, 1621) could still hope to enumerate all known mammals in a few large tomes, combining the classics with new discoveries. Both mentioned the rhinoceros, but only in its one-horned guise. In 1616, Aldrovandi additionally published a figure of a 'horned ass' *Asinus cornutus*, showing an animal with two nasal horns, a smooth skin, three hooves on each foot and a collar around the neck (Fig. 3). He received the drawing from his friend Joachim Camerarius in Nuremberg on 19 May 1595, with the explanation that it was made many years previously in Constantinople (Dougherty, 1996). The animal reportedly had been taken alive in Egypt when the Ottomans conquered the Satrap of Abyssinia and exhibited in Constantinople. It was independently verified by Samuel Kiechel (1866), who saw a 'Renozerus' in the Turkish capital in 1588. The horned ass appeared in Aldrovandi's book on whole-hoofed animals, immediately followed by a host of different kinds of unicorns (Aldrovandi, 1616). The rhinoceros was described in his volume on cloven-hoofed animals on 12 closely-printed folio pages, illustrated with a close copy of Dürer's woodcut (Aldrovandi, 1621). The rhinoceros, therefore, was assumed to be in a different class from the unicorn or the asses, while the number of nasal horns in the 'horned ass' defied all criteria of classification handed down from Aristotle and Pliny (Dougherty, 1996). Although tradition and theoretical considerations could not allow Aldrovandi to make the connection between these two animals, few people, since Cuvier (1812), would fail to recognize it as the first post-medieval depiction of the double-horned rhinoceros from the African continent.

In 1652, Jan van Riebeeck was sent to Africa to establish a permanent trading post at the Cape of Good Hope on behalf of the Dutch East India Company. In preparation for this venture, Hondius (1652) collected the information already available about the region and reported the presence of rhinos on Table Mountain and at Mossel Bay. In the decades that followed, evidence gathered at the Cape by both residents and visitors contributed to an understanding of the differences between the fauna of Africa and the rest of the world. It was a slow process, because zoology was not a skill required for trade and there were many preconceptions and prejudices to overcome that would convince the scholars in Europe to revise the classifications established by Gesner and Aldrovandi. The easiest distinction between the rhinoceroses of Africa and that of Asia would have been in the number of horns, two rather than one, but unfortunately Dürer's

rhinoceros could be interpreted to show either one horn (large and nasal), or two horns (incorporating the one on the shoulders). It was necessary, therefore, to show that the two horns of the rhinos in Africa were both definitely positioned close to each other on the nose and were both almost equally large. The books written about the Cape of Good Hope during the first half century of European presence remained largely equivocal as far as the appearance of the rhinoceros was concerned. There was no consensus and even the most informed readers would have had little reason to suspect that the rhinos in Africa were anything but the armour-plated Dürer rhinoceros. A few authors, such as Flacourt (1658) and Chaumont (1686), definitely stated the presence of two horns in the African rhino. On the other hand, Schouten (1676) first wrote that he examined a mounted skin of a rhinoceros in the Museum of the Company's Fort in March 1665, then continued to describe the Dürer rhino, figured prominently in the frontispiece of his book. The same confusing impression is gained from a plate in Herport (1669), in which a group of Khoi, an ostrich and a Dürer rhinoceros are shown in a landscape dominated by the unmistakable contours of Table Mountain (Fig. 4). Actually, Flacourt (1656, 1658) was the first, and one of the very few, to illustrate a recognizable double-horned rhinoceros in a book of travels using its own name (Fig. 5; Rookmaaker, 1985, 2004a).

It may be said with some justification that the European literature on Africa began in earnest only at the beginning of the 18th century (Pratt, 1992), particularly with the publication of the complete description of the Cape of Good Hope by the German naturalist Peter Kolb (1719). Kolb was sent to Africa in 1703 to make astronomical observations for his patron and returned home 8 years later (Wolfschmidt, 1978). His book provided exhaustive details on the geography, ethnography and natural history of the region. He devoted almost two folio pages to the rhinoceros, which he may never have seen in the flesh, clearly stating that it has a dark-coloured horn on the nose, and a smaller one further backwards towards the forehead. The facts were accurate, but glaringly contradicted by the illustration, which showed an elephant in mortal combat with a typical Dürer rhino. The inconsistency was recognized by the publishers of the Dutch translation of Kolb, which appeared in 1727 (Rookmaaker, 1976). When they commissioned Jan Wandelaar to upgrade the plates in the book, the artist found that there was a mounted skin of a double-horned rhinoceros in the museum of the University of Leiden, listed in a contemporary catalogue (Anonymous, 1733). The animal had been shipped alive from the Cape in 1677, but perished during the journey – one can only guess how its safe arrival and exhibition might have accelerated the recognition of the species. Thus, there are two plates of the rhino in Kolb (1727), one showing the traditional image, the other figuring an animal with two nasal horns and a smooth skin 'according to this description' (Fig. 6). This instance shows how specimens had at best a slow and accumulative impact on classification, which was traditional and unable to cope with an influx of unconventional forms.

