

VIII. *On the Osteology of the Solitaire or Didine Bird of the Island of Rodriguez, Pezophaps solitaria (Gmel.).* By ALFRED NEWTON, M.A., Professor of Zoology and Comparative Anatomy in the University of Cambridge, and EDWARD NEWTON, M.A., Auditor-General of Mauritius. Communicated by P. L. SCLATER, M.A., Ph.D., F.R.S.

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EVIDENCE as to the fact of the island of Rodriguez in the Indian Ocean having been formerly inhabited by a Didine bird specifically distinct from the true Dodo of Mauritius (*Didus ineptus*, Linn.) appears to have been first satisfactorily adduced in 1844 by the late HUGH EDWIN STRICKLAND\*. It is true that, eighty years ago, GMELIN, in his edition of the 'Systema Naturæ' of Linnæus (tom. i. p. 728), described in scientific language, from the account given by LEGUAT† (with which he was apparently acquainted only at second hand through the intervention of BUFFON‡), a second species of the genus *Didus* as inhabiting that island; but this species had been long rejected by all zoologists, except those whose labours had been confined to the work of compilation, until, as just mentioned, STRICKLAND proved, from a renewed examination of the original and other accounts, that the species thus described, however it might have been misrepresented, had certainly once existed, and moreover that remains of it were contained in at least three collections—the Museum of the Jardin des Plantes, the Andersonian Museum of Glasgow, and the collection of the Zoological Society of London.

The opinion thus propounded was, four years later, set forth at greater length by its author, the subject of it being then declared not only specifically but generically distinct from *Didus ineptus*, and called *Pezophaps solitaria* (Gmel.)§, and since that time no one has ventured to impugn its accuracy. Thus, though formally accepting GMELIN as the first author who applied the set rules of zoological nomenclature to this species, little credit is really due to him from the fact. LEGUAT, in 1708, was its original describer||,

\* Proc. Zool. Soc. 1844, pp. 77–79. (Reprinted in Ann. and Mag. Nat. Hist. xiv. pp. 324–326.)

† Voyage et Aventures de FRANÇOIS LEGUAT &c. Londres: 1708, 2 vols. 12mo (vol. i. pp. 98–102); A New Voyage to the East-Indies by FRANCIS LEGUAT &c. London: 1708, 1 vol. 8vo (pp. 71–74).

‡ Hist. Nat. des Oiseaux, vol. i. p. 485.

§ The Dodo and its Kindred &c. By H. E. STRICKLAND, M.A. &c., and A. G. MELVILLE, M.D. &c. London: 1848, 4to (pp. 46–56, and 113–119).

|| The name "*Solitaire*," or (in the contemporaneous English translation of his work) "*Solitary*," by which LEGUAT called the Didine bird of Rodriguez had in reality been previously bestowed by CARRÉ (Voyage des Indes Orientales &c., par Mr. CARRÉ, Paris: 1699, vol. i. p. 12) on the Didine bird of Bourbon (Réunion). As the rule of priority is not necessarily enforced with regard to vernacular names, there seems to be no reason why the Rodriguez species should not retain that by which it has become generally known. We can afford to keep the Bourbon species waiting for a common name until some particle of its remains is discovered.

if he may not be called its discoverer; for we have no knowledge of any writer who had previously distinguished it from the better-known Dodo of Mauritius\*, and STRICKLAND was the first naturalist who placed its former existence beyond all doubt.

The remains of this bird, the "Solitaire" of Rodriguez, existing in museums until within the last few years seem to have been as follows:—The Museum of the Jardin des Plantes possessed *five* bones, said to have been found in a cave in Rodriguez in 1789†; these were a femur, a tarso-metatarsal, a humerus, the median portion of a sternum, and a portion of the cranium‡. The Andersonian Museum at Glasgow contained *six*, being part of a collection made by the late Mr. TELFAIR, a right and left femur with the fragment of a third, a left tibia, and a right and left tarso-metatarsal§. The Zoological Society of London possessed the remaining portion of this collection||; but the specimens (*five* in number) were for some time mislaid, and were consequently not available for the use of Messrs. STRICKLAND and MELVILLE when they published their work¶. In 1851 these specimens were rediscovered in the house of the Society by Mr. BARTLETT, and proved to be a portion of a right humerus, a right femur, a right tibia, and a right and left tarso-metatarsal—the last two belonging to different individuals. In the description of these bones, which Mr. BARTLETT published soon after\*\*, he was induced into several grave, though perfectly excusable, errors, and in fact only referred one of the specimens (the right tarso-metatarsal) to the Solitaire, though there can now be no doubt that they all belong to that species. Nor was STRICKLAND much more fortunate, for early in the following year (1852) he also described these same specimens††, and, misled as his predecessor had been by the same causes (of which, however, he assigned a different explanation), he equally imagined that he had before him the remains of more than one species‡‡.

Besides the *sixteen* bones just enumerated *two* others were the property of STRICKLAND—one, a left tarso-metatarsus, found at the same time and place as those in the Museum at Paris; and another, a right tarso-metatarsus, said to have been found in 1831 by Colonel DAWKINS, but in the same cave as the others§§.

\* Sir THOMAS HERBERT, who in 1628 sailed by "Digarroys" (*i. e.* Rodriguez), mentions ('Some Years Travels into divers parts of Asia and Afrique, &c.' London: 1638, fol. p. 341) "Dodos" as being found in that island, confounding the species to which they belonged with that of Mauritius (*id. op. cit.* p. 347); but he gives no description of the former.

† STRICKLAND, 'The Dodo &c.' p. 51.

‡ These had been exhibited by CUVIER to the French Academy of Sciences in 1830 as belonging to the true Dodo (STRICKLAND, *ut supra cit.* p. 52). We desire to express our very sincere thanks to M. ALPHONSE MILNE-EDWARDS for his kindness in procuring for us models of all these specimens.

§ Sir WILLIAM JARDINE was good enough some years since to give me casts of these specimens.—A. N.

|| Proc. Zool. Soc. 1833, p. 32.

¶ 'The Dodo &c.' p. 52.

\*\* Proc. Zool. Soc. 1851, pp. 280–284, *Aves*, pl. xlv. Reprinted Ann. and Mag. Nat. Hist. 2nd ser. xiv. pp. 297–301.

†† Trans. Zool. Soc. vol. iv. part 6 (1859), pp. 187–196, pl. 55.

‡‡ These bones are now in the British Museum.

§§ Ann. and Mag. Nat. Hist. 2nd ser. iv. pp. 335–337. For a cast of one of these we are indebted to the kindness of Mrs. H. E. STRICKLAND.

In addition to these *eighteen* specimens we are informed that in 1860 or 1861 a tibia, the shaft of a tarso-metatarsal, and some fragments of the shaft of a femur, all of which belonged to the Solitaire, were sent to Professor OWEN by M. BOUTON of the Museum at Mauritius; but the fate of these specimens is unknown to us.

Thus up to the year last mentioned not more than *twenty-one* specimens, of which many were duplicates, of the bones of the Solitaire had been brought to the notice of naturalists. They included portions of the cranium and sternum, the humerus, the femur, tibia, and tarso-metatarsal; but the portions of the cranium and sternum, and the only perfect humerus, all of which were in France, were so much encrusted with stalagmite that their characters were in some parts wholly obscured.

In November 1864 one of the authors of this paper visited Rodriguez\*, and near the entrance of a cave on the south-west side of that island he picked up two bones, a perfect left tarso-metatarsal and the shaft of a left humerus. About the same time Captain BARCLAY found a third bone, a femur. These were sent to England, and described and figured† under the provisional name of "*Didus nazareus*, BARTLETT," the describer having fallen into the same mistake as that naturalist and STRICKLAND had already done.

Meanwhile Mr. GEORGE JENNER, the magistrate of Rodriguez, was urged to make a more thorough search for further remains of the Solitaire in the localities whence the specimens last mentioned had been found.

Accordingly, on the 1st August 1865, a box from this gentleman reached one of the authors at Mauritius. It was found to contain upwards of *eighty-one* specimens of bones, belonging to at least *sixteen* individuals. Among these bones were a portion of the coracoid, examples of the ulna, radius, and fibula, portions of the pelvis and one of the digital phalanges, all of which had been previously unknown. But, more than this, from a series so large it became at once plain, by the presence of many specimens of intermediate size, that the theory of the existence in the island of Rodriguez of two species of Solitaire (originated by Mr. BARTLETT, afterwards adopted with a modification by STRICKLAND, and followed subsequently by one of the present authors in describing the results of the previous "find") became untenable, and this fact was declared when a few months later the specimens arrived in England, and were exhibited at a meeting of the Zoological Society‡.

Immediately on tidings of this very important discovery being made known in this country§, the British Association for the Advancement of Science, then assembled at Birmingham, at the instance of Mr. P. L. SCLATER, appointed a Committee to assist one of the present authors in his researches into the Didine Birds of the Mascarene Islands, and placed a handsome sum of money at his disposal for that purpose. Whereupon Mr. JENNER was requested to order a new examination of the more promising caves

\* Ibis, 1865, pp. 146-154.

† Proc. Zool. Soc. 1865, pp. 199-201, pl. viii.

‡ Ibid. pp. 715-718.

§ Report of the Thirty-fifth Meeting of the British Association; Notices and Abstracts of Miscellaneous Communications to the Sections, p. 92.

in Rodriguez\*. Owing to the scarcity of labourers in that island and the irregularity of communication between it and Mauritius, nearly a year passed before anything could be done, and at last it was found necessary to send a small band of coolies to Rodriguez for the express purpose of digging in the caves there†. These men were dispatched in August 1866 and returned to Mauritius in about two months, Mr. JENNER sending with them the results of their labour, consisting of nearly 2000 bones or fragments of bones of the Solitaire, with a few others belonging to various animals. Two facts, however, it must be said are greatly to be regretted in connexion with this expedition. It had been found impossible to put the coolies employed under an intelligent superintendent, who could have carefully noted down all the circumstances under which the bones were found; and the report which Mr. JENNER was requested to draw up, giving an account of the caves visited and so forth, has unfortunately never reached us‡. Consequently nothing more is known of the specimens described in the present paper than that they were found in caves in the island of Rodriguez, but it is impossible for us to say how long they have been there buried§.

This much, by way of historical statement, is due to those who have before laboured upon the subject of which we are now about to treat as well as to those who have aided us in our attempt to recover the remains of this lost form. A few more words only are necessary before we begin to describe, as best we can, the osteology of the Solitaire of Rodriguez.

First, we have to remark that while the enormously large series of specimens at our disposal has undoubtedly enabled us to form and declare certain opinions with greater confidence than we should otherwise have felt at liberty to do, we confess to having been in some respects much embarrassed by the wealth of our materials. It is not a very difficult task to describe in great detail a single skeleton, but it is not easy to draw up a description which, while being minute and diagnostic, shall yet fit some fifty or more examples. There does not seem to be a single bone in the skeleton of *Pezophaps solitaria* which is not liable to greater or less individual variation of some kind or other. This variation in point of absolute size, in which of course it is most easily recognizable, induced Mr. BARTLETT, STRICKLAND, and one of ourselves (as has been already stated) into a serious error. But the individual variation is not at all confined to absolute size; it extends to the relative proportion of divers parts of the bones, to processes or depressions upon them such as are commonly held to be specifically characteristic, so that it is often utterly impossible to predicate any definite limits of individual modification.

\* We must by no means omit to mention here that the results of Mr. GEORGE CLARK's fortunate discovery of bones of the true Dodo recounted by him in 'The Ibis' (1866, pp. 141-146), though not known in England till some months after the grant of the British Association had been voted, did much to inspire those who were interested in the matter of the resurrection of the Solitaire of Rodriguez.

† Report of the Thirty-sixth Meeting of the British Association, p. 402.

‡ Trans. Roy. Soc. Maur. N. Ser. iii. pp. 31-38.

§ Professor STEENSTRUP, and there cannot be a better authority, on seeing the bones found in 1865, recognized in some of them certain characters which he believed showed unfailingly that these birds had been eaten by men or dogs. No such characters are observable by us on the bones found in 1866.

This statement may seem bold, but we are convinced that it is true. With great deference to the mightiest masters of the science, we venture to submit that many of them have too often undervalued the benefit of consulting long series of specimens, and that the principle of *ex uno disce omnia* is one which must on no account be admitted to hold good in anatomy any more than in zoology. Nor is the variability of which we speak wholly dependent on age or sex\*. Thus we are compelled to refrain from giving any of those precise measurements of the specimens we describe, such as are usually found in works of this nature, an omission which we trust will not be found productive of real inconvenience, owing to the number of figures by which the present paper is illustrated—figures nearly all of the natural size, and drawn most carefully by the artist, Mr. FORD.

Next we must state that Professor OWEN having published an elaborate description of the osteology of *Didus ineptus*†, we have endeavoured, so far as was possible, to make our description of the osteology of the kindred bird conform with his both in general arrangement and special treatment, believing that by so doing we were but consulting the convenience of those who may wish to compare the structure of the two. Professor OWEN's masterly treatise has been always at our side while examining, selecting, and describing the bones of *Pezophaps solitaria*, as has also been the equally elaborate dissertation of Dr. MELVILLE‡ on such bones of this species as were known to him, and we have often availed ourselves of the expressions of either author for the express purpose of making the comparison the more obvious.

Here, lastly, it must be mentioned that, thanks in a great measure to the generosity of Mr. GEORGE CLARK of Mahébourg, in Mauritius, we have had the advantage of studying at the same time a series of Dodos' bones (the fruits of his remarkable discovery) more extensive even than that which furnished the subject of Professor OWEN's treatise, and this by the kindness of the latter we have also had an opportunity of examining. Further, we have been indebted to various other friends and naturalists for other specimens tending to illustrate the subject, to Professors REINHARDT and FRITSCH for casts of Didine remains existing in Copenhagen§ and Prague respectively, to Professor ALPHONSE MILNE-EDWARDS for models of the *Pezophaps*-bones in Paris, and to Sir WILLIAM JARDINE for casts of those in Glasgow; while we have also to express our acknowledgments to the authorities of the Royal College of Surgeons of England for their liberality in lending us the precious skeleton of *Didunculus strigirostris*|| from

\* We have certainly never made a close study of such an extensive series of the bones of any one other species as we have done of the Solitaire, and therefore we are perhaps not in a position to form a true comparison; but it does seem to us that the amount of individual variation both here and in the Dodo is extraordinarily great. The possible explanation of this fact, if it be a fact, will be discussed in our concluding observations.

† Trans. Zool. Soc. vol. vi. pp. 49–85, pls. xv.–xxiv.

‡ 'The Dodo' &c. part ii. pp. 113–119.

§ The Copenhagen Dodo's head is often spoken of as "mutilated," and by one writer as "lacking the lower jaw." Its sole imperfections are the absence of the left pterygoid, and the enlargement of the foramen magnum. The mandible is as perfect as that of the Oxford specimen, or as one in our own possession.

|| The more valuable since it is the specimen described and figured by Professor OWEN in his paper "On the Osteology of the Dodo" (*ut supra cit.*).

their Museum, when informed by their Curator, Mr. FLOWER, of our wish to compare its structure with that of *Didus* and *Pezophaps*. Finally, our thanks are in a special manner due to Mr. JOHN WILLIS CLARK, the Superintendent of our University's Museums of Zoology and Comparative Anatomy, for the trouble he has taken in mounting for us some of the bones both of the Dodo and the Solitaire with the success commonly attained by him in reconstructing the skeletons of animals.

## § 2. *Vertebræ.*

The hundred and sixty-one vertebræ contained in the collection, few of which preserve all their processes in a perfect state, form a subject of no small perplexity, and it is beyond our power to determine precisely the number which the skeleton contained.

On the presumption that *Pezophaps* possessed the same number of dorsal (8) and cervical (12) vertebræ as is assigned to *Didus* by Professor OWEN's draughtsman\*, there is such a great numerical preponderance of specimens of the eighth, ninth, and tenth cervicals (Plate XV. figs. 24–34), counting backwards, that one is at first led to suppose that *Pezophaps* must have been endowed with more, till a diligent study of each example compels the belief that no other presumption will meet the case equally well, and an explanation of the curious fact that the specimens of each of these three vertebræ are nearly twice as numerous as most of those of the rest must be sought elsewhere. And in support of this view it may be stated that of the three anchylosed dorsal vertebræ there are present in the collection but five examples.

The penultimate free dorsal (Plate XV. figs. 56–59) intervening between that which coalesces with the pelvis and the three† anchylosed vertebræ just mentioned, is represented in the collection by nine specimens, none of which is entirely perfect. The hypapophysis is aborted; the centrum posteriorly resembles that of the next anterior vertebra; the neural canal is elongated vertically and contracted in the midst; the neural spine is directed forwards, but its outline is not to be completely traced in any of the examples we possess; near the anterior articular surface on either side is an articular somewhat reniform costal cavity; the postzygapophyses have comparatively small articular surfaces, oval, and slightly concave.

The three anchylosed dorsal vertebræ (Plate XV. figs. 51–55), the last of which is the antepenultimate dorsal, bear a great general resemblance to the same bones in *Didus*. Taking a specimen of each species of nearly the same absolute size, the greater extent of the articular surfaces, and especially the lateral expansion of the anterior centrum, in *Didus* is plainly perceptible. But though these relative proportions are preserved, some

\* Professor OWEN himself does not offer any opinion as to the number of vertebræ in *Didus*. We prefer citing his draughtsman as the authority for the number assigned to the bird in the large plate illustrating his paper, because on the same plate *Didunculus* appears to be represented as possessing fourteen cervical and seven dorsal vertebræ, being altogether two more than we are able to count in the very specimen, now in the Museum of the Royal College of Surgeons, which served as the subject for his pencil.

† Three is the most usual number in the *Columbæ*, but in *Goura* two only are anchylosed. In one example (Plate XVI. fig. 60) of *Pezophaps* the anchylosis is incomplete.

specimens of these bones in *Pezophaps* are in every way very much bigger, and longitudinally bear to the corresponding part of their ally the proportion of ten to nine. In these larger (male?) specimens, the hypapophyses of the anterior and middle vertebræ of the anchylosed three are not generally confluent so as to inclose a full elliptical space, and in none of the specimens, whether large or small, is there any trace of such a second foramen as seems to be invariably the case in *Didus*.

The specimens of anterior dorsal vertebræ (Plate XV. figs. 42–50) are in a very mutilated condition, and it is almost impossible to institute such a comparison between their remains and the corresponding bones in *Didus* as would serve any useful purpose.

