REFERENCE LETTERS.

as. Angulosplenial bone.
bh. Basihyal.
*cbr*². Second ceratobranchial.
ch. Ceratohyal.
d. Dentary bone.
fl. Foramen laterale in figs. 9 and 10; and in figs. 7 and 8 the sinus which later develops into the foramen.
ghe. M. geniohyoideus externus.
ghi. M. geniohyoideus internus.
h, h', h''. Parts of the anterior or hyoidean cornu.
ha. Convex surface by which the ceratohyal articulates with the palatoquadrate cartilage.
hbr. Hypobranchial plate.
hg. M. hyoglossus.
hgs. Hyoglossal sinus.
m. Internal or mesial part of the mandibular cartilage of the larva.
m'. Lateral part of the mandibular cartilage of the larva.
mm. Mentomeckelian bone.
oh. M. omohyoideus.
p^1, p^2, p^3, p^4. The four divisions of the M. petrohyoideus.
pa. Processus anterior.
pal. Processus antero-lateralis.
ppl. Processus postero-lateralis.
s. Space enclosed between the ceratohyal, basihyal, and first ceratobranchial.
s'. Space enclosed between the hypobranchial plate and the proximal ends of the first and second ceratobranchials.
sh. M. sternohyoideus ventralis.
sh'. M. sternohyoideus dorsalis.
sp^1, sp^3. Cartilaginous spicula of the first and third branchial arches.
t. Thyrohyal.
tf. Thyroid foramen.
v. Ventral splint-bone.
IX. Aperture in membrane through which the glossopharyngeal nerve passes.

5. On the Number of Grinding-Teeth possessed by the Manatee. By OLDFIELD THOMAS, F.Z.S., and R. LYDEKKER, F.R.S., F.Z.S.

[Received March 16, 1897.]

(Plate XXXVI.)

With one exception, the authors who have treated of the dentition of the Sirenians, from Cuvier in 1817 to the most recent writer on the subject, have estimated the number of cheek-teeth on each side of each jaw in this genus at from 6 to 8 to about 11 or 12.

The single exception was Dr. Krauss, of Stuttgart, who, in one of his several papers on Sirenian skulls, writing solely of the method of growth of the jaw-bone, and evidently without any idea of the importance of the remark in regard to the number of teeth, says[1]:—

"Allein, vergleicht man den letzten Backenzahn eines jungen

[1] Arch. Anat. Phys. 1862, p. 422.

Thiers mit dem ersten eines alten, so ist dieser viel grösser als jener, so dass wenigstens eine ganze Zahnreihe gebildet und hinausgeschoben sein muss bis diese Zähne die gleiche Grösse erreicht haben."

Commenting on this sentence, Lepsius [1], in his classical work on *Halitherium*, ridicules the idea of any such continued succession of teeth, on the ground that if true there would at least be 20 teeth in all, and states that, like other parts of the animal, the teeth increase in size as age advances.

We now know, however, that this latter statement is incorrect, and that the teeth, when once formed, do not grow at all; and this fact must be kept in mind when examining what we shall show to be the really wonderful and unique dentition of the genus *Trichechus* [2].

Our attention was first drawn to the subject by seeing the teeth of the young specimen of *T. inunguis* on which Mr. Beddard based the observations he read before this Society on January 19th, 1897 [3]. These teeth are so remarkably small as compared to those of adult animals, that, bearing in mind the absence in the Manatee of a vertical tooth-change, and the exceedingly gradual increase in size of the teeth as they progressively grow up behind and are thrown out in front, it becomes evident that the whole series of teeth must be very much longer than has been generally supposed. A second skull of *T. inunguis* slightly younger, which has been for many years in the British Museum, fully bears out this statement. (See Plate XXXVI. fig. 5.)

But since *T. inunguis* is only represented by these two young specimens, and their comparison with adult examples of other species might readily lead to material error, we have in the succeeding part of the paper restricted ourselves entirely to the African species (*T. senegalensis*), of which the British Museum possesses a good series of specimens. Thus, besides a good number of more or less adult skulls, there is one very young example obtained by the late Mr. Alvan Millson at Benin, with a lower jaw 120 mm. long, a larger one from Lagos (180 mm.), and others with this measurement 200 mm. and upwards.