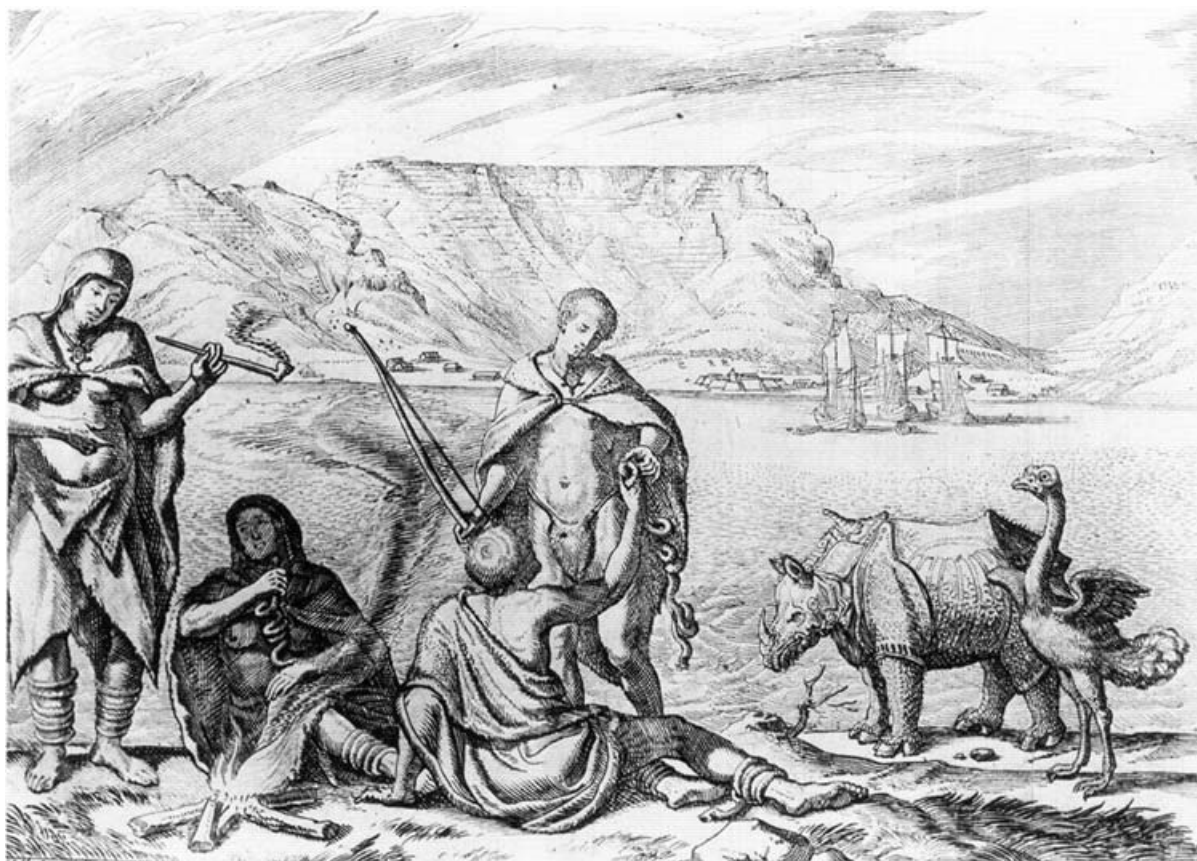


Fig. 4. A scene at the Cape of Good Hope, from Herport's *Kurtze Ost-Indianische Reisz-Beschreibung* (1669: 12).

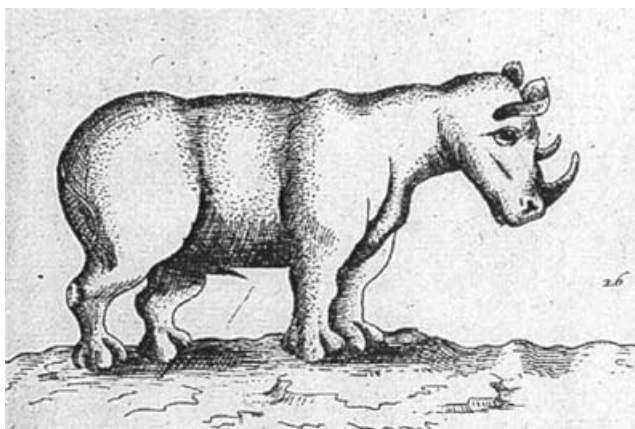


Fig. 5. The 'Rhinocerot' of the Cape of Good Hope, locally called 'Gabah', found on a map of the Island of Madagascar published by Etienne de Flacourt in 1656.

There were relatively few rhino parts in private cabinets and institutional or royal museums in Europe before 1760 (Rookmaaker, 1999). As could be expected, it was most common to find single horns, unattached to a skull or to another horn. Among the richer collections, the one of Hans Sloane in London boasted at the time of his death in 1753 a cup made of rhino horn, horn shavings used to counter poison, a piece of hide, a very large horn as

well as two horns joined together by the skin (Clutton-Brock, 1994). The horns, described by Sloane (1749) and figured by Parsons (1743, 1767), are still kept in the Natural History Museum in London, proving that one of the horns in fact belonged to a white rhinoceros. A few other specimens in continental collections were described in detail (Schroeckius, 1686) or illustrated (Bartholinus, 1678; Jacobaeus, 1696). At the time, this information did not lead to the conclusion that there could not possibly be only one kind of rhinoceros. An opportunity to review the available information presented itself in 1739.