Further onward (Plate XV. figs. 24–41) a sensible though gradual elongation and attenuation of the vertebræ is manifested, which becomes perhaps the greatest about the region of the fifth, sixth, and seventh cervicals (Plate XV. figs. 13–23) on the presumption here followed. The postzygapophyses are considerably elongated as compared with *Didus* in proportion to the breadth of the vertebræ. The neural spine of the anterior cervicals in that bird is much more prominent but less expanded than in *Pezophaps* (Plate XV. figs. 6–12). From the gradual elongation just mentioned the neck of this last, when living, must have been absolutely longer than that of *Didus*, a conclusion which testifies in another point to the fidelity of LEGUAT's figure, of which more will be said in our concluding observations.

Of the axis the collection contains six specimens, to one of which the atlas is united, possibly by partial ankylosis (Plate XV. figs. 1–5). The former closely resembles the axis of *Didus* as figured by Professor OWEN (*op. cit.* pl. xvii. figs. 12, 13); but the odontoid process projects much less, and indeed hardly at all beyond the anterior upper portion, while on the other hand the neural spine and (as in the case already mentioned of the succeeding vertebræ) postzygapophyses project considerably further backward. The same is to be observed in the postzygapophyses of the atlas as compared with *Didunculus*; and in this respect *Pezophaps* resembles *Goura*. The articulating cavity for the reception of the occipital condyles is deep, and its lateral margins approach each other inferiorly somewhat more closely than appears to be the case in either *Goura* or *Didunculus*.

### § 3. *Ribs.*

Of ribs, the collection contains (besides a vast number of fragments) nearly seventy examples, scarcely any of which are perfect, and a large portion consists of merely the upper extremities of the dorsal ribs. Of these there are about fifty-three specimens, and of the sternal ribs some fourteen. Very few of the former have their epipleural appendage preserved (Plate XVI. fig. 63), and as this seems to be the most (if not the only very) characteristic feature possessed by the ribs in birds, not much of importance can be determined in its absence. It would therefore be unnecessary to dwell at any great length on these bones, which present no very apparent distinctive characters from those of *Didus*. Perhaps on the whole the ribs of *Pezophaps* have their heads and articular tubercles proportionally somewhat thicker. This is certainly the case in the

larger (male?) specimens, and many of these are quite as stout as those ordinarily found in *Didus*. A pneumatic foramen near the base of the tubercle is generally but not invariably present, appearing to be, as in *Didus*, rather an individual character. The curvature is much the same in both birds, showing that *Pezophaps* must have been as bulky as its ally. Many of the posterior ribs bear on their outer surface the same marks of pressure or friction (Plate XVI. figs. 62, 63), caused by the movements of the thigh, as have been observed in *Didus*. There appears to have been eight pairs of dorsal and four of sternal ribs. The first probably articulated with the thirteenth vertebra, the last or eighth with the twentieth, and seems to have been sometimes coalescent at its sternal extremity with the sternal rib of the preceding or seventh (Plate XVI. fig. 64); but this feature did not always obtain, as another specimen of the latter from the opposite side, and most likely from a younger bird, shows (Plate XVI. fig. 61). The first and (with the exception of the single coalescent specimen just mentioned) eighth ribs are wanting. On the left side the sixth dorsal rib is missing, but the corresponding sternal rib is present. On the right side the contrary occurs, the sternal rib articulating with the sixth dorsal being absent. Thus the ribs represented in the collection may thus be enumerated:—

Left			Right	
Dorsal.	Sternal.		Sternal.	Dorsal.
0	—	1	—	0
×	—	2	—	×
×	—	3	—	×
×	×	4	×	×
×	×	5	×	×
0	×	6	0	×
×	×	7	×	×
0	—	8	—	$\frac{1}{2}$

#### § 4. *Pelvis.*

The pelvis of *Pezophaps* is represented in the collection by remains which must have belonged to at least thirty-seven individuals; but by far the greater number of these are fragmentary, consisting chiefly of the coalesced sacral vertebræ with mutilated apophyses and separated from the iliac and other bones. One specimen, however, is comparatively perfect and possesses the pubic bones (Plate XVII. figs. 66, 68, XVIII. fig. 70), the form of which in *Didus* can be only conjectured. Compared with the pelvis of that bird, it is by no means so remarkable for the flatness and great breadth of the posterior half. One specimen, complete in this respect, has eighteen coalesced sacral vertebræ. Two equally perfect examples of *Didus ineptus* show only sixteen, which is probably the normal number in that species. The articular surface of the centrum of the last dorsal (Plate XVII. figs. 66, 67) is in *Pezophaps* almost exactly as in *Didus*, but the pit for the head of the rib is placed somewhat more forward in the former. The anterior outlet of the neural canal exhibits as much individual variety as it does in *Didus*, but

is generally vertically ovate and sometimes constricted midway. The buttresses of bone supporting the præzygapophyses are more slender than in *Didus*, and the præzygapophyses themselves are smaller; with their facets inclined more forward and less vertically sloped. The fore part of the neural spine, which is nearly as strong as in *Didus*, has a similar rough syndesmotic surface and a curved anterior outline, but it is not constantly confluent with the ilia, the thickened margins\* of which (Plates XVI. fig. 65, XVII. fig. 68, XVIII. fig. 70), rising behind it and meeting together, appose, more or less, their curved inner (and under) edges to one another till nearly over the anterior renal cavity, when, instead of sweeping backward and forming a prominent gluteal ridge as in *Didus*, they suddenly turn downwards, then, in some specimens, as sharply forwards, and finally trend backwards towards the part over the acetabulum, soon becoming obsolete. The coalesced neural spines of the remaining sacral vertebræ, after dipping down to allow of the meeting together of the margins of the ilia as just described, rise again and form a continuous, elevated and slightly curved ridge (Plates XVI. fig. 65, XVII. figs. 68, 69, XVIII. fig. 70), which, sloping slightly downwards towards its termination, extends to the posterior extremity of the sacral region, where it presents a small lozenge-shaped, partly articular and partly syndesmotic surface to the anterior caudal vertebra, as in *Didus*, receding around the neural canal, here reduced to a very small foramen, but with the centrum projecting backwards.

The abutments of the first sacral vertebra (Plate XVII. fig. 66), which seems to be somewhat more elongated, are generally almost exactly as in *Didus*. One specimen, however, shows a remarkable deviation from the ordinary form, in having the pleurapophysis, usually a slender straight filament, very greatly thickened, and curving downwards outwardly to meet the ilia, with which it is confluent.

In the next three vertebræ there is considerable individual variation: sometimes all have their pleurapophyses thickened, sometimes the first two only, and in one specimen (that which has just been mentioned as having the first sacral abnormal) the last two. The majority of specimens show the thickening of the first two. On the whole, however, the general aspect of this part is very like what it is in *Didus*.

The fourth and fifth sacrals have their pleurapophyses occasionally developed, but though in one specimen those of the fourth are very much thickened, in none are they sufficiently produced to coalesce with the ilia. In another specimen the diapophysis of the fifth is greatly thickened on the right side so as to present the appearance of a thickened pleurapophysis, while on the left it is of the ordinary character.

The next succeeding sacral vertebræ closely resemble those of *Didus*, and are attached to the ilia by their diapophyses only.

In the seventh, eighth or ninth sacrals, however, and most generally in the eighth, the pleurapophysis reappears, just as it does in *Didus*; extending backwards and rapidly widening, it abuts against the underside of the ilium, immediately above the acetabulum, but not, as in *Didus*, behind it.

\* These margins show no disposition to coalesce. In one example (Plate XVI. fig. 65), apparently of a very old bird, they are developed to excess, and then, they turn down outwardly on themselves.

The next succeeding vertebra occasionally develops an imperfect pleurapophysis, but the remainder are attached to the ilia only by diapophyses. These are stouter and less lamelliform than in *Didus*, and, owing to the more convex form of the posterior portion of the pelvis, the cavities they intercept are shorter. The whole of these vertebræ are broader than in *Didus*, and this comparative widening of the centrum becomes more obvious towards the posterior extremity.

The ilium above (Plates XVI. fig. 65, XVII. fig. 68, XVIII. fig. 70) is not so distinctly divided into two parts as in *Didus*, owing to the obsolescence of the gluteal ridge already mentioned. The anterior part is less concave, the posterior more convex, and both are narrower than in *Didus*. The anterior border of the ilium is thickened and curved with the convexity forward, but the most convex part of the curve is nearer the lower margin than in *Didus*, where it is situated about the middle. The form of the upper margin of the ilium has been previously described. The orifices of the ilioneural canals are very much smaller than in *Didus*, and often more circular. The acetabular region is much as in *Didus*, but the trochanterian surface is narrower, more prominent, and directed more forward. Immediately above this surface, where the ilia have diverged furthest from each other, they rise, and without showing any angular ridge, bend over convexly. Here they slope downward till about as far as the fourteenth sacral vertebra, approaching each other slightly, but not so much as in *Didus*. They then again diverge. The inner surface of the ilium is also thickened behind the ischiadic foramen, but in *Pezophaps* to a less degree. The outer border of the posterior part of the ilium projects pretty equally in the two forms, and the coalescence of the ilium, ischium, and pubis is much the same in each. The pubis, of which in *Didus* only a small portion has been described, is present in one specimen of *Pezophaps* (Plates XVII. figs. 66, 68, XVIII. fig. 70) in what appears to be a nearly perfect condition. It originates below rather than behind the acetabulum, and diverges, as soon as it is free, both vertically and horizontally from the ischium. It is at first trihedral with the addition of a sharp projecting ridge on its upper and outer margin. This ridge disappears as the bone passes backward, and broadens into a lamina with the upper edge thickened, and bevelled on the outer side. After passing beyond the extremity of the sacrum the pubis bends upward, slanting slightly inward, and the bevel turning to the inner side disappears. The ischium of *Pezophaps* greatly resembles that of *Didus*, so far as can be judged from the imperfect examples of the latter which exist. The ischiadic foramen of the former, however, is as broad behind as before. The posterior portion of the ischium, at the distance from the ischiadic foramen of about its own length, becomes sensibly convex. It then narrows and becomes concave, its lower margin sloping downward and outward, as if to pass and avoid the pubic style, which is here directed upward and inward in a different plane; but the extremities of both pubis and ischium are broken off, and it is not perfectly certain that they may not have met eventually, though it is not easy to suppose that they have done so. Quite enough, however, remains to show that in the posterior portions of both these bones *Pezophaps* differs entirely from *Didunculus*, or indeed any Columbine form, and we must go far to seek a similar case. The conjectural restoration of the ischium and

pubis in *Didus* by Professor OWEN's artist (*op. cit.* pl. xv.) is probably altogether erroneous; but if it be so the error is, under the circumstances, most excusable, for no one could have predicated the extraordinary forms assumed by these bones in *Pezophaps*.

### § 5. Sternum.

Of this bone the collection contains fragments belonging to at least six individuals, but only one that is at all complete, though some portions of the others furnish information as to certain not unimportant details. The most perfect specimen (Plate XVIII. figs. 71–74) also has received much damage on its sides and posterior extremity, so that their contour can only be inferred—a matter perhaps of the less consequence since the characters afforded by the posterior extremity of the sternum are certainly not so constant in birds generally as those to be deduced from the anterior end\*. This same specimen is also one of the smallest (female?), and on that account it is possible that some of the most remarkable characters of *Pezophaps* may not be very strongly developed in it.

\* In support of this opinion the following cases may be cited among many others that could be mentioned. In the *Limicolæ* (NITZSCH) (= *Charadriidæ* and *Scolopacidæ*, AUCTT.), an eminently natural group, a very great diversity of conformation of the posterior margin of the sternum exists even among forms which are, both in general habits and outward structure, very closely allied. *Totanus ochropus* differs from all other *Totaninæ* known to us by possessing only one posterior emargination on each side the keel, where they (and even *T. glareola*, so long confounded with *T. ochropus*) have two. *Machetes* has a single emargination. *Charadrius morinellus* is unlike any other Limicoline bird we know, inasmuch as both “ectolateral” and “entolateral” processes extend backward nearly as far as the keel does, and the former are somewhat everted as in *Phalaropus*. But *Edicnemus* and *Vanellus* have the extremity of the inner emarginations bridged across so as to become fenestræ. *C. plumialis* and *C. hiaticula*, with many of the smaller Plovers, have two emarginations like most *Totaninæ*. *Scolopax gallinula* resembles these last and the majority of *Tringine*, while *S. gallinago*, *S. wilsoni*, and *S. bernieri* have only one large, and *S. major*, like *S. americana* and *S. rusticola*, one small emargination on each side. As great differences are to be found in other *Limicolæ*; but here we have only mentioned cases of very closely-allied species; for in aberrant forms like *Edicnemus* and *Machetes* some diversity is not much to be wondered at. Examples might also be taken from the *Procellariidæ*; but, to come nearer our present subject, among the *Columbæ* we have *Didunculus* with a single pair of broad lateral processes, and the space between the emarginations without any fenestration (Plate XXIII. fig. 170). In the more normal *Columbæ* the structure is much the same (Plate XXIII. fig. 169), except that the lateral processes are much narrower, but a monstrous example of *C. livia* (Plate XXIII. fig. 172) shows two pairs. In a specimen of *Patagienas caribbæa* in our possession, where the middle of the hinder end of the sternum is very broad, there is a small circular fenestra on the left side, but none on the right (Plate XXIII. fig. 173). In *Goura* and *Leucosarcia* (Plate XXIII. figs. 176, 171) there are two pairs of lateral processes, and in the former (*Goura*) the outer pair is wide and its front edge distinctly turned forwards at its upper extremity. In the latter (*Leucosarcia*) the anterior pair of processes is tapering. In *Geopelia* (Plate XXIII. fig. 175) and for a long time in *Chamæpelia* there are two pairs of lateral processes, but in the latter (Plate XXIII. fig. 174) the inner pair eventually become connected at their extremities, and thus fenestræ are formed.

A singular modification of the posterior margin of the sternum seems, in some birds, to be connected with diving habits. In this respect we have *Cinclus* differing from nearly all the *Passeres*, and *Pandion* from all the *Falconidæ*; while an extraordinary development of the representative of the ensiform cartilage is observable in the Ducks of the group *Clangula* and the *Merginæ* when compared with other *Anatidæ*, and these birds, as is well known, are among the most excellent of divers.

None of the other fragments (Plate XVIII. fig. 75), though undoubtedly belonging to larger (male?) birds, could have come from individuals equalling in size that whose sternum is now at Paris, and believed to have been hitherto unique. Even making every allowance for the stalagmitic incrustation with which the specimen is encumbered, this bird could not have been less bulky than the largest *Didus* whose sternum has been preserved.

The very near affinity of *Pezophaps* to *Didus* is nowhere better shown than on comparison of the sterna of the two forms; and it is self-evident on the most cursory inspection of them. So far as can be determined from the imperfect state of all the specimens of each, hitherto recovered, there is no distinction of any very great importance to be detected. The general configuration of the two—their extraordinary helmet-like form—is precisely similar and unlike that of any other bird known to us. It may be that the keel in *Pezophaps* is relatively somewhat deeper than that of *Didus*, but *Didus* varies not inconsiderably in this respect, and it would be very unsafe, from what we see of other parts of the skeleton, to assert that *Pezophaps* did not vary also.

Yet a closer examination will reveal several characters more or less diagnostic. First it may be remarked that the coracoidal grooves are shallower and narrower in *Didus* than in *Pezophaps*, and in all the specimens, save one of the last, there is a deeper depression, almost a little pit, at the inner extremity of the groove, in a line and, occasionally, to some degree confluent with it. Above this pit there is in one specimen a second, smaller and subtriangular shallow depression. This same specimen is the only one that exhibits any part of the costal processes, and even here their edges have been broken off. It has the same distal enlargement and concave extremity as *Didus*; but the concavity is semi-divided by a well-defined ridge stretching halfway across the cup. A more remarkable difference is presented by the costal border in this specimen, which shows articular surfaces for four sternal ribs only instead of five, which is the normal number in *Didus*\*, and, so far as can be determined from the broken state of the remaining specimens, there is nothing to induce the belief that they possessed more than four such surfaces. A third character which seems to prevail in *Pezophaps* (being found in all our six examples, and also remarkably well shown in the specimen of the Museum at Paris) is by no means constant in *Didus*, such indication of it as exists at all occurring there, so far as our experience goes, only in the smaller examples. This is the presence in *Pezophaps* of a very deep median hollow near the anterior end of the internal surface of the sternum—a hollow so deep that in five (including the Paris example) out of seven instances the bone is actually perforated, and in one the perforation (the external orifice of which is situated below the coracoid grooves) is of very considerable size. In most specimens of *Didus* where anything like this depression exists it seems to be connected with the

\* Too much importance must not be placed on this character. In one of the sterna of *Didus* in our possession, *five* articular surfaces are exhibited on the left side and only *four* on the right. In another specimen all the five surfaces on the left side are bilobed, while on the right (as seems to be usually the case) this is so with four only, and the anterior surface is simple.

pneumatic foramina of the bone, and in the largest examples it is, with them, altogether obliterated. In *Pezophaps*, however, it has a very distinct existence apart from the pneumaticity of the bone, and (as has just been said) it occurs conspicuously in the Paris specimen, which is equal in size to the largest *Didus*, where no trace of any depression, much less of a deep hollow, is present\*.

### § 6. *Scapular Arch.*

Of this portion of the skeleton we have numerous scapulæ and coracoids, but unfortunately not a fragment which we can identify as belonging to the furcula. None of the specimens offer any trace of the remarkable ankylosis, observed not unusually in *Didus*, of these three bones, and from the considerable series in our possession it is perhaps not too much to conclude that such ankylosis never took place in *Pezophaps*.