In the youngest skull (B.M. 94. 7. 25. 8) the mandible has apparently already lost the tooth corresponding to the most anterior of the teeth in the young *T. inunguis*, and has in use three teeth, respectively 8, 10·2, and 10·9 mm. in length, and these would therefore be numbers 2, 3, and 4; while within the jaw

[1] Abh. mittelrhein. geol. Vereins, i. p. 106 (1882). Lepsius also refers to the statement by Gervais (Zool. Pal. Gén. i. p. 184, 1868) that the molars are "en nombre indéterminé"; but as Gervais goes on to say that in number they are "supérieur à cinq," the statement, however true, can hardly be said to be of any importance for our present purpose.

[2] Still often called *Manatus*, in spite of the clear proof of the incorrectness of the latter term given by many systematists and anatomists, among whom may be mentioned Wiegmann, Von Baer, Müller, Stannius, J. A. Allen, Merriam, &c. The proper scientific name of the Walrus is *Odobænus*.

[3] P. Z. S. 1897, p. 47.

there are two more, 11·5 and 12·2 mm. long, which would be nos. 5 and 6 of the full set (Plate XXXVI. fig. 1).

Comparing this with the next-sized mandible (B.M. 1388 *f*), which shows the alveolus of one recently lost tooth, 4 teeth in place, and 2 within the jaw, we cannot match the two posterior teeth of the youngest jaw (nos. 5 and 6) with any teeth further back in it than the 1st and 2nd of the standing teeth, respectively 10·7 and 11·3 mm. long, while they may belong still further forward, as there is a considerable difference in the ages of the two specimens. However, even this matching makes the 7 teeth of this second jaw to be numbers 4 to 10, the last having a length of 14·2 mm. (Plate XXXVI. fig. 2).

The next jaw, 200 mm. long (B.M. 1388 *d*), gives evidence of 8 teeth, and comparing these with the last set we may match no. 10 with the fourth, so that the posterior four would be nos. 11 to 14; but it is by no means certain that the numbers should not be even higher (Plate XXXVI. fig. 3).

A similar comparison with another mandible 242 mm. long (B.M. no. 94. 7. 25. 7) seems to show that the ten teeth of which evidence is shown may be nos. 11 to 20 at the lowest, a result that is fully supported by the other skulls available (Plate XXXVI. fig. 4). Any error there may be in the enumeration is on the side of making the total too low.

No essential difference appears to exist between the dentition of the upper and lower jaws, and we have therefore confined our observations to the latter as being more convenient. It is true that Dr. Kükenthal assigns three premolars to the lower jaw and none to the upper; but all the skulls we have seen appear to have a perfectly similar dentition above and below.

Among the adult skulls both sexes seem to be represented, and we have failed to find any possible cause of error in our calculations due to the factor of sex.

We have therefore, by a method which appears to be perfectly sound, arrived at a number identical with that which Lepsius considered would be the minimum outcome of Krauss's observations.

But in trying to find out how many teeth a Manatee may have in its life, a further complication is introduced by the remarkable fact that in not a single specimen available to us, however large, has the growth of additional teeth behind come to an end, so that fresh teeth are apparently being produced to the close of the animal's life. It would thus seem that a long-lived Manatee might have a much larger number of teeth even than the 20 above referred to, and, in fact, if any certain method of finding out the exact number could be discovered, we should not be surprised if the total were to amount to 30 or more.

But even if there are only 15 or 18 teeth to be dealt with, we are confronted with the very difficult problem of the origin and homologies of these numerous teeth, and, after that, with the bearing that their evolution has on that of other many-toothed mammals.

Firstly, it will not, we think, be contended by anyone, especially in face of the palæontological evidence referred to below, that the great number of the teeth of the Manatee has any direct connection with the polyphyodontism of the primitive Mammalia recognized [1] by many recent authors, even though Dr. Kükenthal, in his account of the embryonic distribution of the Manatee, says [2] : "Ich nehme demnach an, dass nicht weniger als drei auf einander folgende Dentitionen sich am Aufbau dieses Backzahnes beteiligen."

Apart from " pre-lacteal " and " post-permanent " teeth, in whose existence, with Messrs. Wilson and Hill, we should be glad to disbelieve, the utmost number that can be made out of the ordinary mammalian set is 12, of which 4 would be milk-molars, 4 premolars, and 4 molars. This is allowing for the possibility of the milk-molars being regularly retained and the premolars coming up behind instead of below them. Since, however, even with this rather far-fetched explanation, the numbers are still far short of the total required, we are disposed to think it unlikely, and prefer to consider only the first three or four teeth as premolars, and the rest as true molars. Whether such premolars belong to the permanent or to the milk series, we have no evidence on which to base a suggestion. In Elephants, where the tooth-succession is somewhat similar, the corresponding teeth belong to the milk and not to the permanent series.