In June 1739, a young male rhinoceros from India was exhibited in Eagle Street in London. It was the fourth rhinoceros seen alive in Europe after the days of the Romans, as the Lisbon one of 1515 had been followed by examples of the Indian rhino exhibited in Lisbon and Madrid 1579–1586 and in London 1684–1686 (Rookmaaker, 1998a). The second specimen to reach London was examined in detail by the physician James Douglas, who asked his assistant James Parsons to make drawings of the animal while it was still alive and to search the literature for information and illustrations (Rookmaaker, 1978). Parsons presented his findings to a meeting of the Royal Society of London on 9 June 1743, elaborating on the morphology and behaviour of the animal. At the end of his talk, he spoke on the interpretation of Martial's epigram from a zoological perspective, concluding that all rhinos 'of Asia have really but one Horn upon the Nose,' and with

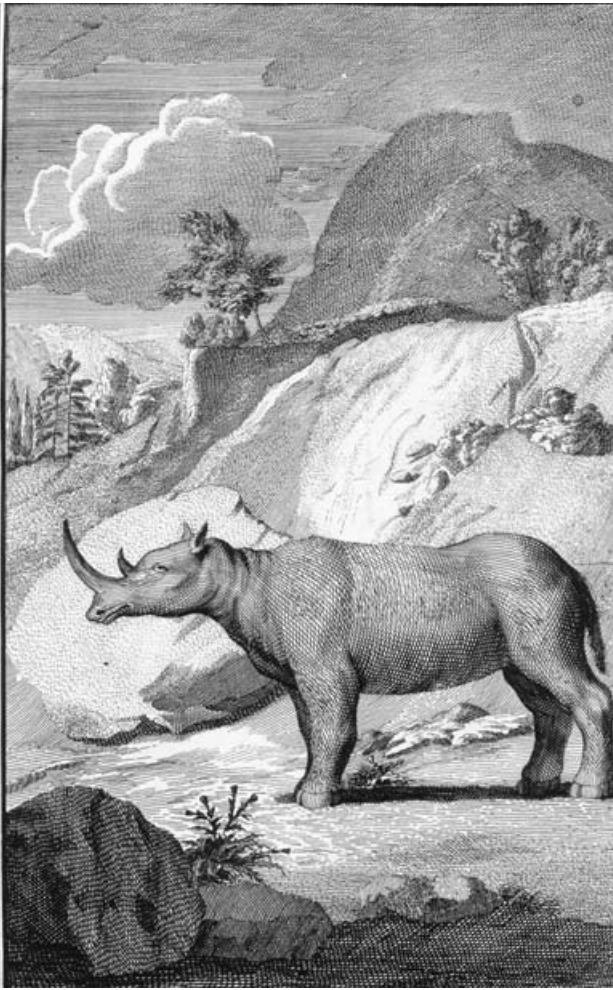


Fig. 6. A naturalistic depiction of the African rhinoceros drawn by the Dutch artist Jan Wandelaar, from the Dutch translation of Kolb's *Description of the Cape of Good Hope* dated 1727.

reference to Kolb (1719) that 'we do not want sufficient Proofs to shew, that there is a Species of those Animals in Africa, having Two Horns on the Nose' (Parsons, 1743). He deliberately left scope for a single-horned rhino existing in Africa, because it would have been all too easy for a critic to point at any number of references to such animals, including the plates in Herport and Kolb.

When, in the middle of the 18th century, the zoological material brought from Africa and Asia increased exponentially, the necessity for description, categorization and classification became more pressing. The popular image of the rhinoceros was gradually moving away from the Dürer-inspired armour-plated beast with the curious hornlet, especially through the exhibition of 'Clara', a female Indian rhinoceros which was taken on extensive tours throughout Europe by its Dutch owner between 1742 and 1756 (Clarke, 1986). Thousands of people went to see her and bought the broadsheets for sale in many languages, while scientists examined her and artists rendered her appearance in drawings and paintings (Rookmaaker & Monson, 2000; Faust, 2003). Once again, the rhinoceros was established in the popular mind as an animal with a single horn on the nose and a skin divided into shields

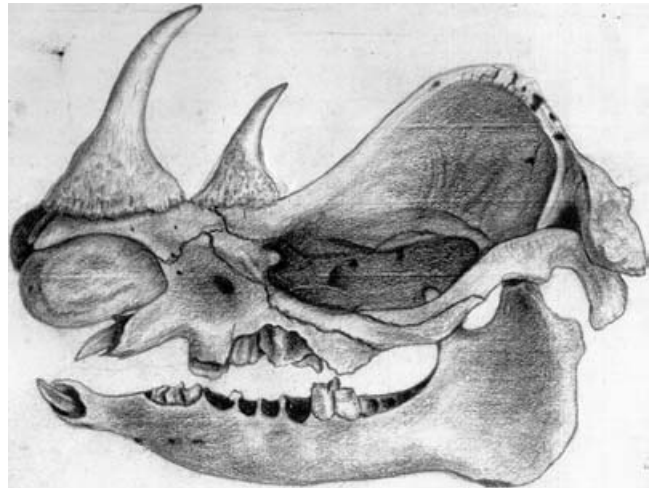


Fig. 7. Drawing by James Parsons (c. 1740) of a skull in a London collection, showing all the characteristics of an Indian rhinoceros with an additional posterior horn. Linnaeus could have examined exactly such a specimen to describe *Rhinoceros bicornis* in 1758 (Glasgow University Library, Department of Special Collections).