The scapula (Plate XIX. figs. 84–86, 97–99, XX. figs. 132, 133), of which thirty-six specimens are contained in the collection, differs very greatly in its general form from that of *Didus*. Instead of being sabre-shaped and curved decidedly backward, it is rather straight, or, if anything, inclining generally somewhat forward—a character not known by us to exist in any other bird, and only pointing backward and inward at its extremity when it becomes spatulate in form. Considerable individual variety of shape, however, is found in this part in *Pezophaps*, as is also the case in *Didus*. As a whole the bone is comparatively stouter in *Pezophaps*, especially its proximal part, and the markings of muscular attachments are not so well defined, there being in this respect little difference between its inner and outer surface. The latter does not so often display towards the distal extremity the slight elongate cavity observable in *Didus*; but is, on the contrary, very frequently somewhat convex, while the inner surface is, almost without exception, decidedly concave, though to a variable extent. The process sent off from the lower and outer border, which is a marked and (so far as we can judge) an invariable feature in *Didus*, is represented merely by a slight notch formed by the abrupt termination of the ridge, which eventually becomes the edge of the thinner and more distal extremity of the bone. The articular end of the scapula is relatively thicker than in *Didus*, with the coracoidal surface occupying a proportionately larger space, while the humeral surface is not so extensive, and the acromial process is proportionately smaller, much less curved, and not containing in its hollow the pneumatic foramen which appears to be always present in *Didus*.

\* In *Didunculus* there is at this part a good-sized hollow, at the bottom of which are some four or five pneumatic foramina. In *Goura* the median hollow is very deep and elongate, constricted in the middle; behind it lies a series of pneumatic orifices, and on each side a shallow depression. *Leucosarcia* is simpler, having a single deep median hollow and two lateral depressions. The same appearance is presented by *Trocaza* (a Mauritian form), *Columba*, and the more normal Doves. *Geopelia* and *Patagienas* much resemble *Goura* in this part. In *Chamæpelia* there is little appearance of the deep hollow, and the lateral depressions are nearly obliterated. Of the normal *Gallinæ*, most forms, as *Phasianus*, *Perdix*, and *Coturnix*, have no lateral depressions here; but the genera *Caccabis*, *Francolinus*, *Ortyx* and *Lophortyx* possess them, while *Odontophorus* does not. A single median depression, which is often thickly set with orifices, exists in most of the genera *Tetrao*, *Bonasia*, and *Lagopus*.

Of the coracoid (Plates XIX. figs. 76–83, XX. fig. 136) the collection contains twenty-seven more or less perfect specimens, besides the anterior extremity of eleven others, thirty-eight in all. This most significant bone differs very greatly from the corresponding part in *Didus*—a fact not perhaps so surprising when the exceedingly abnormal form which it assumes there is taken into consideration. It is in *Pezophaps* proportionately much more bulky, and generally smoother. At its sternal end it differs from *Didus*, and indeed from all Columbine birds, in the extension and rounding off of the outer border so as entirely to mask the more or less elongate process which in some of the *Columbidæ* (*Columba livia* for instance) is turned distinctly forwards. Corresponding with this the inner border is produced into a sharper angle, though blunt at the tip, than it is in *Didus*, and much more so than in most other Pigeons\*. Making allowance for the extreme attenuation of the coracoid in *Didus*, which is its especial characteristic, the surfaces of the coracoid in *Pezophaps* present, on closer study, much the same aspect. The upper surface at the sternal end (Plate XIX. figs. 78, 82) is more convex, and the lower one is less flat, but generally perforated with similar pneumatic foramina†, though these are variable in shape and extent, and sometimes, though seldom, entirely disappear. The muscular ridge and rough surface which mark the back part of this bone, below the middle of the shaft, in *Didus* are not usually so distinct in *Pezophaps*; the former, however, can be traced in all the specimens. At the upper end of the coracoid the articular surfaces (Plate XIX. figs. 77, 81) have much the same aspect as in *Didus*, an allowance being made for its increased relative thickness. The surface for the articulation of the scapula is, however, proportionately larger. It is very variable in form, being in most of the larger (male?) examples roughly quadrate, in the smaller (female?) triangular‡. In these last there commonly springs from the inner corner a somewhat elongate process, directed inward and slightly downward, and then curving backward. The humeral articular surface is not nearly so well defined, and is not oval and smooth as in *Didus*, but generally somewhat semilunar in shape, with two or three depressions, caused (as some of the specimens show) by minute foramina (which in others are entirely obliterated)§. The surface for the articulation of the

\* In *Didunculus* the coracoid exhibits certain well-marked characters; whether they are diagnostic we will not say. Chief among them is the increased development of a muscular ridge along the inner edge of the sternal end. Arising at the front part of the sternal articulation it passes obliquely upward and backward till it ceases abruptly on meeting the usual ridge running along the internal side of the bone. At the other end of this bone also the usual internal curved process which serves as the basis of attachment of the upper side of the scapula is more largely developed than seems to be usual with the Doves, being extended downward so as most nearly to meet the furcula.

† The absence of pneumaticity in the coracoids of the *Ardeidæ*, and their consequent difference of colour, is a striking feature when the specimens have not been macerated so much as to remove all the grease from the bones.

‡ An additional proof of the value of the characters furnished almost invariably by this bone in birds, on which I have elsewhere slightly touched (*Ibis*, 1868, p. 95).—A. N.

§ In one specimen of the coracoid of *Didus* in our possession there exists a good-sized deep circular hollow on the lower side of the bone, immediately opposite to the humeral articular surface. There is no trace of this hollow in any of the other six coracoids we have. This same specimen presents on its upper aspect a singularly

furcula in *Pezophaps* is shorter and broader than in *Didus*. There is no trace in any of the specimens of an actual anchylosis of the coracoid with the furcula any more than with the scapula; but in many of the larger (male?) ones, there is a considerable bony development on the edges of the articular surfaces, as if resulting from the partial ossification of the integument, which may perhaps be an approximation to that condition of the three bones which seems usually to have existed in *Didus*.

The exact angle formed by the axes of the coracoid and scapula at the point where they meet cannot positively be determined. To the best of our judgment, however, it cannot have been much less than it is in *Didus*\*.

### § 7. *Bones of the Wing.*

Compared with the wing-bones of *Didus* those of *Pezophaps* present, even on the most cursory inspection, a more massive aspect with a smoother surface. The humerus (Plate XIX. figs. 91, 92), of which the collection contains forty-six specimens, most of them in a sufficiently perfect condition†, has the proximal extremity considerably more rounded, with the oval convexity of the articular head absolutely (even in the smallest specimens) more elongated outwardly, and in front more transversely concave. The pectoral process projects very slightly, and the ulnar tuberosity is less developed. Of the pits at its base, the upper one is narrower and more oblique, the lower one much narrower, and with a very much larger pneumatic foramen. The longitudinal ridge, so strongly developed on the upper portion of the shaft in *Didus*, is here generally almost, and sometimes quite, obsolete. The muscular ridges of the distal end resemble more closely those of *Didus*. The cancellous structure of either end is perhaps rather less developed in *Pezophaps*.

The radius (Plates XIX. figs. 94, 95, XX. figs. 137, 138), of which forty-three specimens are contained in the collection, is a stout nearly straight subcylindrical bone in-

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increased development, into a similar but deeper and elongate hollow, of the depression commonly situated between the scapular and furcular articulating surfaces; a depression, however, very variable in its extent in other examples.

\* This very marked characteristic of the sternal apparatus in *Didus* I had the pleasure of first making publicly known at the Meeting of the Zoological Society of London on the 12th of December, 1865, when I exhibited a drawing of the confluent coracoid scapula and furcula of that bird from a specimen sent me by my brother, which specimen arrived a few days after the meeting. On learning that Professor OWEN was anxious to have the task of describing the skeleton of the Dodo (from the remains sent him by Mr. GEORGE CLARK), I suppressed the paper containing the remarks I had made on that occasion (Proc. Zool. Soc. 1865, p. 732). I therein stated that (always excepting the *Struthiones*) I knew of no other bird but *Ocydromus* in which the angle formed by the axes of the coracoid and scapula was greater than a right angle, and I have not in the meantime been able to discover any other form presenting this remarkable feature, since recognized by Professor HUXLEY in his course of Hunterian Lectures for 1867, and again in his proposed scheme for the classification of birds (Proc. Zool. Soc. 1867, p. 425), as one of the distinguishing characters of the Orders (Subclasses?) *Carinata* and *Ratite*.—A. N.

† The shaft of a left humerus, wanting its extremities, was picked up by me on my visit to Rodriguez in 1864, and has been figured (Proc. Zool. Soc. 1865, pl. viii. fig. 3).—E. N.

creasing in thickness from near the proximal end, and widening laterally very considerably towards the distal, where it expands to nearly double the original diameter of the shaft, and in the larger specimens (males?) is clothed on the side furthest from the ulna for nearly half an inch by an irregularly-shaped bony growth, having at first sight much the appearance of a stalagmitic encrustation, to which further reference will be made presently. In the smaller specimens the entire bone, though nearly half an inch shorter, is considerably thicker than in *Didus*, especially towards the distal end, in which part there is little resemblance between the two forms. The proximal articular surface though larger is much as in *Didus*.

The ulna (Plates XIX. figs. 93, 96, XX. figs. 134, 135), of which forty-one specimens are present, is cylindrical, straighter, and thicker than in *Didus*, with the muscular depression, described by Professor OWEN, much less deeply marked, smaller, and situated more distally. In some specimens as many as ten impressions of the roots of the secondary wing-quills can be distinctly traced along the anconal surface, besides three elongated and transversely-directed depressions towards the distal end. On the radial side of these depressions there is present in two or three large and well-preserved specimens a small bony tuberosity.

Very many of the largest (male?) specimens of both ulna (Plate XX. fig. 135) and radius bear marks of fracture and healing during the bird's life.

Perhaps the most interesting of the bones in the whole collection is the metacarpal (Plates XIX. figs. 87-90, XX. fig. 131, XXII. fig. 148), of which no specimen belonging to any Didine bird has hitherto been seen. We have here thirty-two. That it would be very short was a safe inference from what we know of it in other flightless birds; but it could hardly have been expected to obtain from it such a singular confirmation of LEGUAT'S statement regarding a remarkable peculiarity in the "Solitaire" as observed by him, nor that it should furnish an explanation of the curious bony growth on the distal end of the ulna and radius already mentioned as presented by the specimens of supposed males. All the perfect specimens of the metacarpal have on the radial side a more or less spherical bony knob or callus-like mass developed immediately beyond the proximal end and the pollex, which last would appear to be thrust away by it to some extent. This knob in the larger specimens, which we suppose to have belonged to males, is out of all proportion to anything of the kind yet known in ornithology. It is subject to a good deal of variation in form and to a less degree in size, sometimes projecting rather downward than laterally, but in all cases more or less pedunculate. In the largest (male?) specimens its longest diameter is about half the length of the entire metacarpal, and its transverse breadth in any direction is not much less. The metacarpal itself is pneumatic and light, the largest specimen weighing, the knob and all, just about a quarter of an ounce; but the knob, which has been broken off from another specimen, weighs as much as the remainder. The appearance of the knob is much that of diseased bone; it has probably been covered by a cartilaginous integument, which may have extended to the somewhat similar though

less developed osseous growths on the ulna and radius just mentioned. But unquestionably it answers most accurately to LEGUAT's words—

L'os de l'aileron grossit à l'extrémité, & forme sous la plume une petite masse ronde comme une balle de mousquet. (1st ed. vol. i. pp. 98, 99.)      The Bone of their Wing grows greater towards the Extremity, and forms a little round Mass under the feathers, as big as a Musket Ball. (Engl. transl. p. 71.)

Mr. JOSEPH GEDGE, of Gonville and Caius College, has been good enough to furnish us with the following account of the microscopic appearance of this singular structure:—

“On removing a portion of the exterior (after reducing it to a sufficient tenuity) it presented under a low power the cancellous appearance of moderately old callus. On examining it with a high power the lacunæ were for the most part irregular in form; some round with jagged edges, others irregularly stellate, connected together by processes from the lacunæ without the intervention of true canaliculi. A few normal lacunæ and a few vascular canals existed; but there was no lamination. The osseous matter was arranged so as to give an unusually fibrillated aspect to the bone. Irregularity in the form of the lacunæ may not unfrequently be observed in the exterior portion of osseous outgrowths (*e. g.* spavin), when the structure of the interior in no way departs from the ordinary characters of normal bone. It is, however, a character which belongs only to bone which has passed through the stage of rudimental fibrous tissue, and which has not been taken up and laid down again. This growth I consider to be of a nature that might have been produced by irritation of the periosteum, and its formation would appear to have been physiologically analogous to the commonest form of callus.”

The indicial and median portions of the metacarpal bear to each other much the same relation that they appear to do in other *Columbæ*, such as *Columba* and *Didunculus*. The distal end has two well-marked articular surfaces for as many phalanges. There is no trace of quill-marks to be seen on any of the specimens.

The remaining bones of the wing are wanting.

#### § 8. *Bones of the Leg.*

The leg-bones of *Pezophaps* when compared with those of *Didus* show very much more strongly-developed ridges and muscular impressions, being exactly the converse of what is to be remarked of the wing-bones of the two birds. As regards massiveness they are more nearly on a par; but in this respect the leg-bones of *Didus* vary considerably from one another\*. Generally, however, the leg-bones of *Pezophaps* are decidedly longer than those of *Didus*, and the excess increases toward their extreme members. Thus while the smaller (female?) femora of *Pezophaps* are in many instances greatly surpassed in length by the larger (male?) ones of *Didus*, the corresponding tibio-tarsals of the two are most generally equal, and of the tarso-metatarsals of *Pezophaps* only some

\* This variability is not likely to have been sexual. Of the two longest tibio-tarsals of *Didus* in our possession, that which is only very slightly (if at all) shorter than the other is most perceptibly and out of all proportion more slender.

of the very smallest (female?) examples fall short of those of *Didus*, so that it is likely that even the smallest (female?) *Pezophaps* stood higher on the leg than the largest (male?) *Didus*. Comparing, however, the bones of what we imagine to have been the same sexes (and this is, of course, the only fair mode of comparison) it is clear that the body of *Pezophaps* was mounted upon legs at least some two or three inches longer than that of *Didus*.

The principal bones of the leg having been already very minutely and correctly described by Dr. MELVILLE (*op. cit.* pp. 115–119) and STRICKLAND (Trans. Zool. Soc. iv. pp. 192–196), it seems unnecessary here to say much more about them. But there are some points to which we may perhaps advert with advantage.

The femur, of which the collection contains one hundred and nineteen nearly perfect examples, has a very great general resemblance to that of *Didus*; but it is of more uniform thickness, not tapering so much towards the middle or upper third. There is also in our series a total absence of the pneumatic foramen\* on the inner side of the anterior ridge of the great trochanter, which is nearly always present and occasionally of large size in *Didus*. On the other hand there is in most cases a single good-sized and apparently pneumatic orifice on the posterior aspect of the neck of the bone, below the ridge of the articular surface which is adapted to the trochanterian prominence of the pelvis. This single orifice we have not found in *Didus*; but, there, the same part is often perforated by several smaller openings of variable position. Turning to the distal extremity of the femur, the popliteal fossa in *Pezophaps* generally presents at least one large, and often two or three smaller pneumatic orifices, which are perhaps more distinct than in *Didus*. The muscular ridges and impressions are usually very strongly marked.

The tibio-tarsal (Plate XX. figs. 100, 102), of which the collection contains sixty-six specimens in a fair state, besides a vast number in a fragmentary condition, has been already minutely described by the authors above mentioned. It need therefore only be said that the inner anterior ridge at the proximal end (which was broken off in STRICKLAND'S specimen) is generally fully as much developed as in *Didus*, and in many examples is certainly thicker, but its precise form is very variable in both birds.

The fibula (Plate XX. figs. 100–103), of which there are fifty-nine specimens in the collection, is very decidedly (it might almost be said absolutely) stouter and more massive than it is in *Didus*; but owing to the extreme variability of this bone it is difficult to seize on any characters that may be considered to be more than those of the individual. Perhaps on the whole the fibula of *Pezophaps* has a smoother surface; but two or three of the examples have their ridges and depressions as strongly marked as any of those of *Didus* which we have seen. As the tibio-tarsal is relatively longer in the former than in the latter, so is it (as might be expected) with the fibula.

The tarso-metatarsus, of which the collection contains one hundred and twenty-three examples in fair preservation, besides a great number of larger and smaller fragments,

\* This foramen is said by Dr. MELVILLE to be absent in all Pigeons except *Goura*. The last statement we can confirm of our own observation. It is also wanting in *Didunculus*.

has already been not only elaborately described by Dr. MELVILLE and STRICKLAND (*opp. citt.*), but also compared by them with the corresponding bone of *Didus*. It is accordingly unnecessary here to say more about it than to remark that the large series of specimens in our possession forbids us from coinciding in the generalization propounded by STRICKLAND (Trans. Zool. Soc. iv. p. 196) as to the "inner or longest calcaneal process" in *Pezophaps* being considerably less developed than in *Didus*. This process, now regarded\* as the head of the third (anchylosed) metatarsal, does not project posteriorly (it is true) so much as in *Didus*; but this fact appears to us to be in consequence of the heads of the second and fourth (anchylosed) metatarsals being expanded laterally rather than antero-posteriorly. In like manner, and for the same reason, we are unable to confirm STRICKLAND'S generalization as to the three trochleæ at the lower extremity being placed more nearly in the same vertical plane in *Didus* than in *Pezophaps*; for in this last the large series of examples shows that the angle formed by joining the centres of the three trochleæ (of course the only mode of accurately testing the observation) is much more obtuse in the smaller (female?) specimens than in the larger (male?). In this case, if any stress is to be laid on STRICKLAND'S inference (*ut supra cit.*), it would follow that the larger (male?) examples of *Pezophaps* did not run so quickly as ordinary examples of *Didus*, while the smaller (female?) attained a greater speed. The orifice of the calcaneal canal is absolutely smaller in *Pezophaps* than in *Didus*, a fact apparently arising from the greater thickening in the former of the "calcaneal processes." For the rest we may safely leave this bone as already accurately and sufficiently described.

The posterior metatarsal (Plate XX. figs. 104, 105), of which fifteen specimens are contained in the collection, is one of the few bones we have not had the opportunity of comparing with the corresponding part of *Didus*. Judging, however, from the figures and a model of the celebrated Oxford specimen, it would appear to be more massive and to present a smoother surface, the furrow for lodging the flexor tendons of the hallux not being so deep, and the whole bone is less crooked. The proximal articular surface is more convex in the middle than it would appear to be in *Didus*; but its lower portion is roughened just as is said to be the case there. The styloid process is much less developed than it would seem to be in *Didus*, and on the surface which is twisted forwards it becomes almost flush with the trochlea, so that its boundaries are not strongly defined; on the other hand the pit on the inner extremity of the trochlea is to all appearance as deep as in *Didus*. Generally this bone in *Pezophaps* would seem to be longer, which is of course in proportion to the increased length of the lower extremities.