If the presence of a specially large number of teeth in this genus had any connection with a primitive multiplication of the sets of teeth, the ancestors of *Trichechus* should have possessed an equally redundant dentition, and on this point we are provided with evidence to the contrary. For it fortunately happens that there are fossil Sirenians so closely allied to the modern ones that we may almost treat them as if they were direct ancestors.

Of these, by far the most important—because the best known—is the Oligocene *Halitherium*, of which large numbers of specimens have been described and figured by various authors, notably Drs. Krauss [3] and Lepsius [4].

In this genus a careful examination of the teeth seems to show that although there was a distinct tendency towards the rapid wear and degeneration of the anterior cheek-teeth so characteristic of *Trichechus*, yet that the series of molars did not exceed four in number, and in any case came to an end as soon as the animal was adult. This latter point, so important for our present purpose, is clearly demonstrated by Krauss's plate vi. and Lepsius's plate x. fig. 96, where may be seen a terminal molar, considered to be m.^{4}, fully up, beginning to be worn, and yet without any trace of a posterior tooth rising up to succeed it, as would be the case in the Manatee.

1 This, apparently with good reason, is altogether denied by the latest writers on the subject, Messrs. Wilson and Hill, Quart. Journ. Micr. Sci. 1897, p. 427 *et seqq.*

2 Anat. Anz. xii. p. 524 (1896).

3 N. Jahrb. Min. 1862, pp. 385–414, pls. vi. & vii.

4 Abh. mittelrhein. geol. Vereins, 1882, pp. 100–200, pls. i. to x.

Prorastomus[1], again, believed to be also of Oligocene age, whose dentition has been recorded as $i. \frac{3}{3}$, $c. \frac{1}{1}$, $p. \frac{4}{4}$, $m. \frac{4}{4}$, has—whether this dental formula is correct in details or not—quite clearly no trace of a continuous succession of teeth such as occurs in *Trichechus*. This observation we have been able to make on the type specimen of *P. sirenoides* from Jamaica (B.M. no. 44897), which Dr. Woodward has been good enough to have further developed from the matrix with a special view to the settlement of the point under discussion.

From these facts it results that the continuous succession of teeth in *Trichechus* is not a primitive character, but a new development, evolved to make up for the rapid wear and tear of the cheek-teeth which must take place in an animal living on seaweed and water weeds, and consequently having a large amount of sand mixed with its food.

The evolution of these extra teeth may be supposed to have taken place by a gradual extension of the process seen in the early development of the posterior molars of ordinary mammals. There it is generally considered that the appearance of the budding-out of the posterior molars from the germs of the anterior ones is really merely due to the retardation of the growth of the posterior end of the dental lamina in relation to the shortness of the jaw in the young animal. Then, as the jaw lengthens, the lamina grows further backwards, the molars budding off from it in succession[2]. Now there seems to be no inherent reason why, if the jaw were to go on lengthening indefinitely, the dental lamina should not also go on lengthening, and equally go on budding-out more and more molars behind. And although there is of course no indefinite lengthening of the jaw in the Manatee, the exact effect of such a lengthening, so far as the teeth are concerned, is attained by the steady progression forwards of the teeth in the jaw, which would equally leave a space behind the teeth, needing further teeth to fill it.

We may note in this connection that Mr. M. F. Woodward has suggested—on the jaw-lengthening theory—that the late-appearing fourth molar of *Centetes* is similarly a new development[3], and not a primitive character, but up to the number of four, common to *Otocyon* and most Marsupials, there are not the objections to bringing in the primitive theory that are so strong in the case of the Manatee. Still, with the fourth molars of *Centetes* and *Otocyon*, the fifth of *Bettongia*[4], and even the fifth and sixth of *Myrmecobius*, our views on the dentition of *Trichechus* make it clear that their primitive origin must not be too confidently presumed, as has often been the case.

[1] Owen, Quart. Journ. Geol. Soc. vol. xi. p. 541 (1855), and xxxi. p. 559 (1875). See also Lydekker, Cat. Foss. Mamm. Brit. Mus. pt. v. p. 12 (1887), and P. Z. S. 1892, p. 77.

[2] Mr. M. F. Woodward has been good enough to supply us with a concise account of the present state of opinion on this vexed question.

[3] P. Z. S. 1896, p. 572.

[4] See Thomas, Cat. Marsup. B.M. p. 105 (footnote).

