The Regeneration of the Anterior Horn of the Black Rhinoceros, *Diceros bicornis* (Linn.).

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(Plates I & II)

On the 31st December, 1914, the National Zoological Gardens received a female Black Rhinoceros calf ("Maggie") from Gatooma in Southern Rhodesia. The animal's age was unknown, but it was believed to be from 12 to 18 months old on receipt. This specimen lived in the collection until the 15th November, 1942.

"Maggie" was inclined to be nervous when there were many people in the Gardens, and on such occasions she would run around the enclosure a good deal. On being locked up in the sleeping quarters, however, she soon became calm.

On the 29th September, 1928, "Maggie" collided with the iron fence of her enclosure, and soon after it was observed that the animal's anterior horn was loose, and that there was a good deal of bleeding from the base of the horn. When she bent her head downwards the horn could be seen to move forwards, but it did not fall off until the 8th October, 1928. The shed horn was found to weigh 9¼ lbs., and its measurements taken with a tape measure were as follows:—

Measurement along the median line of the anterior surface, 22¼ inches.

Measurement along the median line of the posterior surface, 20 inches.

Circumference around the base, 17½ inches.

In cross-section the shed horn was more or less four-sided, so that an anterior and posterior surface as well as two lateral surfaces were distinguishable. This shape was due to the constant rubbing of the horn against the iron bars and walls of the enclosure. Sclater (1900) states that the anterior horn is rounded at the base, but higher up it becomes laterally flattened and greatly curved backwards; both horns vary very much in shape and size. The shed horn shows the characteristic backward curve (Pl. I. fig. 1). The inferior surface, by means of which it fits on to the rough bony boss of the nasal bones, is somewhat concave with a small, deeply concave cavity, the centre of which lies in the median line about two inches from the posterior margin of the horn (Pl. I. fig. 1). The surface of attachment of the horn is more or less circular in outline and measures 5¼ inches in the median line from the anterior to the posterior surface and 5⅝ inches across the middle transversely (Pl. I. fig. 2).

In rhinoceroses the horn is a purely integumentary structure. The horny layer of the epidermis forms a mass of long hair-like horn fibres which are joined together to form a curved conical horn, and which grow on long dermal papillae (Weber, 1927). According to D'Arcy Thompson (1942), the longitudinal growth of the horn of a rhinoceros proceeds with a maximum velocity anteriorly and a minimum posteriorly. As the ratio of these velocities is constant, the horn curves into the form of a logarithmic (equiangular) spiral.

An attempt was made to record the rate of growth of the regenerating horn, but owing to the animal's habit of rubbing the horn against hard objects in the enclosure and the varying amount of abrasion at the free end, accurate measurements could not be made.

The first measurements were made on the 23rd April, 1929, or 6½ months after the horn had fallen off. The growing horn was then a mere stump (Pl. I. figs. 3 and 4). Measured with a tape, the length along the median line

of the anterior surface of the stump was 3 inches and along the posterior median line 2 inches. The differential rates of growth of the fibres on the anterior and posterior surfaces are confirmed by these measurements and the measurements cited in the table that follows.

At this stage the free surface of the growing horn was very distinctly truncate (Pl. I. figs. 3 and 4), and two sets of horn fibres could be distinguished, viz., an inner core and a surrounding sheath. A very clear annulus marked the contact of the two sets of fibres (Pl. I. fig. 4).

On the 23rd August, 1929, measurements of the regenerating horn were again made. On this and a number of subsequent occasions a large pair of dividers was used for the measurements. The anterior measurement was taken in the median line from the point where the skin abuts on the base of the horn to the point where the median line intersects the annulus on the anterior side of the truncate surface of the horn. On the posterior side the corresponding two points were taken. This method has the obvious disadvantage, however, that it does not allow for the curvature of the horn, and hence the values are too low.