Among the phalanges, of which the collection contains in all one hundred and fifty-specimens, there is wanting the second and third of the inner, and the second, third, and fourth of the outer toes. The first, or proximal phalanx of the hind toe (Plate XX. figs. 106, 107) seems to be a good deal stouter relatively than it is in *Didus*,

\* Cf. GEGENBAUR, Arch. für Anat. und Physiol. 1863, pp. 450-472; Untersuchungen zur vergleichenden Anatomie der Wirbelthiere (4to, Leipzig: 1864), pp. 93-108, pl. vi.

and the ungual segment (Plate XX. figs. 108, 109) proportionally longer. In the inner toe the proximal phalanx (Plate XX. figs. 128-130) is the longest in the whole foot, whereas in *Didus* it would appear to be about equal in length to that of the middle toe. This (Plate XX. figs. 116-118), again, is relatively and in large (male?) specimens absolutely longer and especially thicker than that of *Didus*, and the next two phalanges of this toe (Plate XX. figs. 119-124) are in proportion to it, but the ungual segment (Plate XX. figs. 125-127) is longer than the third. Of the outer toe the first (Plate XX. figs. 110-112) is the shortest of the proximal phalanges of the whole foot. The other segments of this toe, except the ungual (Plate XX. figs. 113-115), are missing. This is also, like the rest of the ungual phalanges, larger and especially longer than in the single corresponding example of *Didus*.

### § 9. *Skull.*

Of the cranial portion of the skull (Plates XXI. figs. 139-147, XXII. figs. 149, 150) the collection includes five specimens, more or less imperfect, but all containing the foramen magnum, which, as in *Didus*, but not to the same extent, varies not a little in shape, one specimen (of a male?) having it much wider below than above, but in the others the upper and lower curves are more nearly alike. So also the occipital condyle is to some extent inconstant. In the (male?) specimen just mentioned, and in two at least of the smaller ones, it slopes gradually from its base; but in an example of median size it rises abruptly, and on one side (the left) slightly overhangs its base, so that regarding it from that aspect it looks as if it were pedunculate.

Three of the specimens (Plate XXI. figs. 141, 144, 147) are sufficiently perfect to show the supraoccipital orifice, the existence of which in *Pezophaps* was surmised by Dr. MELVILLE (*op. cit.* p. 114). The other small foramina and protuberances correspond singularly with those in *Didus*, exhibiting the same amount of individual variation.

On the other hand the cranium of *Pezophaps* differs remarkably from that of *Didus* in several important features, some of which have been already pointed out by Dr. MELVILLE (*loc. cit.*), while others will be rendered more apparent by an inspection of the accompanying figures. It is narrower and longer, entirely destitute of the peculiar frontal protuberance, and generally more compressed and less ventricose, while the orbital chambers are larger. In one respect, however, that accurate osteologist has been misled. He attributes the apparent depression of the central tract of the upper surface entirely to the stalagmitic deposit on its anterior and posterior parts in the only specimen then known. In the specimens in the present collection, which are wholly free from that deposit, this apparent depression is equally to be observed. It is due, however, to the elevation of the anterior and particularly of the posterior parts into two bony ridges of the cancellous structure which in *Didus* occupies the whole surface, and indeed is most prominently developed on its central portion (Trans. Zool. Soc. vi. pl. 23. fig. 1), but in *Pezophaps* does not rise in the middle to any considerable degree, and consequently leaves the exterior surface almost perfectly flat, while the posterior ridge, being continued

forward on either side, a somewhat dish-like formation is given to the top of the head\*.

The frontals rise abruptly as in *Didus*, but, as will have been gathered from what has just been said, to a much less extent. The cranium also in this place is much compressed, the largest specimen measuring only 1.76 inch at the narrowest part between the orbits, and the interorbital septum is not so thick as in *Didus*, but composed of the same cancellous structure. None of the specimens are sufficiently perfect to show the entire extent of the posterior olfactory chambers, which are, as in *Didus*, partially divided. At the junction of the nasals with the nasal process of the premaxillary, the proximal portion of which is not preserved in any of the specimens, the surface is extremely rugose, indicating the position of the caruncular ridge, which, from LEGUAT's figure and description, we already knew the bird to have possessed at the base of its bill.

In the upper mandible (Plate XXII. figs. 151–158) we have presented one of the most remarkable differences between *Didus* and *Pezophaps*. Instead of that singular characteristic of the former (which has been duly dwelt on by previous investigators), the vertical enlargement and coalescence, before reaching the core of the dertrum, of the maxillary branches of the premaxillary, we have in the latter a structure much more in accordance with the normal *Columbæ*, and presenting an appearance laterally though not from below much as in *Treron*. The maxillary branches of the premaxillary in *Pezophaps* approach each other gradually, but do not coalesce until about halfway between the commencement and extremity of the core of the dertrum, and thus they do not meet the nasal process of the premaxillary at an acute angle immediately behind the core of the dertrum, but the core of the dertrum intervenes vertically (Plate XXII. figs. 152, 155, 157). In other words, the axes of the nasal process and maxillary branches in *Didus* are convergent, in *Pezophaps* divergent.

There is remarkable variation in the size of the upper mandible in different individuals to the extent of very nearly one-half the linear dimensions between the largest and smallest specimens, of which the collection contains thirteen in all, some of which, however, are merely fragmentary, and the best exceedingly imperfect. No portion of the palatals is preserved.

Of the lower mandible (Plate XXII. figs. 159–162) the collection contains thirty-four fragments, one-half belonging to the distal and the other half to the proximal end. It has not been possible to fit together with certainty any two of them so as to form a perfect ramus. To one of the dentary portions, however, part of the core of the symphysis (Plate XXII. fig. 162) remains attached, and there is a second such core which is perfect though detached from both its rami. Still the exact outline of the lower as of the upper mandible must be left in some degree a matter of conjecture. Enough, however, is present to prove that it was sufficiently different in shape from that of *Didus*,

\* It is proper to observe that in the only portrait we possess of the bird, that of LEGUAT, there is no trace of this formation to be found.

and still more from that of *Didunculus*. In the sudden vertical narrowing of the dentary in front of its junction with the surangular (Plate XXII. fig. 160) *Pezophaps* shows a greater approach to some of the more normal *Columbæ*, *Treron* for example. While in *Didunculus* the lower mandible sweeps on with a continuous downward curve, and in *Didus* it exhibits but a slight projecting angle at its splenial region (in both cases preserving nearly the same vertical height throughout), in *Pezophaps* (the upper edge of the whole mandible being apparently much straighter than in *Didus*) the angular and surangular slope steeply down to meet the dentary, which immediately afterwards rises as steeply, thereby forming on its lower edge a salient angle altogether wanting in *Didunculus* and not very considerable in *Didus*. From this the dentary rapidly tapers till it descends to form the gonys, which is fully as much developed proportionately as in *Didus*, while the angle formed by the two rami at their symphysis is somewhat more acute, and thus, with the less massive proportions of the upper mandible already described, the whole bill of *Pezophaps* must have been very much more slender and less powerful than the formidable, not to say monstrous weapon of *Didus*. The various foramina for the passage of the different nerves or vessels are situated much as in *Didus*. This is especially noticeable in the case of the large dental canal, which opens externally nearer the upper than the lower edge, while in *Didunculus* it occupies a position nearly midway.

The proximal portion of the lower mandible (Plate XXII. figs. 159, 161) offers further differential characters between *Didus* and *Pezophaps*. Notwithstanding the small size of the entire head in the latter, the angular and articular bones are fully as large as in the former, though neither the internal pyramidal process nor the external semilunar plate are so largely developed. The basal facet therefore assumes a very different form. Instead of presenting as in *Didus* the shape of a nearly isosceles triangle, the equal angles of which are subtended by the sides forming the internal process, it is in *Pezophaps* more equilateral; its extreme width only slightly exceeds its height, and its nearly vertical surface is less concave. The walls of the articular surface also are much thicker absolutely, and of course still more so comparatively, in *Pezophaps* than in *Didus*, and that which supports the concave reniform tract on its outer surface thrust out as to form a much more considerable projection in place of the elongated tubercle in *Didus*. As if further to add to the solidity of this part of the jaw, the tract for the insertion of the external pterygoid muscle is perceptibly less deeply concave.

Of the quadrate or "tympanic" (Plate XXII. figs. 163-168), the collection includes nineteen specimens. We have not had any opportunity of comparing this bone in *Pezophaps* with the same in *Didus*, and the latter has not been figured separately, but only represented *in situ*, and consequently with some of its parts foreshortened and concealed. To judge, however, from the figures, the bone in the two birds is of much the same general form, though in *Didus* the angle formed by the mastoid articular segment and the orbital process seems to be more filled up than in *Pezophaps*, thereby making this process more slender, while in *Pezophaps* the mandibular condyle appears to

be more elongated and transverse, and the process to which the squamosal is articulated does not project backward so far as in *Didus*. There is still less resemblance in the structure of this part to the same in *Didunculus*, where the inferior articular surface deviates, as has been already stated by Dr. MELVILLE (*op. cit.* pp. 99, 100), most greatly from the normal Columbine form. In point of bulk, the quadrate of *Pezophaps* would seem to be nearly absolutely as large as that of *Didus*. The intero-posterior cavities present very considerable individual variation both in shape and extent.

The remaining parts of the skull are unfortunately wanting.

#### § 10. *Comparison of the Skeleton.*

As the whole of the preceding description has been in a manner comparative, there remains little to be said that can be placed under this heading. Nevertheless, to preserve the uniformity of arrangement with Professor OWEN's treatise on the Dodo, we here include such general remarks on the subject as we have to make.

The most important distinctions between *Pezophaps* and *Didus*, as may be gathered from what we have already said, are on the whole such as not to remove the former further from the normal *Columbæ* than the latter. In several respects (of which the enormous development of the cancellous boss on the top of the head, the general form of the lower mandible, and, above all, the extreme attenuation of the coracoid in *Didus* may be mentioned as chief) *Pezophaps* holds a middle place between that form and ordinary Pigeons. On the other hand the armature of the wing is a character equally remote from either\*. We had expected to have found that *Pezophaps* would prove to be a link between *Didus* and *Didunculus*; but this is not the case: the latter seems to be a perfectly distinct form, and, in our opinion, sufficiently isolated from other *Columbæ* to be considered the type of a separate family, in which light it has before been regarded; but at the same time this family *Didunculidæ* must not be considered to be so aberrant as the *Dididæ*, which we look upon as the most remotely connected of the Order COLUMBÆ, consisting of three well-marked families of equal rank, (1) DIDIDÆ, (2) COLUMBIDÆ, and (3) DIDUNCULIDÆ, the first and last of which are only related to each other by means of the second, and have no direct affinity, however much superficial resemblance there may be between the beak of *Didunculus* and that of *Didus*.

The grounds on which STRICKLAND ('The Dodo' &c. p. 54) established the genus *Pezophaps*, by separating it from *Didus*, were merely "the greater length of the legs and the less development of the beak." The result of our investigations prove that he was amply justified in coming to this conclusion. Still we would desire to see his genus more firmly established, and accordingly we venture here to propound its characters in set phrase as follows:—

PEZOPHAPS, Strickland, 1848. *Genus Columbarum Didinum*.

*Char. gener.* Rostrum mediocre, curvatum, processu nasali et ramis maxillaribus antice divergentibus. Frons plana, porcâ osseo-cancellatâ circumdata. Ossa coracoidea

\* In *Goura*, as Professor HUXLEY has lately most kindly pointed out to us, the wing is armed with a knob, but it is, even comparatively, much smaller than in *Pezophaps*.

robusta. Alæ breves, involatiles. Manus singulis bullis osseo-callosis armatæ. Collum et pedes longiores.

In like manner the allied genus might be defined:—

DIDUS, Linnæus, 1766.

*Char. gener. emend.* Rostrum magnum, aduncum, processu nasali et ramis maxillaribus antice convergentibus. Frons tumida in umbonem hypoconicum osseo-cancellatum surgens. Ossa coracoidea attenuata scapulis obtuse attingentia. Alæ breves, involatiles. (Manus inermes?) Collum et pedes breviores.

### § 11. *Concluding Observations.*

It may be convenient here to quote at length the account given by LEGUAT of this bird as observed by him during his sojourn at Rodriguez from the 1st of May, 1691, till the 21st of May, 1693.

*Voyage et Aventures de FRANÇOIS LEGUAT & de ses Compagnons, en deux isles désertes des Indes Orientales.* Londres: 1708. 2 vols. 12mo.

De tous les oiseaux de l'Isle, l'espèce la plus remarquable est celle à laquelle on a donné le nom de *Solitaires*, parce qu'on les voit rarement en troupes quoi qu'il y en ait beaucoup.

Les mâles ont le plumage ordinairement grisâtre & brun, les pieds de coq d'Inde, & le bec aussi, mais un peu plus crochu. Ils n'ont presque point de queue, & leur derrière couvert de plumes est arrondi comme une croupe de cheval. Ils sont plus haut montés que les coqs d'Inde, & ont le cou droit, un peu plus long, à proportion, que ne l'a cet oiseau quand il lève la tête. L'œil noir & vif, & la tête sans crête ni huppe. Ils ne volent point, leurs ailes sont trop petites pour soutenir le poids de leurs corps. Ils ne s'en servent que pour se battre, & pour faire le moulinet, quand ils veulent s'appeler l'un l'autre. Ils font avec vitesse vingt ou trente pirouettes tout de suite, du même côté, pendant l'espace de quatre ou cinq minutes: le mouvement de leurs ailes fait alors un bruit qui approche fort de celui d'un Crécerelle; & on l'entend de plus de deux cens pas. L'os de l'aile grossit à l'extrémité, & forme sous la plume une petite masse ronde comme une balle de mousquet: cela & le bec, sont la principale défense de cet oiseau. On a bien de la peine à les attraper dans les bois, mais comme on court plus vite qu'eux, dans les lieux dégagés, il n'est pas fort difficile d'en prendre. Quelquefois même on en approche fort aisément. Depuis le mois de Mars jusqu'au mois de Septembre, ils sont extraordinairement gras, & le goût en est excellent, sur tout quand ils sont jeunes. On trouve des mâles qui pèsent jusques à quarante cinq livres.

*A New Voyage to the East Indies by FRANCIS LEGUAT and His Companions. Containing their Adventures in two Desert Islands.* London: 1708. 1 vol. 8vo.

Of all the Birds in the Island, the most remarkable is that which goes by the Name of the *Solitary*, because 'tis very seldom seen in Company, tho' there are abundance of them. The Feathers of the Males are of a brown, grey Colour: The Feet and Beak are like a Turkeys, but a little more crooked. They have scarce any Tail, but their Hind-part cover'd with Feathers is Roundish, like the Crupper of a Horse, they are taller than Turkeys. Their Neck is straight, and a little longer in proportion than a Turkeys, when it lifts up his Head. Its Eye is black and lively, and its Head without Comb or Cop. They never fly, their Wings are too little to support the weight of the Bodies; they serve only to beat themselves, and flutter when they call one another. They will whirl about for twenty or thirty times together on the same side, during the space of four or five Minutes: The Motions of their Wings makes then a Noise very like that of a Rattle; and one may hear it two hundred Paces off. The Bone of their Wing grows greater towards the Extremity, and forms a little round Mass under the Feathers, as big as a Musket Ball: That and its Beak are the chief Defence of this Bird. 'Tis very hard to catch it in the Woods, but easie in open Places, because we run faster than they, and sometimes we approach them without much Trouble. From *March* to *September* they are extremely fat, and tast admirably well, especially while they are young, some of the Males weigh forty-five pounds.

La femelle est d'une beauté admirable ; il y en a de blondes & de brunes ; j'appelle blond, une couleur de cheveux blonds. Elles ont une espèce de bandeau comme un bandeau de veuves au haut du bec qui est de couleur tanée. Une plume ne passe pas l'autre sur tout leur corps, parce qu'elles ont un grand soin de les ajuster, & de se polir avec le bec. Les plumes qui accompagnent les cuisses sont arrondies par le bout en coquilles ; & comme elles sont fort épaisses en cet endroit-là cela produit un agréable effet. Elles ont deux élévations sur le jabot, d'un plumage plus blanc que le reste, & qui représente merveilleusement un beau sein de femme. Elles marchent avec tant de fierté & de bonne grace tout ensemble, qu'on ne peut s'empêcher de les admirer & de les aimer ; de sorte que souvent leur bonne mine leur a sauvé la vie.

Quoique ces oiseaux s'approchent quelquefois assez familièrement quand on ne court pas après eux, on ne peut jamais les apprivoiser : si tôt qu'on les arrêtez ils jettent des larmes sans crier, & refusent opiniâtement toute sorte de nourriture, jusqu'à ce qu'ils meurent enfin. On leur trouve toujours dans le gésier, (aux femelles aussi bien qu'aux mâles) une pierre brune de la grosseur d'un Oeuf de poule ; elle est un peu raboteuse, platte d'un côté & arrondie de l'autre, fort pesante, & fort dure. Nous avons jugé que cette pierre naît avec eux ; parce que quelque jeunes qu'ils soient, ils en ont toujours, & n'en ont jamais qu'une ; & qu'outre cela, le canal qui va du jabot au gésier, est trop étroit de moitié pour donner passage à une pareille masse. Nous nous en servions préférablement à aucune autre pierre pour aiguiser nos couteaux.

Quand ces oiseaux veulent bâtir leur nids, ils choisissent un lieu net, & ils l'élèvent à un pied & demi de terre sur un tas de feuilles de palmier qu'ils ont ramassées pour ce dessein. Ils ne font qu'un Oeuf, qui est beaucoup plus gros que celui d'une oye. Le mâle & la femelle le couvent tour à tour, & il n'éclopent qu'après sept semaines. Pendant tout le tems qu'ils couvent, ou qu'ils élèvent leur petit, qui n'est capable de pourvoir seul à ses besoins qu'après plusieurs mois, ils ne souffrent aucun oiseau de leur espèce à plus de deux cens pas à la ronde ; & ee [*lege* ce] qui est assez singulier, c'est que le mâle ne chasse jamais les femelles ; seulement, quand il en aperçoit quelqu'une, il fait en pirouettant son bruit ordinaire, pour appeler la femelle qui vient donner aussi-tôt la chasse à l'étrangère, & qui ne la quitte que lorsqu'elle l'a conduite hors de ses limites. La femelle en fait de même & laisse chasser

The Femals are wonderfully beautiful, some fair, some brown ; I call them fair, because they are of the colour of fair Hair : They have a sort of Peak like a Widow's upon their Breasts [*lege* beaks], which is of a dun Colour. No one Feather is stragling from the other all over their Bodies, they being very careful to adjust themselves, and make them all even with their Beaks. The Feathers on their Thighs are round like Shells at the end, and being there very thick, have an agreeable effect : They have two Risings on their *Craws*, and the Feathers are whiter there than the rest, which livelyly represents the fine Neck of a Beautiful Woman. They walk with so much Stateliness and good Grace, that one cannot help admiring and loving them ; by which means their fine Mein often saves their lives.