Whether the possibility that mammals may secondarily develop a practically unlimited number of teeth has any bearing at all on the case of the Cetacea, we are not at present prepared to say. But it is evident that the complexity of the Manatee's numerous teeth quite disproves the idea that Mammal-teeth cannot be at the same time both numerous and complex—an idea on which the theory that cetacean teeth are the separated portions of a smaller number of complicated teeth was very largely based. That the same theory in another form may still be true—viz., that they are the separated cusps of Seal-like or Zeuglodon-like teeth highly developed and then separated by hypsodontism,—we are not at present disposed to deny.

From what is said above, it will be evident that we think the multiplicity of the teeth in the Cetaceans has in any case an entirely different origin to that in the Sirenians and does not indicate any unsuspected affinity between them. In fact we still think that the probabilities are on the whole in favour of a Carnivorous origin for the Cetacea, and an Ungulate one for the Sirenia.

In any case, whatever bearing the secondary development of a continuous and indefinite multiplication of teeth may have on general problems of tooth-evolution, the mere fact itself is sufficiently interesting to be recorded.

EXPLANATION OF PLATE XXXVI.

Fig. 1. Young lower jaw of African Manatee, showing teeth 2 to 5.
2. Somewhat older jaw of same, with teeth 5 to 10.
3. Still older jaw of same, with teeth 9 to 13.
4. Very old jaw of same, with teeth 12 to 19.
5. Very young lower jaw of Amazonian Manatee, showing the first six teeth.

June 1, 1897.

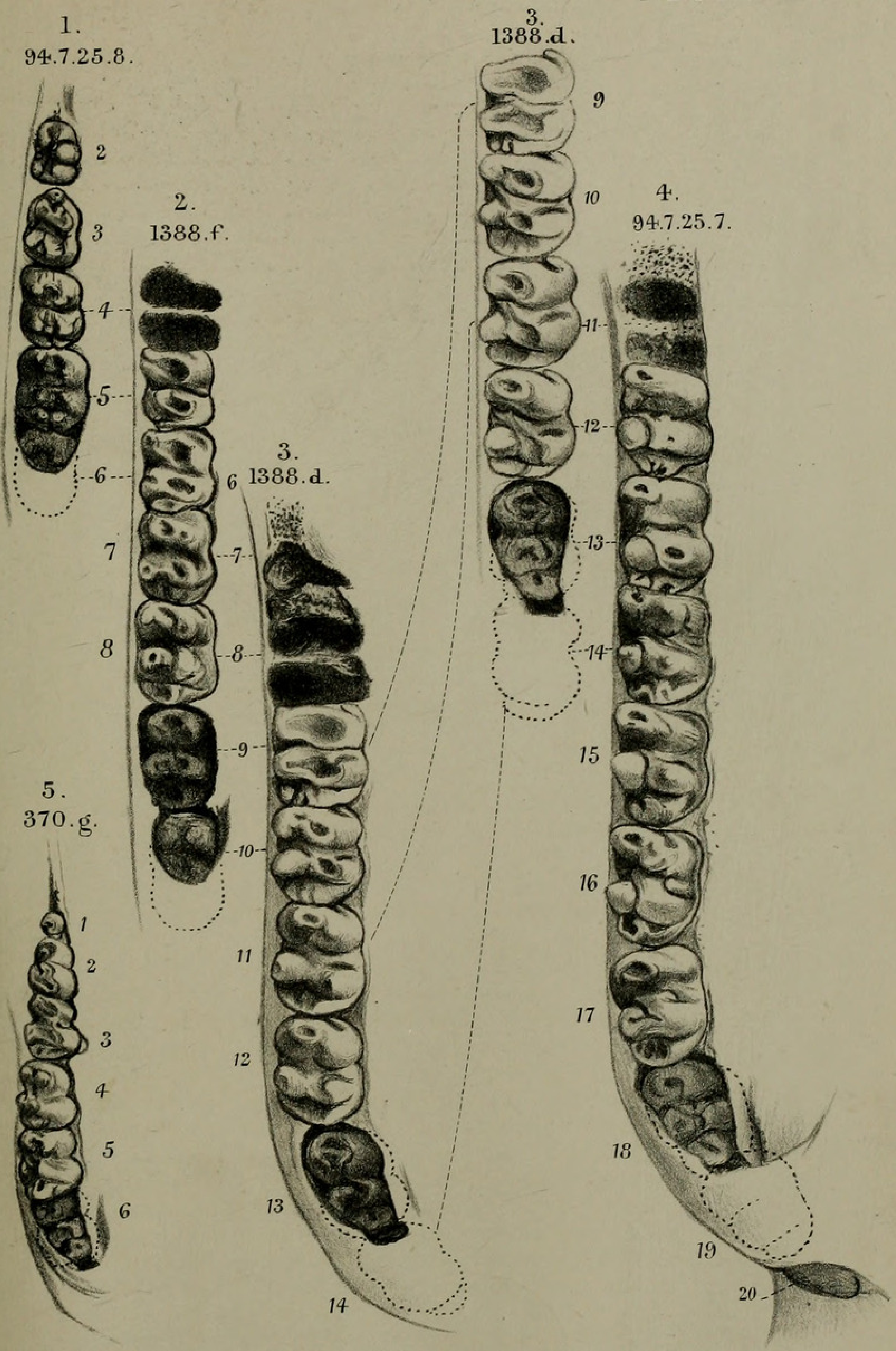
Dr. A. Günther, F.R.S., V.P., in the Chair.