by deep folds. The tour of 'Clara' sparked new interest in the rhinoceros and led to two elaborate reviews of the literature. Regarding the number of species, Freytag (1747) found evidence in his sources that both in Asia and in Africa there were rhinos with two horns. Ladvocat (1749) reached the surprising conclusion that females on both continents had a single nasal horn, while the African males substituted the hornlet on the shoulder with a small one on the forehead.

When Linnaeus started to construct a universal system of classification and nomenclature, he decided to use the number of front teeth as an important characteristic in mammals. In the authoritative 10th edition of his *Systema naturae*, Linnaeus (1758) recognized the genus *Rhinoceros* for animals with two front teeth and one or two horns on the nose, which then included two species: *Rhinoceros unicornis* with a single horn, from Africa and India, and *Rhinoceros bicornis* with two cuneiform horns, from India. The second species has always been assumed to refer to the African black rhinoceros, because Linnaeus included references to Schroeckius (1686), Jacobaeus (1696) and Kolb (1719). He explicitly stated that he was convinced of the existence of a double-horned rhinoceros, because he had personally examined 'cranium tantum' or 'only a skull'. According to his description, that specimen came from India, had two teeth in the front part of each jaw and two large horns placed in tandem on the nose. No specimen of this description is known from collections in Sweden and Holland studied by Linnaeus, nor is a loose skull or head depicted in any of his references (Rookmaaker, 1998b). Nevertheless, Linnaeus may have described exactly what he saw, possibly when he visited England in 1736, because a skull matching his diagnosis was sketched by Parsons in an English (probably London) collection in that period (Fig. 7). The drawing shows a skull of *Rhinoceros unicornis*, from India, with front teeth, but anomalously with two horns, one of which must have

been added at some stage to increase the value of the specimen.

There remained at this time ample scope for disagreement, simply because the evidence was too fragmentary. There continued to be reports that could point to the existence of a single-horned rhinoceros in Africa, or a double-horned one in Asia. There were still conflicting theories on how the species should be interpreted. For instance, Buffon (1764) combined all information on the rhinoceros in one chapter, quoting the description by Parsons (1743) and illustrating the text with a likeness of 'Clara', after a painting made in Paris by Jean-Baptiste Oudry in 1749 (Clarke, 1984). He was aware of reports about double-horned rhinos and had a few specimens in the Cabinet du Roi in Paris. He suggested that the number of horns could change according to climatic conditions and consequently that the two varieties were mere expressions of the same species.

The system proposed by Linnaeus facilitated comparison of specimens and the addition of hitherto unrecognized forms. Certainly as far as the Cape of Good Hope was concerned, the number of travellers looking to collect and describe specimens of the local fauna increased significantly after 1770 (Rookmaaker, 1989). Although rhinos could still be encountered within the confines of the colony, south of the Orange River and west of the Great Fish River, the animals were by no means common and travellers rarely recorded more than a few during a journey lasting several months. There were no longer reports of their presence in the vicinity of Cape Town, where they probably disappeared towards the end of the 17th century. Anders Sparrman, a pupil of Linnaeus, was present when two rhinos were shot on 19 December 1775 at Quammedacka Spring, a few miles north-east of Port Elizabeth. He carefully measured and examined the animals, collected the horns and one of the skulls to take home, and after his return to Sweden published an accurate morphological and anatomical description, providing details hitherto not found in print (Sparrman, 1778, 1783). The morphology of the rhinoceros was also studied by Robert Jacob Gordon, commander of the Cape garrison, who made three extensive journeys into the interior between 1777 and 1780 (Raper & Boucher, 1988; Cullinan, 1992). On 2 November 1778, he was with a party that killed a rhino on the Gamka River, near Beaufort West. Gordon made a number of sketches on the spot and recorded a wealth of information about the animal's appearance and behaviour (Cave & Rookmaaker, 1977). Although he never published his observations on African fauna and flora, he sent reports and specimens to friends in Holland, where the most important discoveries were published by Allamand in supplements to Buffon's *Histoire naturelle* printed in Amsterdam (Rookmaaker, 1992). In one of these chapters, Allamand (1781) presented a detailed account of the double-horned rhinoceros of Africa with 36 measurements, accompanied by a plate showing the animal with the correct number of horns and the absence of folds in the skin. Gordon correctly reported that this rhino had a total of 28 teeth, seven in each half of the upper and

lower jaws, and lacked front teeth. Buffon seemed to value Allamand's contribution, because it was reprinted in one of the volumes of the work printed in Paris (Buffon, 1782). Disconcertingly, however, the details about the dentition were changed without explanation, to give the animal six molars in each side of the jaws, as well as an incisor in the front, still a total of 28. Buffon, therefore, could still maintain that there was just one species of rhinoceros.