Tho' these Birds will sometimes very familiarly come up near enough to one, when we do not run after them, yet they will never grow Tame : As soon as they are caught they shed Tears without Crying, and refuse all manner of Sustenance till they die.

We find in the Gizards of both Male and Female a brown Stone, of the bigness of a Hens Egg, 'tis somewhat rough, flat on one side, and round on the other, heavy and hard. We believe that this Stone was there when they were hatch'd, for let them never be so young, you meet with it always. They have never but one of 'em, and besides, the Passage from the Craw to the Gizard is so narrow, that a like Mass of half the bigness cou'd not pass. It serv'd to whet our knives, better than any other Stone whatsoever.

When these Birds build their Nests, they choose a clean Place, gather together some Palm-Leaves for that purpose, and heap them up a foot and a half high from the Ground, on which they sit. They never lay but one egg, which is much bigger than that of a Goose. The Male and Female both cover it in their turns, and the young is not hatch'd till at seven Weeks end : All the while they are sitting upon it, or are bringing up their young one, which is not able to provide for its self in several Months, they will not suffer any other Bird of their Species to come within two hundred yards round of the place : But what is very singular, is, The Males will never drive away the Females, only when he perceives one he makes a noise with his Wings to call the Female, and she drives the unwelcome Stranger away, not leaving it till 'tis without her Bounds. The Female do's the same as to the Males, whom she leaves to the

les mâles par le sien. C'est une particularité que nous avons tant de fois observée, que j'en parle avec certitude.

Ces combats durent quelquefois assez long-tems, parce que l'étranger ne fuit qu'en tournant, sans s'éloigner directement du nid; cependant, les autres ne l'abandonnent jamais qu'ils ne l'aient chassé. Après que ces oiseaux ont élevé leur petit & l'ont abandonné à lui-même, ils ne se déparient pas comme font tous les autres, mais ils demeurent toujours unis & compagnons, quoi qu'ils aillent quelquefois se mêler parmi d'autres de leur espèce. Nous avons souvent remarqué que quelques jours après que le jeune étoit sorti du nid, une compagnie de trente ou quarante en amenoient un autre jeune, & que le nouveau déniché avec ses père & mère, se joignant à la bande, s'en alloient dans un lieu écarté. Comme nous les suivions souvent, nous voyions qu'après cela, les vieux se [*lege se*] retiroient chacun de leur côté, ou seuls, ou couple à couple, & laissoient les deux jeunes ensemble; & nous appellions cela un mariage.

Il y a dans cette nouvelle circonstance, quelque chose qui semble un peu fabuleux: mais ce sont pourtant des vérités pures, & des choses que j'ai bien souvent remarquées avec soin, & avec plaisir. Je ni pouvois m'empêcher non plus, d'abandonner mon esprit à diverses reflexions.—vol. i. pp. 98–102.

Male, and he drives them away. We have observ'd this several times, and I affirm it to be true.

The Combats between them on this occasion last sometimes pretty long, because the Stranger only turns about, and do's not fly directly from the Nest: However, the others do not forsake it, till they have quite driv'n it out of their Limits. After these Birds have rais'd their young One, and left it to its self, they are always together, which the other Birds are not, and tho' they happen to mingle with other Birds of the same Species, these two Companions never disunite. We have often remark'd, that some days after the young one leaves the Nest, a Company of thirty or forty brings another young one to it; and the new fledg'd Bird with its Father and Mother joyning with the Band, march to some bye Place. We frequently follow'd them, and found that afterwards the old ones went each their way alone, or in Couples, and left the two young ones together, which we call'd a *Marriage*.

This Particularity has something in it which looks a little Fabulous, nevertheless, what I say is sincere Truth, and what I have more than once observ'd with Care and Pleasure; neither cou'd I forbear to entertain my Mind with several Reflections on this Occasion.—pp. 71–74.

The only other original testimony, of which we know, with regard to the Solitaire (if we except the vague notice, already mentioned, of Sir THOMAS HERBERT) is that of D'HEGUERTY\* in 1754, as quoted in 1849 by STRICKLAND†, who states that D'HEGUERTY had been Governor of the Island of Bourbon (now Réunion) about the year 1734, and a few years afterwards thus expressed himself of the sister Island of Rodriguez:—

“On y trouve aussi des oiseaux de différentes espèces, que l'on prend souvent à la course, et entre autres des Solitaires, qui n'ont presque point de plumes aux ailes; cet oiseau, plus gros qu'un Cygne, a la physionomie triste; apprivoisé on le voit toujours à la même ligne, tant qu'il a d'espace, et retrograder de même sans s'en écarter. Lorsqu'on en fait l'ouverture, on y trouve ordinairement des Bézards, dont on fait cas, et qui sont utiles dans la médecine.”

Such is the meagre information‡ we have respecting the history of this remarkable form, blotted out from existence within the last hundred and fifty years, by means at which we can only guess. It is now no longer a matter of doubt that many species of

\* “Mémoires de la Société Royale des Sciences et Belles Lettres de Nancy, vol. i. p. 79.” We have not been able to consult this work.

† Ann. and Mag. Nat. Hist. 2nd ser. iii. pp. 138, 139.

‡ For a further notice, which renders it probable that the species lingered so late as 1761, see Postscript.

animals have become extinct through the agency of man; but in nearly all the cases the history of which is sufficiently well known to us, the extirpation has been caused less by his direct than by his indirect agency. The most noticeable exceptions to this rule are perhaps those of the Gare-fowl (*Alca impennis*)\* and the Northern Manatee (*Rhytina gigas*). And while in the first of these the submersion of its chief remaining breeding-station, owing to a volcanic eruption (and, we may presume, an accompanying earthquake), unquestionably was not without its influence, it does seem as if man himself actually, though unintentionally, had destroyed these two species. But with the Solitaire of Rodriguez, as with the Dodo and many other animals, it seems to us that there is no good ground for believing that they were pursued to the death of the race by man. It is far more likely that they succumbed to other forces set in motion indeed by him but without a thought of thereby accomplishing their destruction. It does not seem at all unreasonable to suppose that either or both might have survived for many years his direct attacks. They would doubtless have become more shy, and have retired to the most secluded parts of the islands they inhabited. They might even have acquired greater wariness, and been enabled in some manner to baffle his pursuit. But they had not to contend with man alone. He had allies fighting against them. In our own country we see that man has not, after many hundred years of incessant warfare, succeeded in extirpating by direct action a single species of bird. Birds of prey still exist, and in some districts in not inconsiderable numbers, in spite of the war of extermination carried on against them. In those districts where their destruction has been most nearly accomplished, it is because man has fought them with other weapons, more fatal because apparently more peaceful. It is to the plough and the draining-spade, with the changes that have followed their use over large areas, rather than to the gun or the gin that they have succumbed. The Crane and the Wild Goose have been banished from the English fens with the Harriers, and more species than we can here stay to enumerate by the simple act of bringing under cultivation by means of improved drainage the extensive tract of the "Bedford Level." The Bustard has yielded to the driver of the horse-hoe and the maker of plantations†. These have gone from us without an idea that any such effects would follow the causes employed; nay, they have gone from us, some of them, in spite of legal protection, and therefore against the will of man. Now, so far as we are able to judge, the Solitaire of Rodriguez has been subject to no disturbances of this kind. The island seems to bear now much the same appearance as it presented to the eyes of LEGUAT‡, and if the popular tradition be true that forests once existed in it which were destroyed some forty or fifty years ago by fire, it seems to be certain, from GRANT'S silence in 1801§, that there were then no Solitaires left to perish in the flames. Some other cause of extinction must therefore be sought, and it

\* Though it may still be premature to speak of this species as extinct, there can be no doubt about its fate should a colony yet be discovered. (Cf. Natural History Review, October 1865, pp. 467-488.)

† STEVENSON'S 'Birds of Norfolk,' vol. ii. pp. 9-17.

‡ Ibis, 1865, p. 148.

§ History of Mauritius and the Neighbouring Islands, pp. 100-145.

has been already long since suggested\* that Cats, turned out by the Dutch settlers may have destroyed the species "by devouring the young ones as soon as they were hatched." That this may have been the case is quite possible; but it seems quite as, or even more, likely that a feller enemy than the Cat may have been introduced. We mean the Hog, which we cannot but believe was the principal agent in destroying the Dodo in Mauritius†, though, so far as we are aware, the efficacy of this agent of destruction has not been sufficiently appreciated by former writers. It has been always so universal a practice to liberate Pigs in countries newly discovered by Europeans that we cannot suppose any exception to have been made in the case of Rodriguez, and at almost every place where these omnivorous animals have been set free we know them to have speedily increased and multiplied, replenished the land, and in most instances to have subdued it.

In every way save one, perhaps, the account given by LEGUAT of the Solitaire of Rodriguez seems to be fully borne out by a study of its osteology, so far as that can throw any light on the subject. The rugose surface at the junction of the nasal bones with the nasal process of the premaxillary indicates the position of the caruncular ridge which he likens to a "widow's peak," and in his figure represents at this place. The curved contour-lines of the upper and posterior part of the pelvis is quite in accordance with his statement that the "hind-part" of this bird was "roundish, like the crupper of a horse." We can well imagine that it was a somewhat less heavy bird than the Dodo‡, and, judging from its longer legs, that it was capable of attaining considerable speed. The remarkable and unexpected confirmation of his description of the extraordinary knob on the wing has been already noticed—a fact which alone would place him high in the ranks of truthful observers. The appearance presented by this knob is so exactly that of diseased bone that one is led to believe that it had its origin in injuries received by the birds in such combats as are mentioned by LEGUAT, and was aggravated by a continuance of fighting-propensities transmitted from generation to generation. Other Pigeons, despite their proverbially peaceful reputation, are as much given to fighting as

\* Proc. Zool. Soc. 1833, pp. 31, 32.

† In 'A Voyage to *Arabia Felix* through the Eastern Ocean and the *Streights* of the Red-Sea, being the First made by the French in the Years 1708, 1709, and 1710. Translated from the French' (London: Printed for E. SYMON, 1732, small 8vo, pp. xvi. and 372), the editor, whose name (as appears for the anonymous translator's preface, p. vii) was LA ROQUE, says that the expedition touched at Mauritius in Sept. 1708, when they found (p. 147) that "on the other side of the Isle beyond the Mountains, there were Drovers of wild Boars; that, not long before, a general Hunting had been order'd to root them out; and that, the Inhabitants having assembl'd for that purpose, they slew above fifteen hundred of them in one Day." It is plain that inactive birds could not long be the inhabitants of an island swarming with feral swine. It is perhaps possible to imagine a venerable Dodo capable of assuming sufficient dignity to disconcert an impetuous Hog, but the awe of the latter once dispelled by any mark of resentment the result would be the same as when the Roman Senator provoked the fury of the Gaulish soldier; while the more helpless part of the community would rapidly fall victims, young birds and eggs being inevitably traced to destruction by the unerring power of scent possessed by the riotous new-comers. (Cf. LEGUAT, 1st ed. ii, pp. 70, 71, Engl. transl. p. 170.)

‡ HERBERT (cf. STRICKLAND, 'The Dodo, &c.', pp. 19, 20) puts the weight of the Dodo at fifty pounds; LEGUAT (*ut supr. cit.*) that of the Solitaire at forty-five.

many other birds, and theirs is literally *pugnacity*, for, the majority not possessing any other weapons of attack or defence, their battles consist of a succession of cuffs and buffetings administered by the wings. LEGUAT speaks of his having witnessed the combats of his Solitaires, and it is quite possible that these engagements were occasionally even more serious than any of which he was an eye-witness, for we find in the collection a fair proportion of broken bones, broken and mended during the bird's life. Among these are examples of the ulna (Plate XX. fig. 135), radius, and coracoid (Plate XX. fig. 136)\*.

The particular in which we think LEGUAT may have erred is in the assertion (or perhaps rather inference) as to their monogamous habits, and the cause of the error (if such it be) may, we think, be ascribed, without derogation of his truthfulness or accuracy, to his anxiety to point a moral which has led him to imagine he saw what he wished to see†. We think we are right in saying that most monogamous animals when they fight at all fight without regard to sex. Now in describing the combats of these birds he especially mentions that the opposite sexes would not fight with one another, but that the combatants were invariably of the same sex, and this is just what occurs in polygamous birds. However it is not always easy to decide whether a species is monogamous or the contrary. Respecting a species which has been so much studied, and of which so much has been written as the Bustard (*Otis tarda*), it seems undecided whether it is polygamous or not, though the testimony is on the whole in favour of its occasionally being so‡. It is therefore not to be wondered at if LEGUAT, setting aside even his evident leaning, should have been mistaken in this particular. We venture here to reproduce some remarks on this matter, which one of us has already made.

“So far as I know, none of the existing *Columbæ* represent any remarkable sexual distinctions§ either in bulk or otherwise. As a group, the Pigeons are remarkably, and, relatively to most birds, abnormally uniform in this respect. In the species [*Pezophaps*] to which the bones now exhibited belong, however, the contrary is most conspicuously

\* This last is exactly matched by a specimen of *Didus* in our possession.

† A great part of the misfortunes with which LEGUAT was afflicted during his absence from Europe arose from the determination of leaving Rodriguez, at which his companions, overruling his own wish, arrived. This determination was, as he naively tells us (*op. cit.* 1st ed. vol. i. pp. 148–154, Engl. transl. pp. 107–112), finally brought about by the fact that, in founding their proposed colony, they had altogether forgotten the necessity of including the softer sex in their company! He consequently never loses an opportunity of inculcating the prudence of making early marriages, and calls his dear Solitaires to witness to their expediency.

‡ Cf. NAUMANN, ‘Vögel Deutschlands,’ vol. vii. pp. 35–41; STEVENSON, ‘Birds of Norfolk,’ vol. ii. p. 13.

§ Mr. DARWIN (Variation of Animals and Plants under Domestication, vol. i. p. 162, note) demurs to this assertion and cites the case of *Carpophaga oceanica*, in which he says the excrescence at the base of the beak is “sexual.” Whether or not it is so we have no means of judging, but the word “sexual” has been accidentally substituted by him for “seasonal,” and therefore his remark does not bear on the question. On the other hand we are ready to admit that the assertion is not so universally true as it was thought to be when made. Our friend Mr. OSBERT SALVIN has shown us two species of *Chamaepelia* in which the plumage of the two sexes exhibits a manifest difference, and Mr. WALLACE (*Ibis*, 1865, pp. 365–400) cites some similar instances among the Malayan Pigeons.

the case; and one naturally turns to seek other instances in which a species differs from most of its allies in a similar manner. Two, if not more, such instances will at once occur to every ornithologist. They are those of the Capercally (*Tetrao urogallus*) and the Great Bustard (*Otis tarda*). In both these birds, I believe, the disproportion in size between the sexes is not greater than in the remains of the species now before the Society. But then another idea is called up: *Tetrao urogallus* departs from the usual habits of the *Tetraonidæ* by being polygamous; and (though I am aware that the statement has been disputed) the same is said to be the case with *Otis tarda*. Indeed I am inclined to suppose that with all species of birds the practice of polygamy is accompanied with more or less disproportion in the size of the sexes. Whether the converse is true I am not in a position to declare.”—Proc. Zool. Soc. 1865, pp. 716, 717.

The strongest objection that seems possible to the suggestion here thrown out is in the fact recorded by LEGUAT, that the male birds of the Solitaire of Rodriguez assisted the females in the work of incubation; but the question of its polygamy or monogamy is not likely to meet with a solution now.

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From the amount of variability which every portion of the skeleton of this species displays, it may not unreasonably be supposed that as much was exhibited in those parts of its structure which have perished, even if we had not LEGUAT's direct evidence as to the individual difference in plumage among the female birds. There would accordingly have been abundant room for the operation of any such process as that which has been described under the names of “Natural Selection” and “Survival of the Fittest” to have operated; and it may therefore appear at first sight, there having been known to us only one species of *Pezophaps*, that an argument against the existence of such a process might hereon be founded. A little reflection will, we think, show that such an argument would be unsound. Confined in a space so restricted as one small island, every individual of the species must have lived, moved, and had its being under conditions essentially identical in all cases. Whatever power such a process might have had of operating, there would be neither occasion nor opportunity for it so long as no change took place in the physical character of the island. But, if we venture to indulge our fancy and regard what would have been the inevitable consequences of a gradual upheaval of the land and a corresponding extension of its area until it became vastly increased, and its original low rounded hills were exalted into mountains, it is plain that a great variety of physical conditions would be thereby incurred. One side of the island would be exposed to the full force and direct influence of the trade-winds, the other side would be completely sheltered from them. The climate of these two portions would accordingly differ, and a great difference would be speedily wrought in the character of their vegetation, while that of the lofty central part would undergo a corresponding modification. After some longer or shorter period of time, we can conceive the island itself being broken up into two portions, separated from one another by a strait, such as divides the North and Middle

Islands of New Zealand. This rupture would certainly tend still more to affect the existing fauna and flora, and, at the end of another epoch, there can be little doubt but the animals and plants of each portion, exposed to different influences, would present a decidedly different appearance, and the eastern and western islands (supposing the separation to have taken place longitudinally) might each possess its own special form of Solitaire, as the islands composing New Zealand have their peculiar species of *Apteryx*.

But it is only in such case as that which we have imagined that considerable modifications would be likely to be effected. It seems, therefore, to us not to be an argument against the existence of such a process as that of "Natural Selection," but in reality an argument in its favour to find a small oceanic island tenanted by a single species, restricted in its range, which was subject to very great individual variability. Indeed a believer in this theory would, we think, be inclined to predicate that it would be under just such very circumstances that the greatest amount of variability would be certain to occur. In its original state, attacked by no enemies, its increase would be only dependent on the supply of food, which, one year with another, would most likely not vary much; the form would continue without any predisposing cause to change, and thus no advantage would be taken of the variability of structure presented by its individuals.