A communication was read from Dr. John Anderson, F.R.S., who sent for exhibition a coloured drawing of the Egyptian Weasel (*Mustela subpalmata*), accompanied by the following remarks:—

"The three examples of the Egyptian Weasel now living in the Society's Gardens were obtained in Lower Egypt, but the exact locality where they were caught I shall not know until Mr. Birdwood arrives in this country, I hope, about the middle of June.

"On two previous occasions living examples of this species captured for me have unfortunately died on their way to this country.

"I have made many enquiries about the Weasel in different parts of Egypt, during my frequent visits to that country, and as it is familiar to the natives by its well-known name *Ersa*, there can be no question that they clearly understood the animal I had in view. My informants have been unanimous in saying that it frequents houses, and that it is found not only in villages and towns throughout Lower Egypt, but even in the cities of Cairo and Alexandria.



J. Smit del. et lith.

Mintern Bros. imp.

LOWER CHEEK-TEETH OF MANATEES.

1–4. *Trichechus senegalensis*. 5. *T. inunguis*.

Two specimens that died on their way to London were captured in Cairo. The natives say that it is most useful to them in destroying the rats and mice with which their houses are infested, and it seems to me probable that its services in this respect may account for the difficulty that is experienced in getting them either to capture it or kill it.

"Hemprich and Ehrenberg, in their description of it (Symb. Phys., Mamm. sig. K), under the specific term *Mustela subpalmata*, also state[1] that it frequents houses, attracted to them by the presence of rats and mice. The term *subpalmata* has reference to the rather marked palmation of the digits; but how it compares in this respect with *Putorius boccamela* I cannot at present say. I have never met with the Weasel in my wanderings in Egypt, and I have never learned of any one who has. The natives say that they only see it at night. The material at present existing in London is not sufficient to enable the question of ther elation in which the Egyptian Weasel stands to *Putorius boccamela*, Bechstein, and *P. africanus*, Desm., to be settled. The six specimens that have come under my observation are unquestionably of one species and are examples of *M. subpalmata*, Hempr. & Ehrenb., but whether this species differs from *P. boccamela* has yet to be ascertained. I therefore prefer to speak of the Egyptian Weasel tentatively as *M. subpalmata*, Hempr. & Ehrenb. I hope, however, soon to obtain additional materials for the solution of this question.

"I have the pleasure to submit a coloured drawing made from life of the largest specimen in the Society's Gardens, as this is the first time that this most interesting animal has been seen alive out of its own country.

"It is thus a most valuable addition to the Gardens, and we are much indebted to Mr. Birdwood, our Corresponding Member in Egypt, for the three specimens.

"The drawing has been made by Mr. P. J. Smit for my work on the Mammals of Egypt, now in progress."

Mr. E. Cavendish Taylor, F.Z.S., exhibited a skin of the Egyptian Weasel (*Mustela subpalmata*), on which he made the following remarks:—"This Weasel was obtained by me at Cairo about the end of January 1896. It was caught close to Cairo by an Arab, who sold it alive to Mr. Bramly, the then Curator of the Cairo Zoological Gardens. On the first day of its arrival at the Gardens it killed and ate a rat, but unfortunately died the next day. Mr. Bramly kindly sent me the dead body to my hotel, and I made of it the skin I now exhibit. The animal is a male, very large in size, with the tail very long and the throat very yellow. These characters are, I believe, constant in the Egyptian Weasel. In one respect I have been more fortunate than Dr. Anderson, for I have once met with the Weasel alive in Egypt. I well remember

[1] "Quarta *Mustelinorum* forma *Mustelæ vulgari* admodum affinis est. In itinere *Mustelæ subpalmatæ* nomine eam distinximus, digiti enim membrana latius coniuncti erant, statura minor. In domibus ægyptiacis Cahiræ et Alexandriæ murium vulgaris socius."