Buffon's position became increasingly hard to maintain in view of the descriptions, drawings and specimens of African rhinos which became known to the scientific community in Europe. The reluctance to double the number of rhino species may be explained by the impossibility of refuting traditional views with conflicting reports, as well as by the absence of an authoritative reviewer. This role was finally filled by Petrus Camper, Professor of Anatomy at the University of Groningen. In 1771, he received the skull, head-skin and horns of a rhino from South Africa. When he examined these specimens during a public lecture in February 1772, he was uncertain about the absence of front teeth, because that part of the skull could have been damaged. When he later presented his findings both in a Latin summary and a Dutch monograph, Camper (1780, 1782) was more confident about his conclusions, given the additional assurance provided by Sparrman (1778) and Gordon (in Allamand, 1781). He therefore categorically stated that the number of horns found in the rhinoceros did not rely on sex, age or climate. Hence, there were two rhino species: one in Asia, with a single round horn on the nose and conspicuous folds in the skin, and another in Africa, with two flat horns and a smooth skin. Finally, 130 years after the Dutch settled in South Africa, the matter of the African rhinoceros was settled.

In 1812, the English naturalist William John Burchell was among the first to explore the African interior beyond colonial boundaries. He went as far as Chué Springs in the country of the Bechuanas, just north of Kuruman. Having encountered only a few rhinos *en route*, he must have been excited to find two different types around the spring, one of which was larger than the other and had a square upper lip. He shot at least one of these, took measurements, made sketches and collected a skull and horns (Fig. 8; Cave, 1947, 1962). Two years after his return to England in 1815, he wrote about his discovery to H. M. Ducrotay de Blainville in Paris, who duly published the letter in which Burchell (1817) described the new species as *Rhinoceros simus*. He did not give the animal an English name, stating that the Bachapins used *killenyan* for the common species and *mohohu* for the one new to science (Burchell, 1825). Today these two African rhino species, *Diceros bicornis* and *Ceratotherium simum*, respectively, can be called 'prehensile-lipped' and 'square-mouthed' rhinos, or 'browse' and 'grass' rhinos, but commonly they are known as 'black' and 'white' rhinos. The name 'white', evidently inconsistent with the colour of the skin, is generally explained as a corruption of 'wyd' allegedly used by Boers for the wide upper lip, as first suggested by Pitman (1931). This derivation, however, is linguistically impossible and just as implausible as a host of other

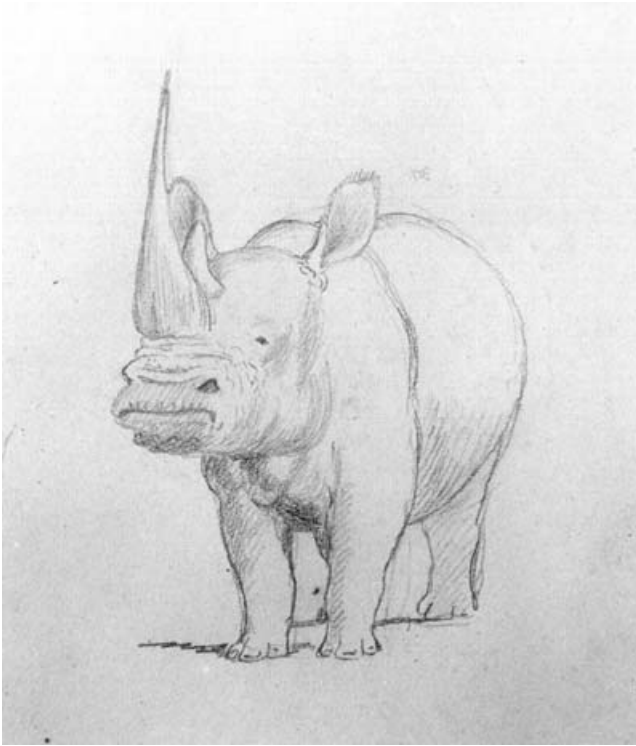


Fig. 8. One of the first drawings of a white rhinoceros, made in the field near Chué Springs in South Africa in October 1812 by William John Burchell (MuseumAfrica, Johannesburg, no. 68/1844).

theories on the origin of the name (Rookmaaker, 2003a). The juxtaposition of black and white for different rhinos dates back at least to Alexander (1838) and Harris (1838), but as they never explained this choice of epithets, this probably reflected a more common usage then at the Cape of Good Hope.