On the other hand, instead of speculating on what might have come to pass, it is perhaps more profitable to reflect on what certainly did take place. Of the other terrestrial members of the avifauna of Rodriguez but few now remain. A small Finch (*Foudia flavicans*\*) belonging to a group almost entirely confined to Madagascar and its satellite-islands, but specifically distinct, and a Warbler (*Drymæca rodericana*\*) belonging to a genus extending to Africa and Australia, though mainly represented in India and the adjacent territories, but also specifically distinct, are the only two land-birds of its original fauna which, so far as we know, now exist. The Guinea-fowl and the Love-bird have in all probability been introduced from Madagascar\*; but the blue and green Parrots†, and the slate-coloured Pigeons‡, of which LEGUAT speaks, have vanished with the Solitaire. The remains of one of the first, and the description of the last, leave little room to doubt but they also were closely allied to the forms found in the other Mascarene Islands and Madagascar, and thus it is clear that certainly *four* out of the *five* or *six* indigenous species had their natural affines in other species belonging to the same zoological province. It seems to us impossible on any other reasonable supposition than that of a common ancestry to account for this fact. We are compelled to the

\* Proc. Zool. Soc. 1865, pp. 46-48, pl. i.; Ibis, 1865, pp. 148-150.

† LEGUAT, *op. cit.* 1st ed. i. pp. 67, 107, and 132; Engl. transl. pp. 49, 77, and 95. On the fragment of a maxilla of a Parrot sent with the Solitaire's bones, Professor ALPHONSE MILNE-EDWARDS has founded his *Psittacus rodericanus* (Ann. des Sc. Nat. 5e sér. Zool. viii. pp. 145-156, pls. 7, 8; Comptes Rendus, lxx. (Dec. 30, 1867) pp. 1121-1125.

‡ LEGUAT, *op. cit.* 1st ed. i. p. 104; Engl. transl. p. 75.

belief that there was once a time when Rodriguez, Mauritius, Bourbon, Madagascar, and probably the Seychelles were connected by dry land, and that that time was sufficiently remote to permit of the descendants of the original inhabitants of this now submerged continent to become modified into the many different representative forms which are now known to the ornithologist. Whether this result can have been effected by the process of "Natural Selection" must be regarded as an open question; but that the Solitaire of Rodriguez and the Dodo of Mauritius, however much they eventually came to differ, sprang from one and the same parent stock, seems to us a deduction from the facts so obvious, that we can conceive no one fully acquainted with them hesitating about its adoption any more than he can doubt the existence of the POWER by whom they were thus formed.

#### POSTSCRIPT, August 1869.

Since this paper was written a communication made some years ago to 'Notes and Queries' (First Series, vol. vi. p. 83, 24 July, 1852) by Mr. PINKERTON has attracted our attention. That gentleman refers to the account of Rodriguez, given by M. EUGÈNE DE FROBERVILLE in the 'Iles de l'Afrique' of M. D'AVEZAC (part iii. pp. 67-80, Paris: 1848), forming a volume of the series entitled 'L'Univers, ou Histoire et Description de tous les peuples,' &c., wherein the writer quotes freely from a manuscript written by the Abbé PINGRÉ, who passed some months of the year 1761 in Rodriguez, which he visited for the purpose of observing the transit of Venus, as already mentioned by Dr. HAMEL\* and STRICKLAND†. As this manuscript was in existence not long prior to 1848, there seemed a good chance of its being found, and accordingly we applied to our good friend Professor ALPHONSE MILNE-EDWARDS, requesting him to make some inquiries respecting it. With his wonted readiness he most kindly undertook the research at once, and after some little time we had the pleasure of hearing from him that the manuscript had been found in the library of Ste. Geneviève at Paris. Subsequently he was so obliging as to transcribe for us that part which relates to the zoology of the island, and from his copy the following is an extract;—

"Relations du voyage de l'abbé Pingré à l'île de Rodrigue.

\* \* \* \* \*

"Les *Solitaires* étaient communes à Rodrigue du temps de *François Leguat*: Mr. de Puvigné‡ m'a assuré que la race n'en était pas encore détruite, mais ils se sont retirés dans les endroits de l'île les plus inaccessibles."

This brief though interesting notice undoubtedly renders it probable that the Solitaire of Rodriguez existed as lately as 1761, but taken alone it is insufficient to afford foundation for the statement of M. DE FROBERVILLE (*ut supr. cit.* p. 71), that "ces tristes restes d'une population dont Leguat admirait la beauté et les mœurs curieuses, étaient sans

\* 'Der Dodo, der Einsiedler', &c. 8vo, St. Petersburg: 1848, pp. 16, 17.

† 'The Dodo', &c. pp. 64, 65.

‡ "M. de Puvigné commandant de l'île."

cesse pourchassés sans pitié par les nègres, et ne vivaient que dans une inquiétude qui fut bientôt fatale à leur propagation;" and in the absence of any other evidence we shall continue to entertain the belief that the cause we have suggested in the foregoing pages was that which brought about the extinction of this species. How PINGRÉ and LE MONNIER elevated it to a place among the constellations has been already told by Dr. HAMEL and STRICKLAND—*sic itur ad astra!*

#### DESCRIPTION OF THE PLATES.

\* \* Unless the contrary is stated the figures are of the natural size.

#### PLATE XV.

- Figs. 1–5. Atlas and axis (partially anchylosed?), from the side, front, behind, above and below.
- Figs. 6–8. Third cervical vertebra, from the side, above and below.
- Figs. 9–12. Fourth cervical vertebra, from the side, behind, above and below.
- Figs. 13–16. Fifth cervical vertebra, from the side, front, above and below.
- Figs. 17–20. Sixth cervical vertebra, from the side, behind, above and below.
- Figs. 21–23. Seventh (?) cervical vertebra, from the side, above and below.
- Figs. 24–26. Eighth (?) cervical vertebra, from the side, above and below.
- Figs. 27–30. Ninth cervical vertebra, from the side, front, above and below.
- Figs. 31–34. Tenth cervical vertebra, from the side, behind, above and below.
- Figs. 35–37. Eleventh cervical vertebra, from the side, above and below.
- Figs. 38–41. Twelfth (and last ?) cervical vertebra, from the side, front, above and below.
- Figs. 42–44. First (?) dorsal vertebra, from the side, above and below.
- Figs. 45–47. Second (?) dorsal vertebra, from the side, above and below. Fig. 45 (the original having been damaged on the left side) has been drawn unreversed to preserve the continuous appearance of the series.
- Figs. 48–50. Third (?) dorsal vertebra, from the side, above and below.
- Figs. 51–55. Three anchylosed dorsal vertebræ (fourth, fifth, and sixth ?) from the side, front, behind, above and below. To fig. 51 the upper portion of the corresponding dorsal ribs are shown attached.
- Figs. 56–59. Penultimate (seventh ?) dorsal vertebra from the side, behind, above and below.

#### PLATE XVI.

- Fig. 60. The same three dorsal vertebræ as in figs. 51–55, but from another specimen, and incompletely anchylosed (♂?).
- Fig. 61. Left sternal rib (seventh ?), outer side (♂?).
- Fig. 62. Left dorsal rib (eighth ?), outer side, showing marks of pressure or friction (♂?).

Fig. 63. Right dorsal rib (sixth?), outer side, showing similar marks ( $\sigma$ ?).

Fig. 64. Sternal extremity of right dorsal rib (eighth?), coalescent with preceding (seventh?) sternal rib ( $\sigma$ ?).

Fig. 65. Pelvis, from above ( $\sigma$ ?).

#### PLATE XVII.

Fig. 66. Pelvis, from below ( $\varphi$ ?).

Fig. 67. The same, from before, showing anterior surface of last (eighth?) dorsal vertebra.

Fig. 68. The same, from above.

Fig. 69. The same, from behind.

} Slightly reduced.

#### PLATE XVIII.

Fig. 70. The same pelvis, from the side ( $\varphi$ ?). Slightly reduced.

Fig. 71. Sternum, from before ( $\varphi$ ?).

Fig. 72. The same, from the side.

Fig. 73. The same, from below.

Fig. 74. The same, from above.

Fig. 75. Posterior portion of sternal keel from below ( $\sigma$ ?).

#### PLATE XIX.

Figs. 76–79. Left coracoid, from below, front, behind and above ( $\sigma$ ?).

Figs. 80–83. Left coracoid, from below, front, behind and above ( $\varphi$ ?).

Figs. 84–86. Left scapula, outer, lateral and inner surfaces ( $\sigma$ ?).

Fig. 87. Left metacarpal, upper view ( $\sigma$ ?).

Figs. 88–90. Right metacarpal, front, lower and upper views ( $\sigma$ ?).

Figs. 91, 92. Right humerus, lower and upper views ( $\sigma$ ?).

Fig. 93. Right ulna, upper view ( $\sigma$ ?).

Figs. 94, 95. Right radius, upper and lower views ( $\sigma$ ?).

Fig. 96. Right ulna, lower view ( $\sigma$ ?). (From same specimen as fig. 93.)

Figs. 97–99. Right scapula, inner, lateral and outer surfaces ( $\sigma$ ?).

#### PLATE XX.

Fig. 100. Left tibia, with fibula attached, from front ( $\sigma$ ?).

Fig. 101. The same fibula, from behind.

Fig. 102. Left tibia, with fibula attached, from front ( $\varphi$ ?).

Fig. 103. The same fibula, from behind.

- Figs. 104, 105. Right posterior metatarsus, from behind and outside ( $\sigma$ ?).
- Figs. 106, 107. Proximal phalanx of right hallux, from above and side ( $\sigma$ ?).
- Figs. 108, 109. Ungual phalanx of right hallux, from above and side ( $\sigma$ ?).
- Figs. 110–112. Proximal phalanx of right outer toe, from above and from each end ( $\sigma$ ?).
- Figs. 113–115. Ungual phalanx of right outer toe, from above, below, and side ( $\sigma$ ?).
- Figs. 116–118. Proximal phalanx of right middle toe, from above and from each end ( $\sigma$ ?).
- Figs. 119–121. Second phalanx of right middle toe, from above and from each end ( $\sigma$ ?).
- Figs. 122–124. Third phalanx of right middle toe, from above and from each end ( $\sigma$ ?).
- Figs. 125–127. Ungual phalanx of right middle toe, from above, below, and side ( $\sigma$ ?).
- Figs. 128–130. Proximal phalanx of right inner toe, from above and from each end ( $\sigma$ ?).
- Fig. 131. Right metacarpal, lower view ( $\sigma$ ?). (From a second specimen.)
- Figs. 132, 133. Left scapula, outer and inner surface ( $\varphi$ ?).
- Fig. 134. Right ulna, upper view, showing impressions of secondary quill-feathers ( $\varphi$ ?).
- Fig. 135. Left ulna, upper view, showing the same, and also mark of fracture and healing ( $\sigma$ ?).
- Fig. 136. Right coracoid, side view, showing mark of fracture and healing ( $\sigma$ ?).
- Figs. 137, 138. Right radius, upper and hinder view ( $\sigma$ ?). (From a second specimen.)

## PLATE XXI.

- Figs. 139–141. Cranium, from above, below, and behind ( $\varphi$ ?).
- Figs. 142–144. Cranium, from above, below, and behind ( $\sigma$ ?).
- Fig. 145. Cranium, from below ( $\varphi$ ?). (From a second specimen.)
- Fig. 146. Cranium, from behind ( $\varphi$ ?). (From a third specimen.)
- Fig. 147. Cranium, from behind ( $\sigma$ ?). (From a second specimen.)

## PLATE XXII.

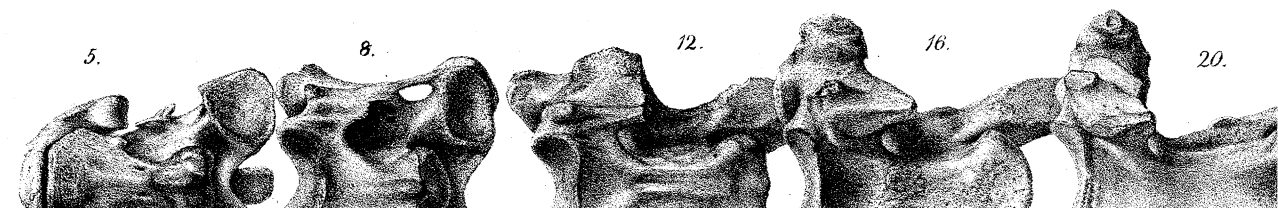
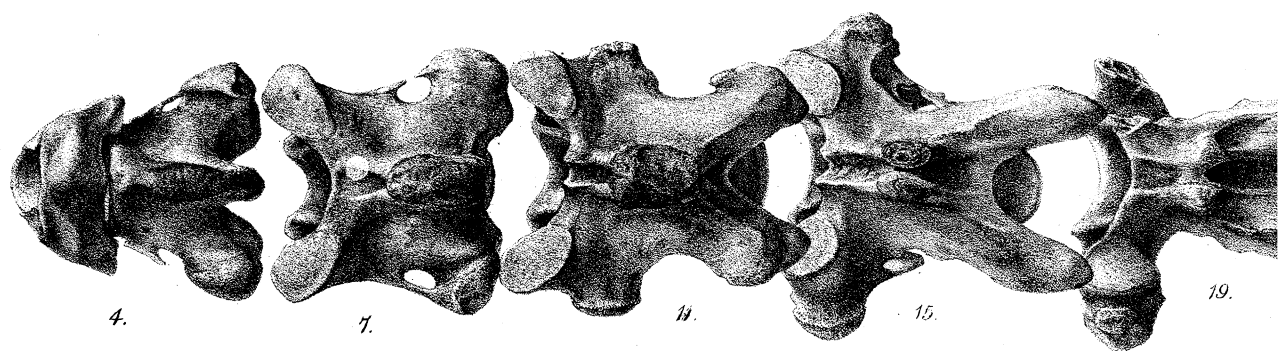
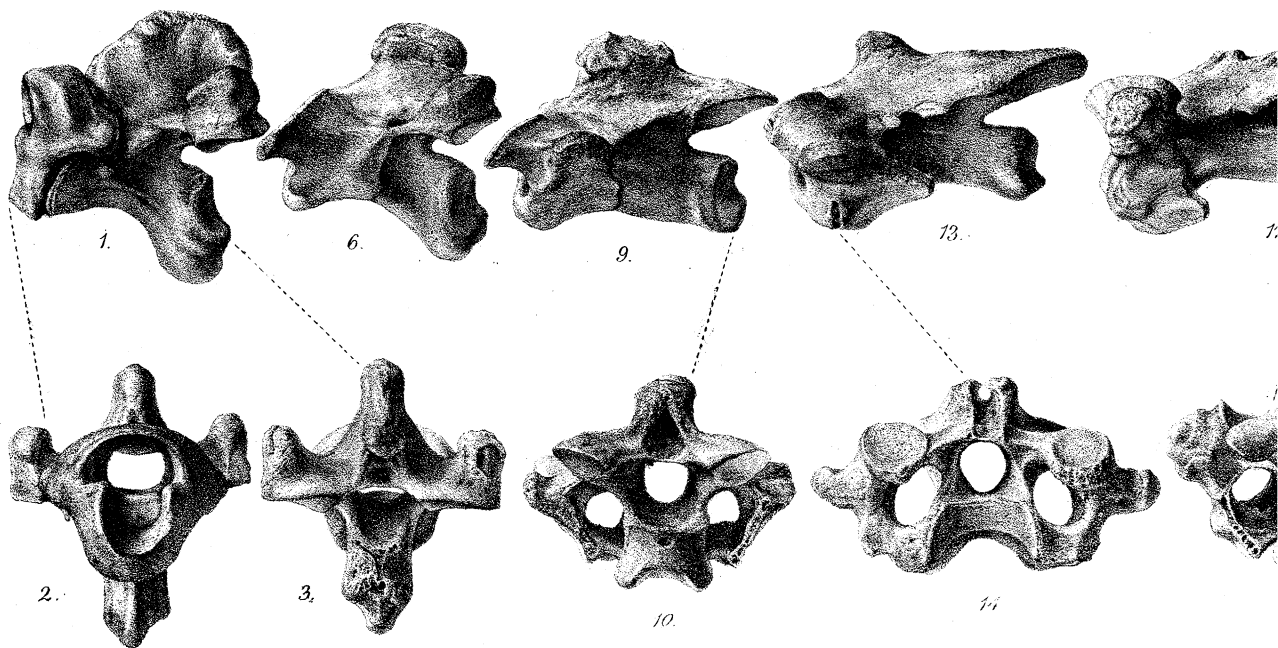
- Fig. 148. Left metacarpal, upper view ( $\varphi$ ?).
- Fig. 149. Cranium from the side ( $\sigma$ ?). (From same specimen as figs. 142–144.)
- Fig. 150. Cranium from the side ( $\varphi$ ?). (From same specimen as figs. 139–141.)
- Figs. 151, 152. Maxilla, from below and side ( $\sigma$ ?).
- Fig. 153. Dertrum, from side ( $\sigma$ ?).
- Figs. 154, 155. Maxilla, from side and below ( $\sigma$ ?). (From a second specimen.)
- Figs. 156–158. Maxilla, from above, side, and below ( $\varphi$ ?). (Fig. 157 shows a portion of the outside of the left lower branch of the premaxillary drawn unreversed—the right being injured.)
- Figs. 159, 160. Proximal and distal portions of mandible (possibly belonging to the same individual), from the side ( $\varphi$ ?).
- Figs. 161, 162. The same, from above.
- Figs. 163–168. Quadrate from outside, inside, above, below, behind, and front ( $\sigma$ ?).