The following table shows the measurements made during a period of ten years :—

Measurements of Regenerating Anterior Horn of *Diceros bicornis* ♀

Date.	Measurement along the median line of the anterior surface.	Measurement along the median line of the posterior surface.	Measured with
	Inches.	Inches.	
a. October 8, 1928.....	Nil	Nil	—
b. April 23, 1929	3	2	Tape measure.
c. August 23, 1929	4	3	Dividers.
d. February 23, 1930.....	$5\frac{3}{8}$	$4\frac{3}{4}$	,,
e. June 23, 1930.....	$5\frac{13}{16}$	$5\frac{1}{4}$	,,
f. October 8, 1930	$6\frac{5}{8}$	$5\frac{7}{8}$	,,
g. July 8, 1931	$8\frac{1}{8}$	$7\frac{1}{4}$	,,
h. April 8, 1932	10	8	Tape measure.
i. February 23, 1933.....	12	$8\frac{3}{4}$	,, ,,
j. October 8, 1933	$13\frac{3}{4}$	$11\frac{1}{4}$	,, ,,
k. October 8, 1934	15	14	,, ,,
l. April 8, 1935	$16\frac{1}{4}$	$15\frac{1}{4}$	,, ,,
m. October 8, 1935	17	16	,, ,,
n. April 8, 1936	18	$17\frac{1}{2}$	,, ,,
o. October 8, 1936	19	$18\frac{1}{2}$	,, ,,
p. October 8, 1937	$20\frac{1}{2}$	$19\frac{1}{2}$	,, ,,
q. October 8, 1938	$20\frac{1}{2}$	$21\frac{1}{4}$	,, ,,

On the 23rd February, 1933, it was observed that the outer sheath of fibres had grown over the central core to such an extent that the core was no longer visible. A short slit was still present when the measurements *j*, *k*, *l* were taken, but on the 8th October, 1935, it was absent. The outer sheath of fibres now completely enclosed the inner core. The measurements made on the 8th October, 1938, seem to be anomalous owing to the fact that the *posterior* length exceeds the anterior length by $\frac{3}{4}$ inch. This is accounted for by the shape of the horn and the wear to which it had been subjected (Pl. II. fig. 8.). The tip of the horn now showed very little truncation.

After nine years of growth the regenerated horn was still $1\frac{3}{4}$ inches short anteriorly and $\frac{1}{2}$ inch posteriorly of the measurements of the shed horn. Although the figures for the tenth year can unfortunately not be used for comparative purposes, it can be deduced that approximately ten years of growth were necessary for the new horn to attain the length of the shed horn.

Apart from the present case, there appears to be but one other record of the regeneration of the anterior horn of a Black Rhinoceros. Antonius (1937) furnishes a note about a young male Black Rhinoceros (*D. bicornis*) about four years old obtained from Rhodesia. In this case the horn was also shed as the result of an injury, and Antonius states that after the lapse of a year the new horn was about as long as the previous one.

Wunderlich (1892 *a* and *b*) has recorded several cases in which specimens of the Indian Rhinoceros (*Rhinoceros unicornis*) shed and regenerated the single horn which this species possesses. He cites the case of a bull *R. unicornis* that shed its horn in the Berlin Zoo in the early eighties of the nineteenth century. The horn was regenerated and fell off again in the year 1891; almost at the same time a cow exhibited together with this bull also shed the horn.

Wunderlich also states that a female Indian Rhinoceros in the Zoological Gardens of Cologne lost its horn in the early eighties of the nineteenth century; the exact date could not be ascertained. By the summer of the year 1888 the new horn had attained a considerable length, but on the 3rd February, 1891, the animal broke it off against the iron bars of its enclosure. Wunderlich states that this specimen lost its horn twice in a period of 20 years.

A case is recorded by Bartlett (1898) of the Zoological Gardens of London, in which an Indian Rhinoceros tore the horn bodily from the head when the animal was trying to demolish the iron fence of its enclosure. There was profuse bleeding, but a new horn commenced to grow after a few months.

Blyth (cited by Marshall (1891) states that old rhinoceroses lose their horns in the same manner as old people lose their hair.

On the basis of the cases observed by him, Wunderlich (1892 *a*) feels justified in concluding that *R. unicornis* sheds its horn regularly at intervals of ten years, but he admits that it is desirable to collect further information.

Whatever the case may be with *R. unicornis* (Wunderlich's contention seems to me to be by no means proved), there is no justification for inferring that the horns of *D. bicornis* are shed at regular intervals. The two cases of the Black Rhinoceros that have been observed hitherto are not instances of the normal shedding of a deciduous structure, like the antlers of deer or the horns of *Antilocapra americana*, but the results of injuries incurred by the two animals. It is noteworthy, also, that although the Pretoria Black Rhinoceros was in the collection 27 years and 10 months, the posterior horn was never lost. If the horns of the *D. bicornis* were deciduous structures shed at regular but long intervals, it seems incredible that this should have escaped the attention of the great hunters of the nineteenth century. One would have expected them to have recorded the finding of shed horns in the veld.

The well-known animal dealer, C. Schulz, states that he has never come across a rhinoceros in the wild state (East Africa) with a missing horn (Schneider, 1929).