Burchell's discovery of a new species of rhinoceros in the South African interior was just one in a series of similar claims as people went further into the interior. Samuel Daniell (1805) figured a rhino 'supposed to be a new species' shot in December 1801 at Koussie Fontein near Kuruman, during an expedition undertaken by P. J. Truter and W. Somerville (Rookmaaker, 1998c). John Campbell returned to England with the head of a rhinoceros which was killed in Mashow near Mafeking on 18 May 1820. As it had a very short posterior horn, it was suspected to be a new species and maybe even a kind of unicorn, but no scientific name was given (Campbell, 1822; Home, 1822). Andrew Smith, superintendent of the South African Museum, was in the same area around Mafeking 15 years later as director of the 'Expedition for Exploring Central Africa'. On 1 June 1835, members of his party shot a rhino which was said to differ from the black species in its greater ferocity, greater length of the second horn and the shape of the head. In the report of the expedition, Smith (1836) described it as a new species, *Rhinoceros keitloa*, and later (Smith, 1838) figured it prominently in the first instalment of his *Illustrations of zoology* (Fig. 9) The easiest character to distinguish the *keitloa*, and probably the only one used in the field, is the equal or near-equal length of both horns. Unwittingly, by allowing

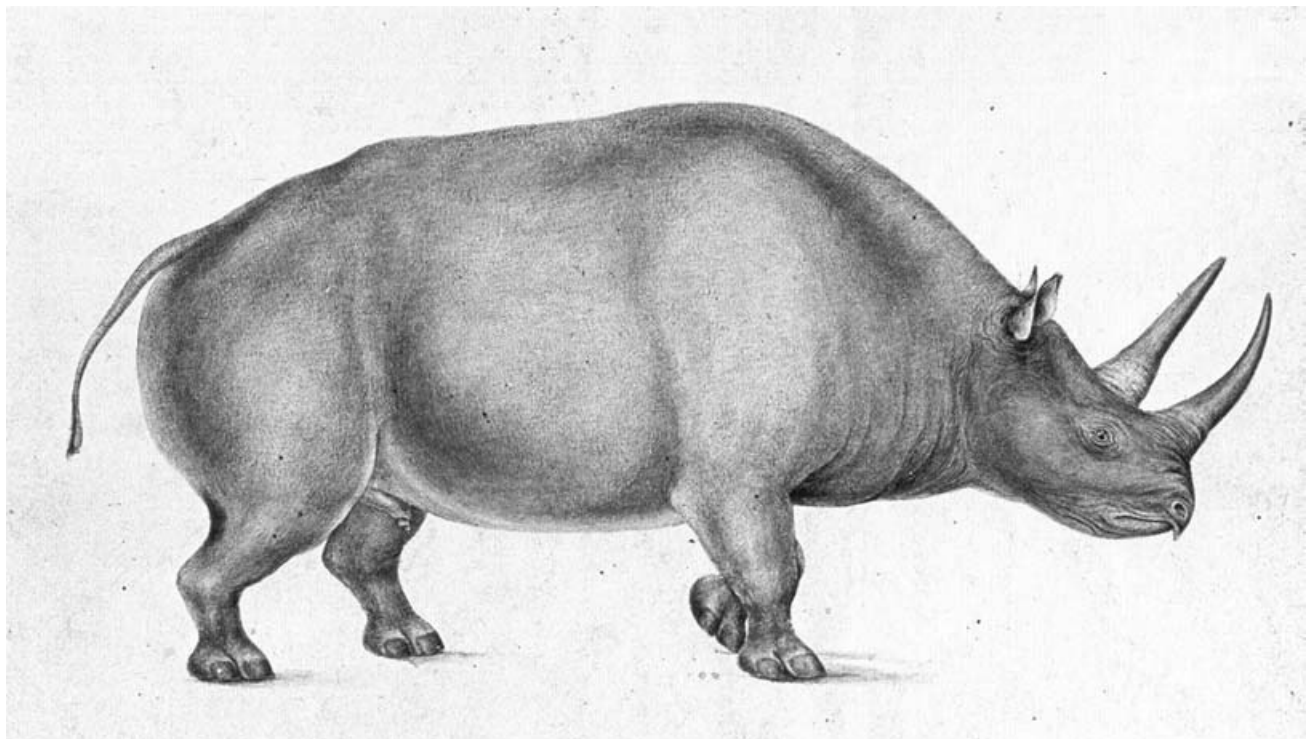


Fig. 9. *Rhinoceros keitloa*, with horns of equal size, discovered by Andrew Smith in June 1835. Drawn by Gerald Ford to be published in Smith's *Illustrations of the zoology of South Africa*, pl. 1 (University of Witwatersrand, Johannesburg).

this new species, Andrew Smith gave scientific approval to the sportsmen's future predilection for identifying rhinos by the size and shape of their horns.