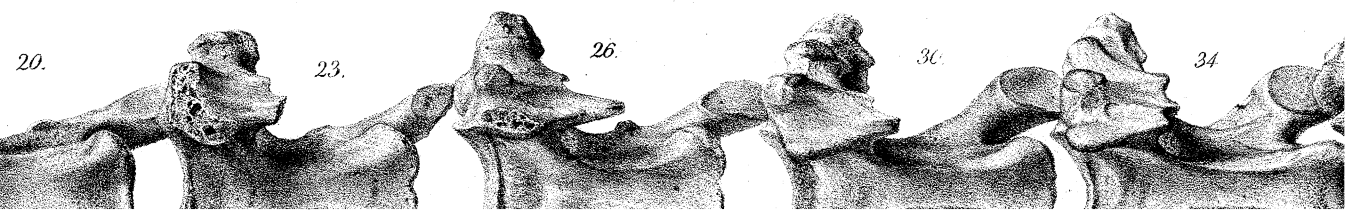
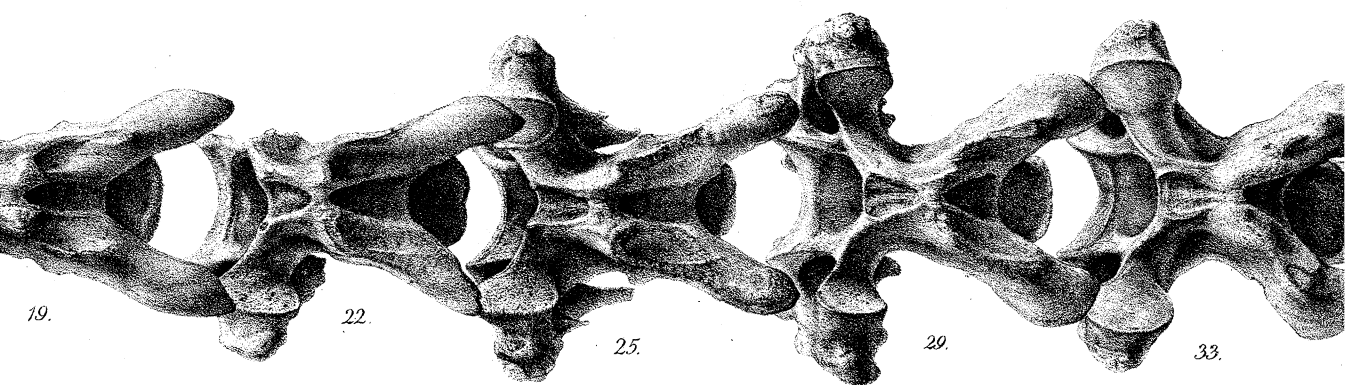
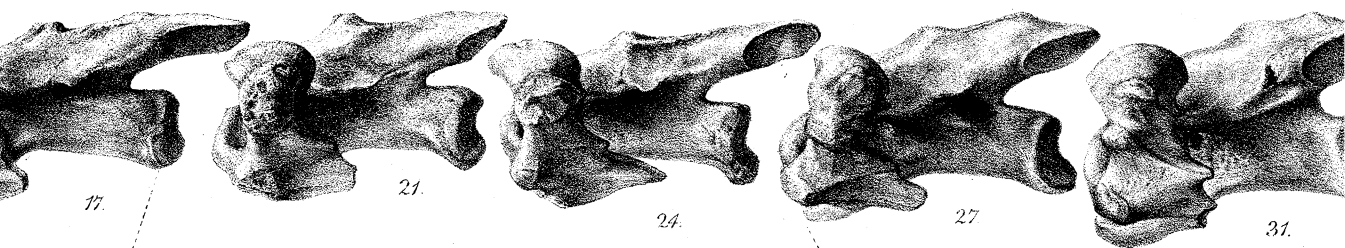
PLATE XXIII.

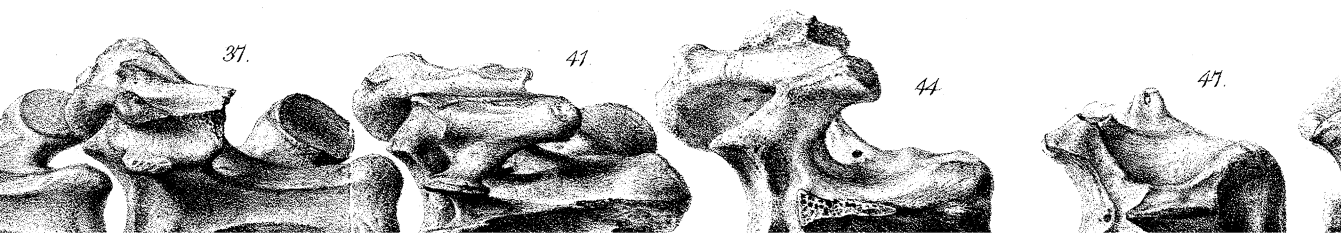
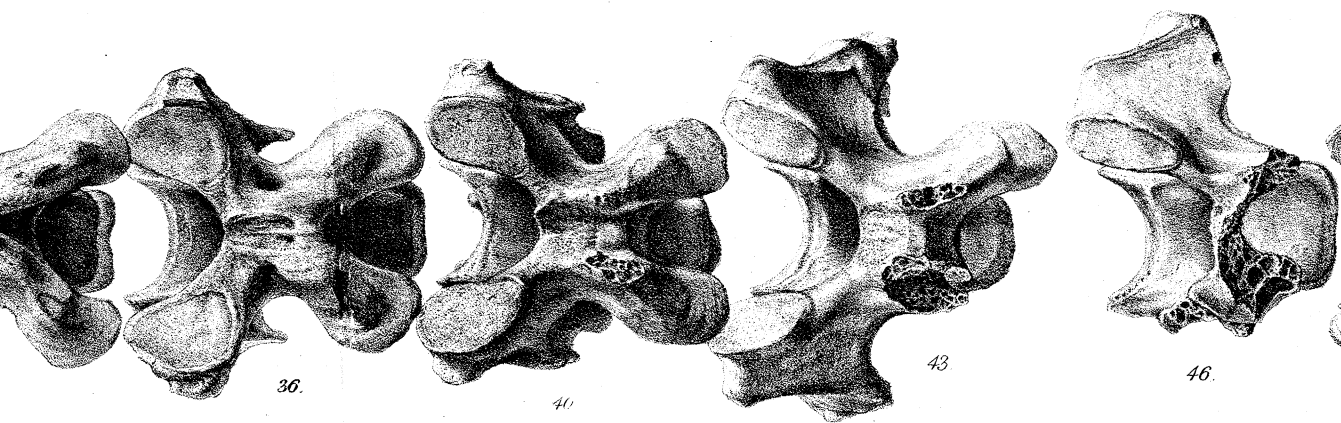
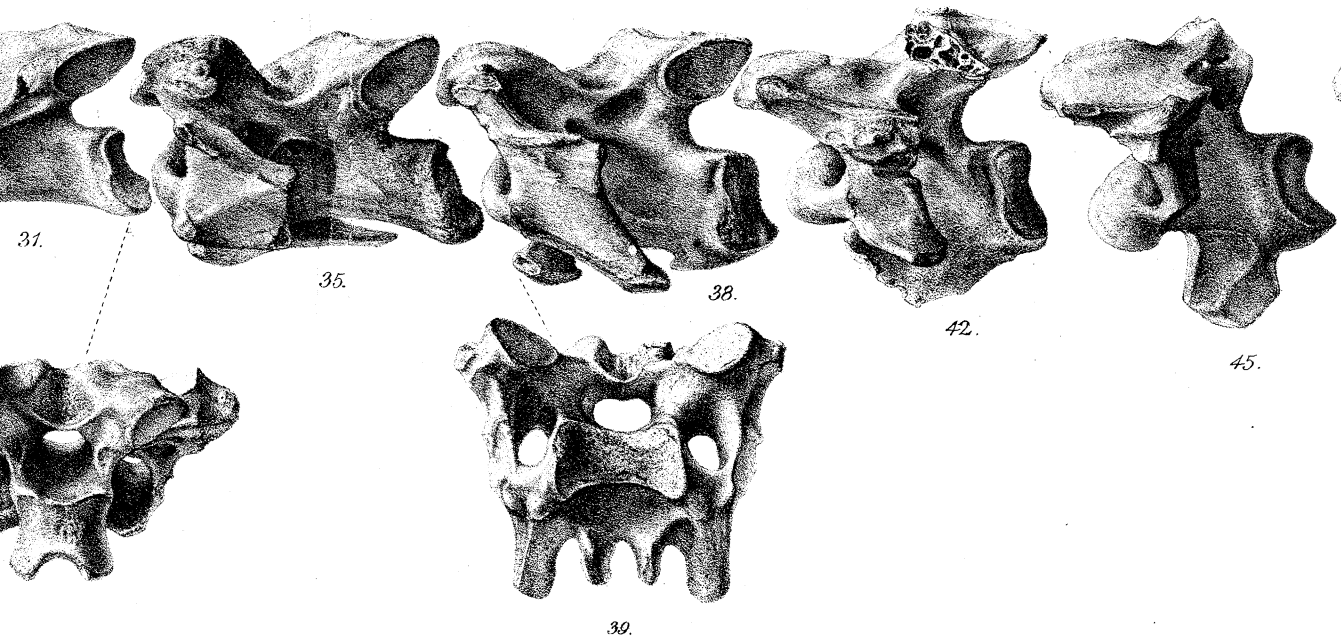
- Fig. 169. Sternum of *Columba livia*.  
 Fig. 170. Sternum of *Didunculus strigirostris* (Mus. Coll. Reg. Chirurg. Lond.).  
 Fig. 171. Sternum of *Leucosarcia picata*.  
 Fig. 172. Sternum of *Columba livia*, var. *domestica* (exempl. monstr.).  
 Fig. 173. Sternum of *Patagioenas caribbæa*.  
 Fig. 174. Sternum of *Chamæpelis trochila*.  
 Fig. 175. Sternum of *Geopelia striata*.  
 Fig. 176. Sternum of *Goura coronata*.

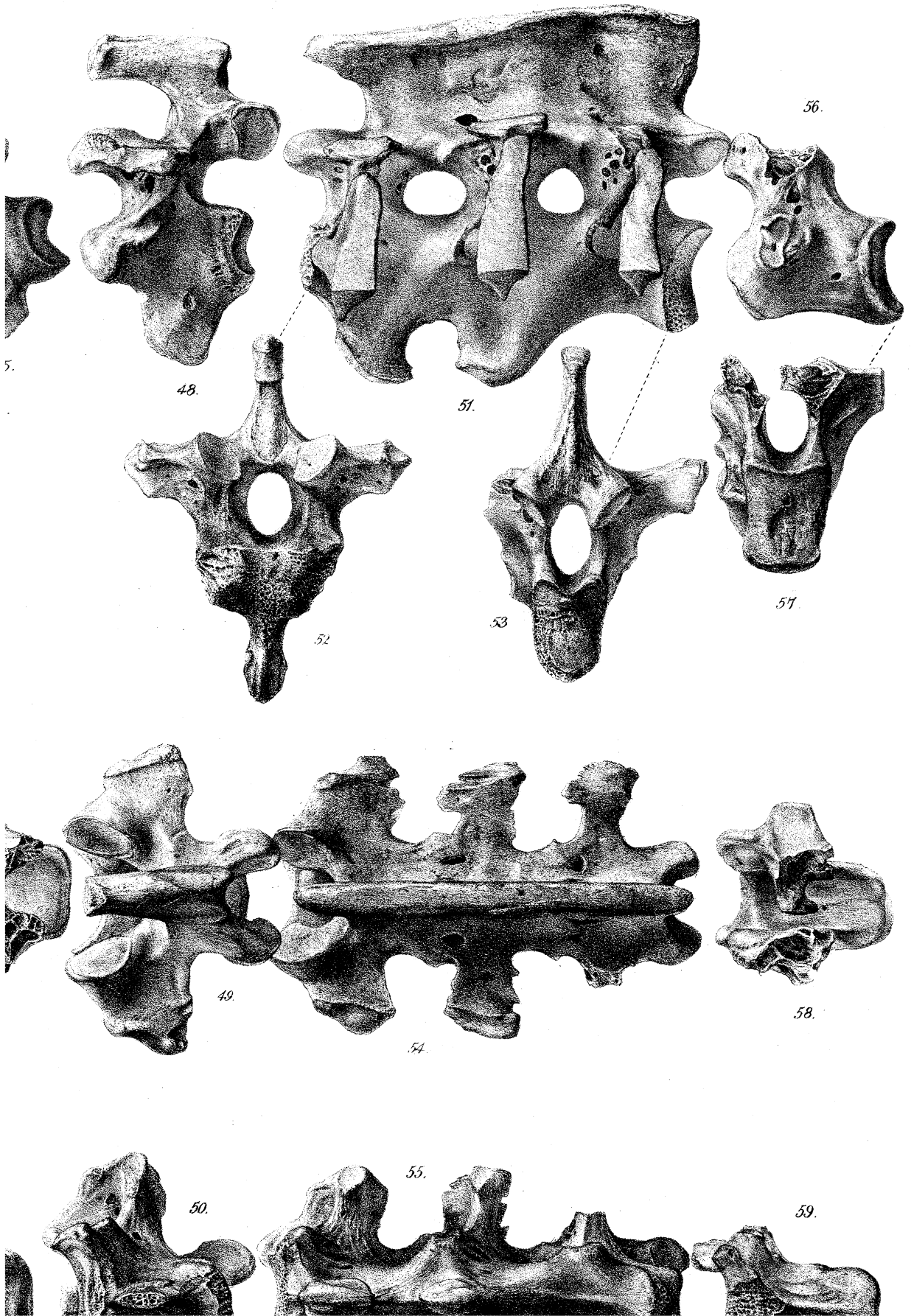
PLATE XXIV.

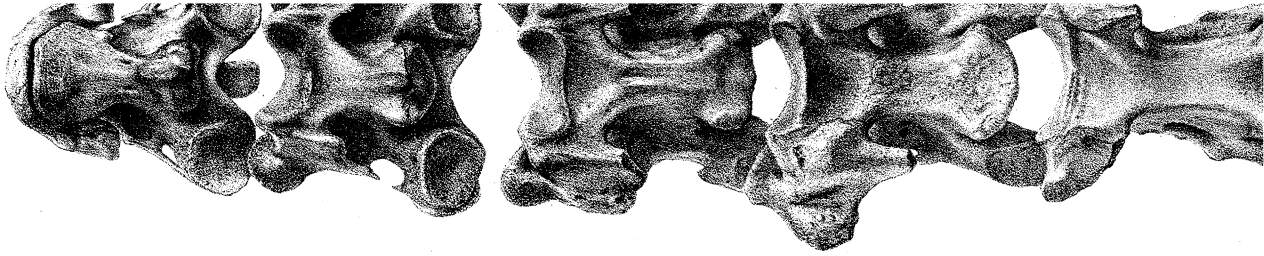
- |  |  |
|--|--|
| Fig. 177. Skeleton of <i>Pezophaps solitaria</i> , from<br>front (♀?). | } From photographs of the mounted<br>specimens (p. 332) deposited in<br>the Museum of the University of<br>Cambridge. Greatly reduced. |
| Fig. 178. Skeleton of <i>Pezophaps solitaria</i> , from<br>front (♂?). |  |
| Fig. 179. The same from the side.                                      |  |



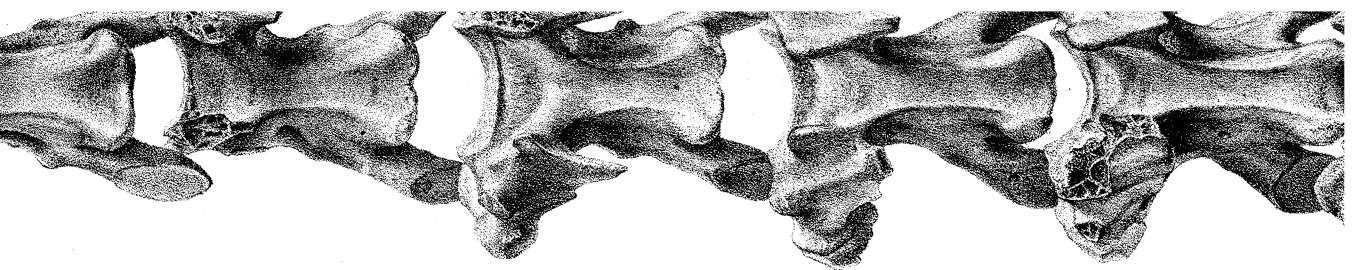








G.H. Ford ad nat. lith.