Schillings (1905) depicts a wallowing Black Rhinoceros cow that has lost the anterior horn and is clearly regenerating it. But nothing is known about the circumstances under which this animal lost its horn. He also states that the Black Rhinoceros sometimes sheds one or both horns, and expresses the belief that very old specimens may sometimes lose the horns without renewing them. This opinion is almost entirely based on a hornless specimen which fell to his gun, and which he believed to be very old. But as nothing is known about the circumstances under which this particular specimen lost both horns, any conclusions based thereon are merely speculative.

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EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. Shed anterior horn of the Black Rhinoceros cow, "Maggie."

2. Inferior surface of the shed anterior horn of the Black Rhinoceros cow, "Maggie."

3. Side view of the regenerating horn of the Black Rhinoceros cow, "Maggie," at 6½ months (April 23, 1929).

4. Free surface of the regenerating horn of the Black Rhinoceros cow, "Maggie," at 6½ months (April 23, 1929). Note the inner core and the outer sheath of fibres as well as the annulus.

PLATE II.

Fig. 5. Photograph of the regenerating horn of the Black Rhinoceros cow, "Maggie," after two years (October 9, 1930).

6. Photograph of the regenerative horn of the Black Rhinoceros cow, "Maggie," after five years (October 8, 1933).

7. Photograph of the regenerating horn of the Black Rhinoceros cow, "Maggie," after seven years (October 9, 1935).

8. Photograph of the regenerating horn of the Black Rhinoceros cow, "Maggie," after ten years (October 8, 1938)

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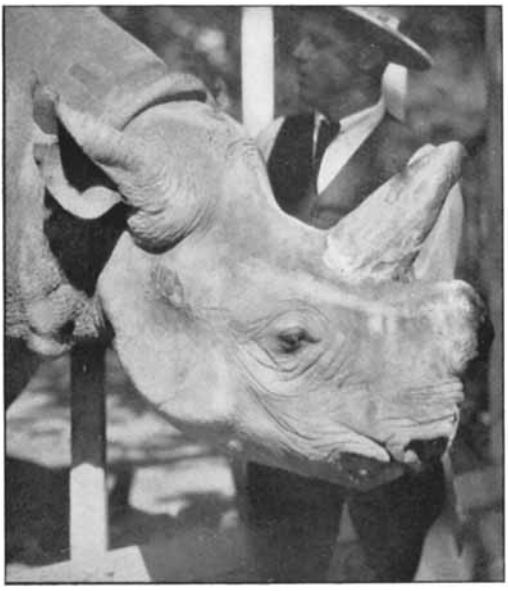

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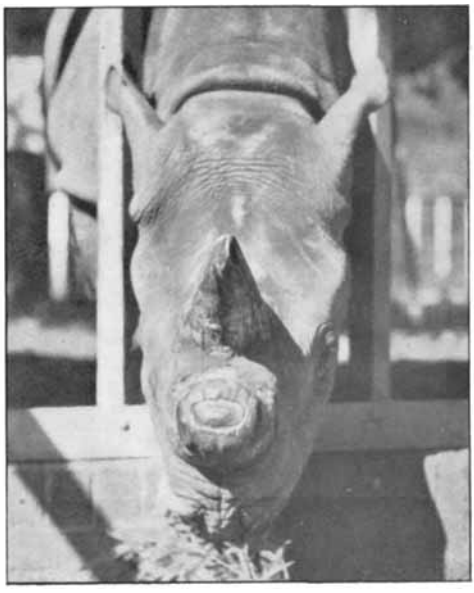

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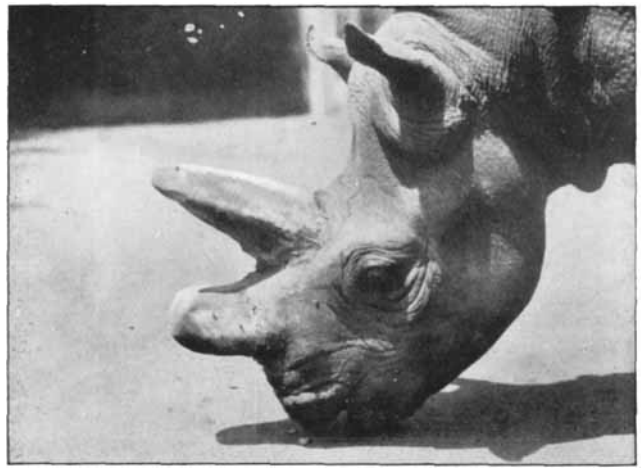

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