A further type of rhinoceros was recognized in July 1846 by William Cotton Oswell during a shooting trip on the banks of the Makolwe (Mokolo) River, a southern tributary of the Limpopo. Generally like a white rhinoceros, it had a long anterior horn which curved forward. Elliot (1847) named it *Rhinoceros oswelli*, while the local Bechuana referred to it as *quebaba*. When reading the sporting literature of the 19th century, rhinos were commonly divided into four species referred to by their vernacular names in a rather bewildering variety of spellings. The two kinds of black rhino were *killenyan*, *borele* or *chakuru* and *keitloa* or *ketloa*, while the two types of white rhino were *mohohoo* and *quebaba* or *kuabaoba*. This practice was by no means restricted to tales recounted around the campfires, and it soon entered the taxonomic literature. Gray (1869) divided the African specimens in the British Museum into four species: *Rhinaster bicornis* (bovili), *R. keitloa* (keitloa), *Ceratotherium simum* (mahohoo) and *C. oswellii* (kobaaba). Drummond (1875) even added a fifth species, based on field experiences in Natal, by dividing *Rhinoceros bicornis* into two sympatric subspecies, named *Rhinoceros bicornis minor* (borele) and *R.b. major* (kulumane). This classification, which Drummond (1876) reiterated in a lecture at the Zoological Society of London, must have baffled his audience, based as it was entirely on individual characters, and it was greeted by a prolonged silence. Interested parties were waiting for a new reviser with a different perspective.

When Smith travelled through the region of the Magaliesberg, rhinos were plentiful; on 13 July 1835 he saw between 40 and 50 (Smith, 1940). Shooting in the same area a year later, Harris (1838) counted over 60 black rhinos in one day and 22 white ones within a distance of half a mile of the Limpopo River. Ten years later, a little further north in the south-eastern corner of Botswana, Gordon Cumming (1850) recorded a group of 12 white rhinos, and the black species was equally common. This situation changed through the introduction of firearms and increased possibilities of commerce, settlement and agriculture. Although precise data are absent, the sporting literature after 1850 certainly gives the impression that hunters needed to travel increasingly further into the interior to meet with wildlife in large numbers, into the territories north of the Orange and Limpopo Rivers. When Selous (1881) wrote about his wanderings in the present Botswana and Zimbabwe, he predicted the rhino's disappearance within a very few years. Even if he may only have meant the white rhino near the Zambezi River, the idea of a reduction in the number of all rhinos was probably sadly accurate. The last pair of white rhinos in northern Zimbabwe was shot in 1893 to secure the remains for museums in England (Rookmaaker, 2003b). The black rhino, more elusive and secretive and able to survive in forests unattractive to people, saw a similar sharp reduction in numbers.

No sooner had the white rhino been declared extinct, than word spread in 1894 that six had been killed on the

Umfolozi River in Zululand. This population had hitherto been overlooked and European naturalists were so convinced of the rarity of the white rhino that they suggested that only a few animals could still survive there. The animal soon became a mascot of the budding conservation movement, rallying against the official slaughter of wildlife in Zululand in the 1920s aiming to open up the country to farming and settlement (Pringle, 1982). Although the area was at first rarely visited and no survey of the rhino population was undertaken until 1929, it was generally suggested that only about 20 animals remained. It is likely, however, that such low figures were given for political reasons and I have suggested that the population never actually decreased below 200 (Rookmaaker, 2001, 2002). The population in the south-eastern part of South Africa has increased substantially over more recent years thanks to stringent protection, innovative management techniques, translocation of surplus stock and sale to private owners. In 2001, there were 11 640 southern white rhinos in the wild (Emslie, 2002), which possibly does not include the captive population nor 1969 animals privately owned in South Africa (Castley & Hall-Martin, 2003).

The existence of the white rhino in central parts of Africa was first unequivocally confirmed when Percy H. G. Powell-Cotton presented the Natural History Museum in London with a skull of a specimen, which he shot in the Lado District, South Sudan, named *Rhinoceros simus cottoni* by Lydekker (1908). It was soon established that in this part of the continent the species was confined to pockets in Uganda west of the Nile, southern Sudan, eastern Congo and the Central African Republic (Sidney, 1965). The animal was abundant in Uganda where Roosevelt in 1912 saw up to nine in a single day (Heller, 1913). Schomber (1966) estimated that the total population in central Africa stood at 2800. The decline in numbers has been devastating, and the northern white rhino now only survives in Garamba National Park in the Democratic Republic of Congo, with numbers reduced to less than 30 individuals in 2003 (Hillman *et al.*, 2003).

While the range of the white rhino is conspicuously discontinuous, the black rhino was found through most of the African continent south of the Sahara, from Somalia in the east to Niger in the west, from Sudan and Ethiopia in the north to the southern coast (Sidney, 1965; Rookmaaker, 2004b). The animal was locally abundant and able to adapt to a variety of habitats depending on the availability of browse and water. The decline in numbers of the black rhinoceros has been precipitous, however, especially in the 1970s and 1980s. The latest figures estimate just 3100 black rhinos to be present throughout Africa, of which 66% are found in Kenya, Zimbabwe and South Africa (Emslie, 2002). This total again does not include animals in captivity or a possible 118 held privately in South Africa (Hall-Martin & Castley, 2003). As far as can be established, the species is now extinct in Angola, Botswana, Central African Republic, Chad, Congo, Ethiopia, Mozambique, Niger, Nigeria, Somalia, Sudan, Uganda and Zambia, while populations in Rwanda and Cameroon are below 10 (Emslie & Brooks, 1999; Planton, 1999).

The first black rhino in captivity, caught near Kassala in Sudan, arrived in the London Zoo in September 1868. Until the end of the 19th century, only 13 animals were imported to be exhibited in zoos (Berlin and Paris), travelling menageries and circuses. Imports, mainly from East Africa, continued to arrive in small numbers during the 20th century, increasing only from the 1950s onwards (Reynolds, 1963; Rookmaaker, 1998a). The first captive birth occurred on 7 October 1941 and breeding success has advanced ever since. In 2001, there were 275 black rhinoceros in 73 institutions worldwide (Ochs, 2001a). The world population has been stable during the last decade, with births balancing deaths, requiring a minimum of imports from the wild. The first white rhino arrived in the zoo of Pretoria as late as 1946, and captive numbers only increased substantially in the 1960s when the populations in the reserves in Natal had reached high levels. As the species is gregarious, the zoos in Whipsnade and San Diego imported herds of 20 animals each in 1970–71 to encourage breeding. In the course of the 1970s, 467 white rhinos were transported from South Africa to zoos on all continents (Rookmaaker, 1998a). As the species breeds well in captivity, there are only occasional additions from the wild, and in 2001 the captive population of southern white rhinos was 761 animals in 248 institutions (Ochs, 2001b). The northern white rhino has always been poorly represented in captivity. In 1975, the zoo in Dvur Kralove received six animals from South Sudan. Although a few births have occurred, as at 29 June 2000, the world captive population has dwindled to 11 specimens in 2001 concentrated in Dvur Kralove and San Diego Wild Animal Park (Holeckova & Bobek, 2001; Ochs, 2001b).

Genetic studies unequivocally separate the two African genera *Diceros* and *Ceratotherium* from the Asian genus *Rhinoceros*, while the phylogenetic position of *Dicerorhinus* remains open to discussion (Tougaard *et al.*, 2001). On a lower taxonomic level, the two subspecies of *Ceratotherium simum* (*simum* and *cottoni*) are well-established (Groves, 1975). The subspecific taxonomy of the black rhino is still unresolved, partly owing to the scarcity of material from some parts of its range. Hopwood (1939) accepted three subspecies in a study limited to specimens available in London. Reviewing a wealth of data in a major study of black rhino systematics, Zukowsky (1965) recognized 16 subspecies and a variety. As such splitting had become generally unacceptable when the work was published, Zukowsky's results were revised by Groves (1967), who reduced the number of subspecies to seven, all clearly defined and delimited. Without additional data, Du Toit (1987) suggested that it would be more practical for conservation purposes to focus on four groups, which he called 'ecotypes', but which were soon referred to as subspecies: south-western *Diceros bicornis bicornis*, south-central *D. b. minor*, eastern *D. b. michaeli* and western *D. b. longipes* (Emslie & Brooks, 1999). The range of the typical subspecies was extended to include the surviving populations in Namibia, although previously it had been regarded as extinct (Rookmaaker & Groves, 1978; Hillman & Groves, 1994). The taxonomy of the black rhinoceros urgently needs to be verified

in a comprehensive study, to encompass evidence from the entire continent to improve our understanding of the variation within the species. Genetic studies by Ashley, Melnick & Western (1994), O'Ryan, Flamand & Harley (1994) and S. M. Brown & Houlden (2000) have shown variation in the levels of mitochondrial DNA between populations. These studies will need to be expanded to encompass specimens from less well-known populations.

The reasons for the decline of the African rhinos are partly intrinsic to the continent where they include effects of war, political instability, increased human pressure and habitat destruction. In traditional African societies, rhino meat is seldom eaten and there is little demand for rhino parts. The hide is occasionally used in the manufacture of shields or whips, while the horn is valued as a medicine only in isolated instances (Lagercrantz, 1960). In Asia, horns were made into ornamental cups only up to the first half of the 20th century (Chapman, 1999). References to the use of rhino horn as an aphrodisiac have never been confirmed. The major threat to rhinos today is the immense financial value of the horns in countries outside its current range. In China and Korea, rhino horn is an essential ingredient in traditional medicine as a fever-reducing agent (Martin & Martin, 1982; Leader-Williams, 1992). In Yemen, wealthy and important men wear daggers with handles of this material (Chapman, 1990; Martin & Vigne, 1993, 2003).

The times that rhinos roamed freely and abundantly in the African wilderness have gone forever. There are manifold strategies aiming to increase the probability of their long-term survival ranging from field protection and law enforcement to captive breeding and sustainable use options (Emslie & Brooks, 1999). Not one on its own represents the panacea that will preserve the rhinoceros forever and most have both advocates and opponents. A universal ban in trading rhino horn aimed to reduce poaching and to increase rhino numbers, but some authors advocate a return to an open market (G. Brown & Layton, 2001). Dehorning of rhinos has been attempted as a deterrent to poachers and could have an economic incentive (Milner-Gulland, Beddington & Leader-Williams, 1992). Private ownership has led to an increase in rhino numbers in South Africa, where owners can benefit through eco-tourism and trophy-hunting (Buys, 2000). It is imperative that old and new strategies of rhino conservation continue to be designed, tested and evaluated. It is equally important to foster research in all aspects of rhinoceros biology as well as to document and preserve the existing data on these magnificent creatures. An African ecosystem without black and white rhinos is as intolerable as it is inconceivable.

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