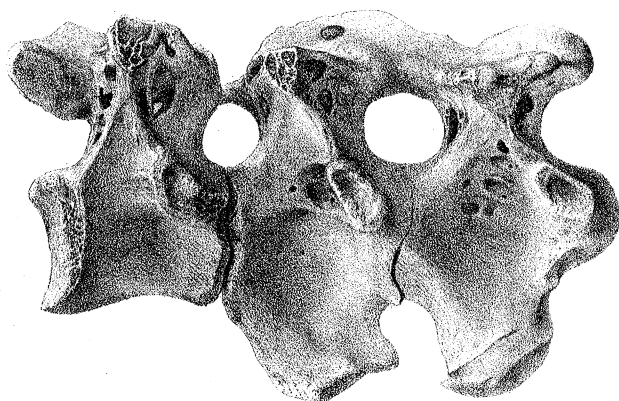






W. West imp.

60



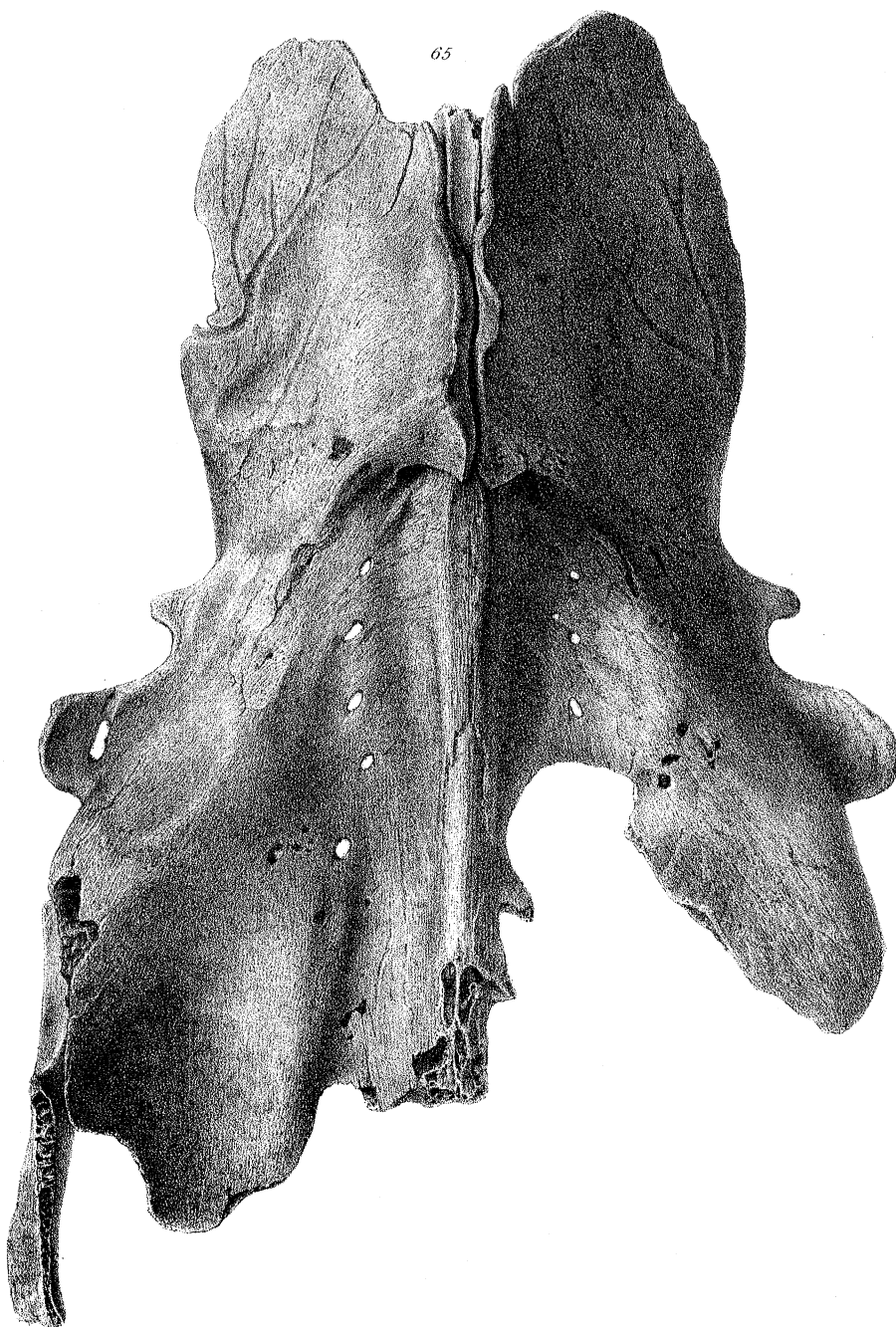
61



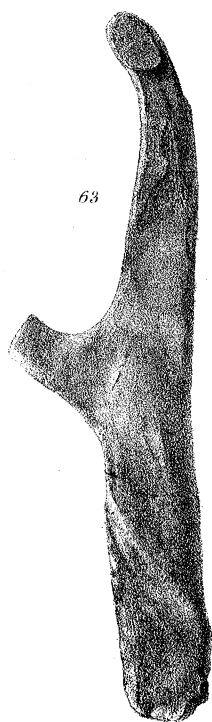
62



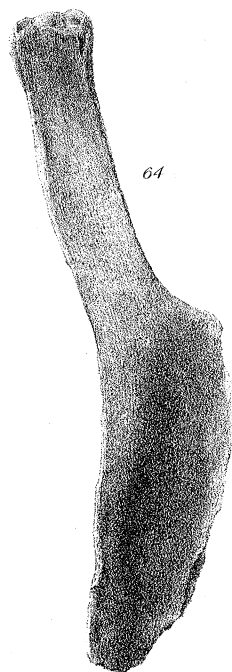
65

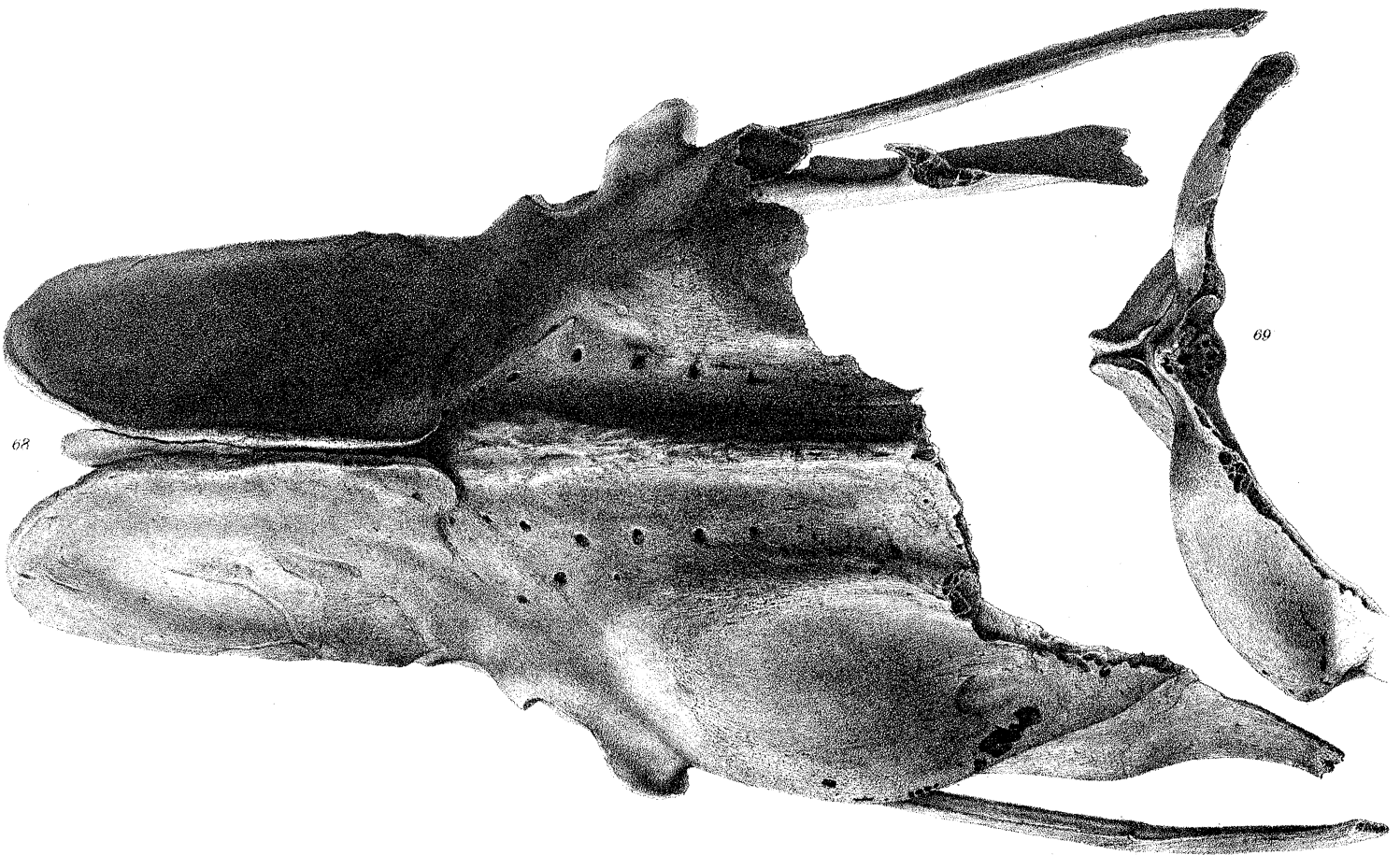
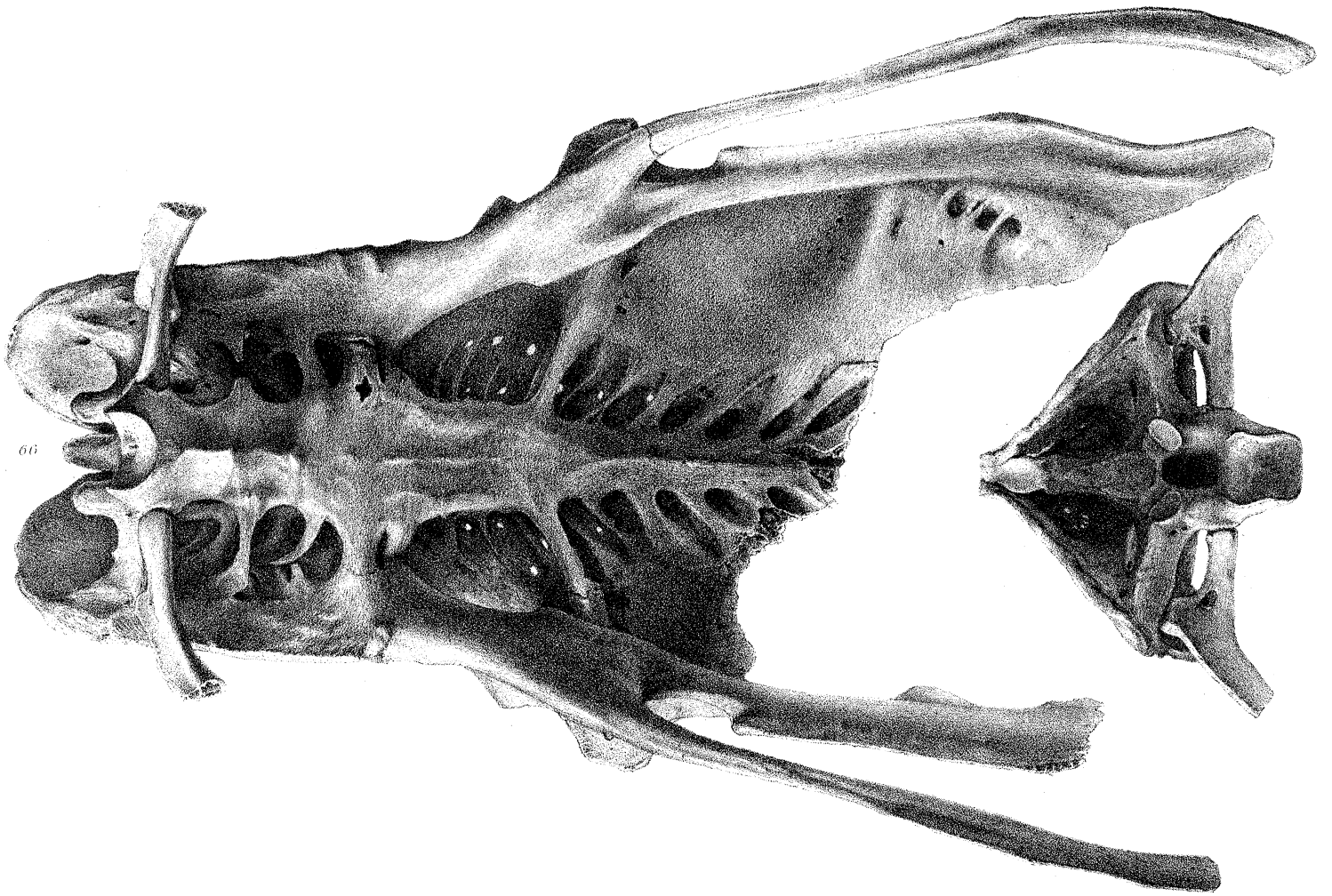


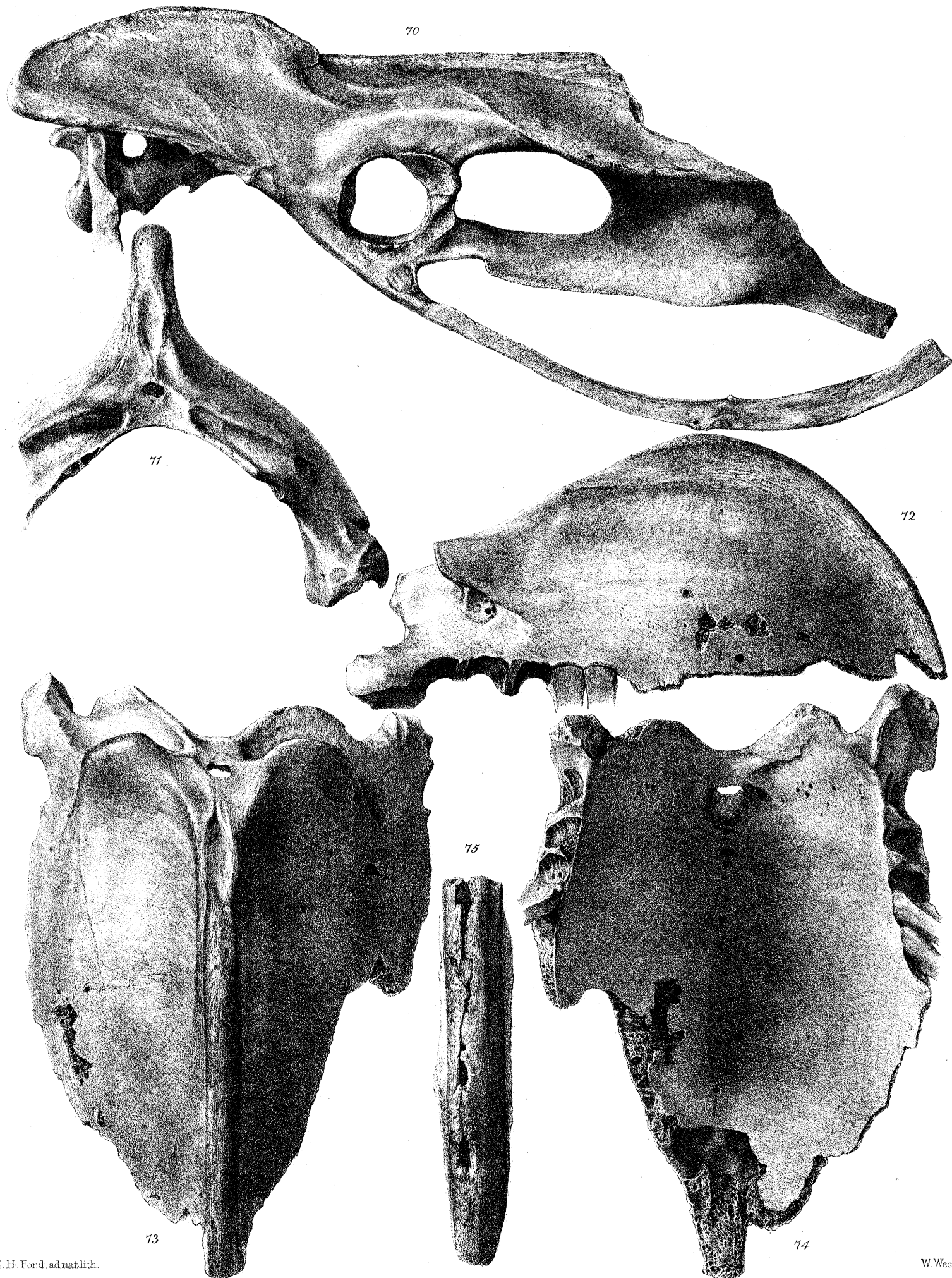
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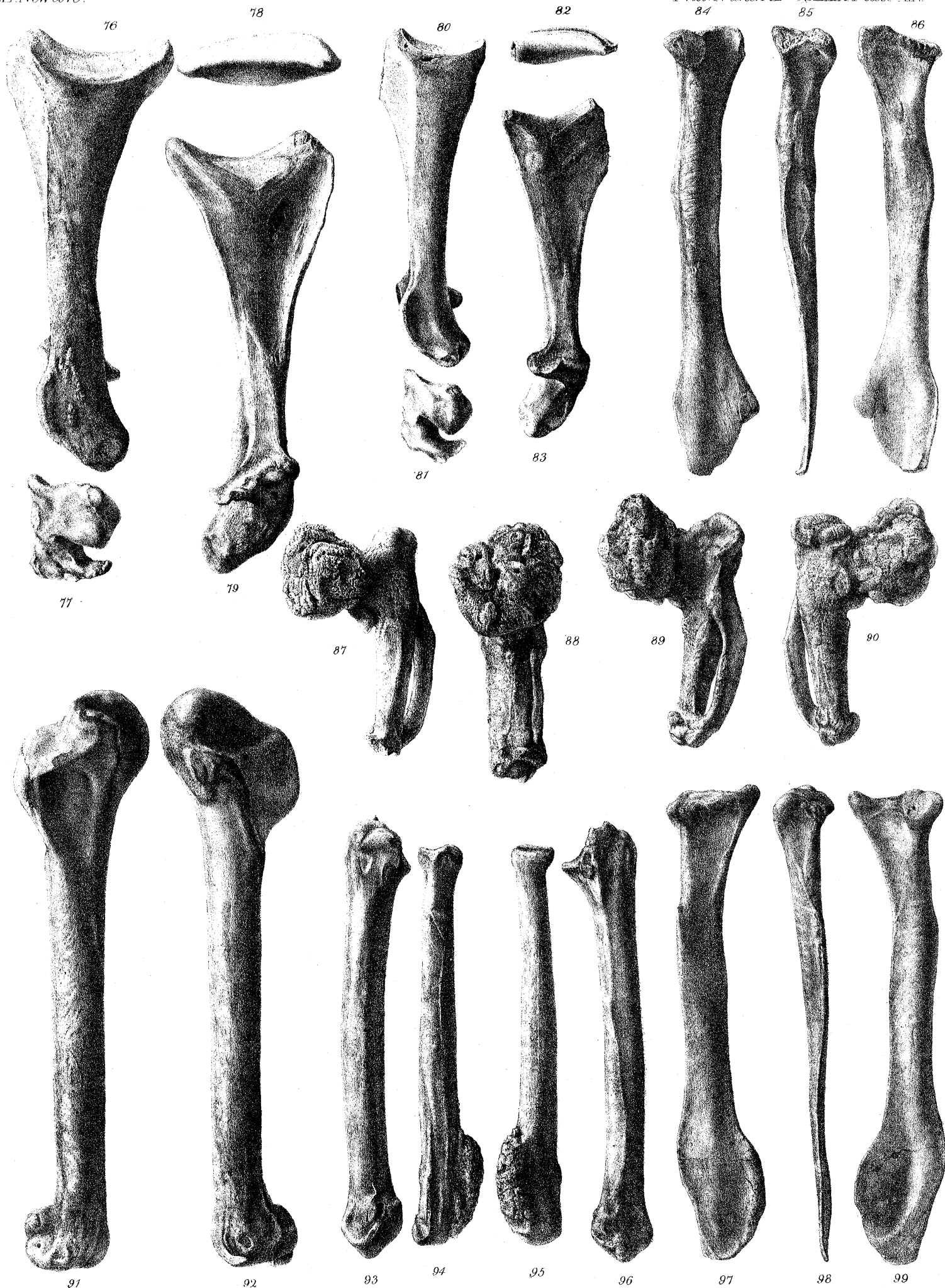


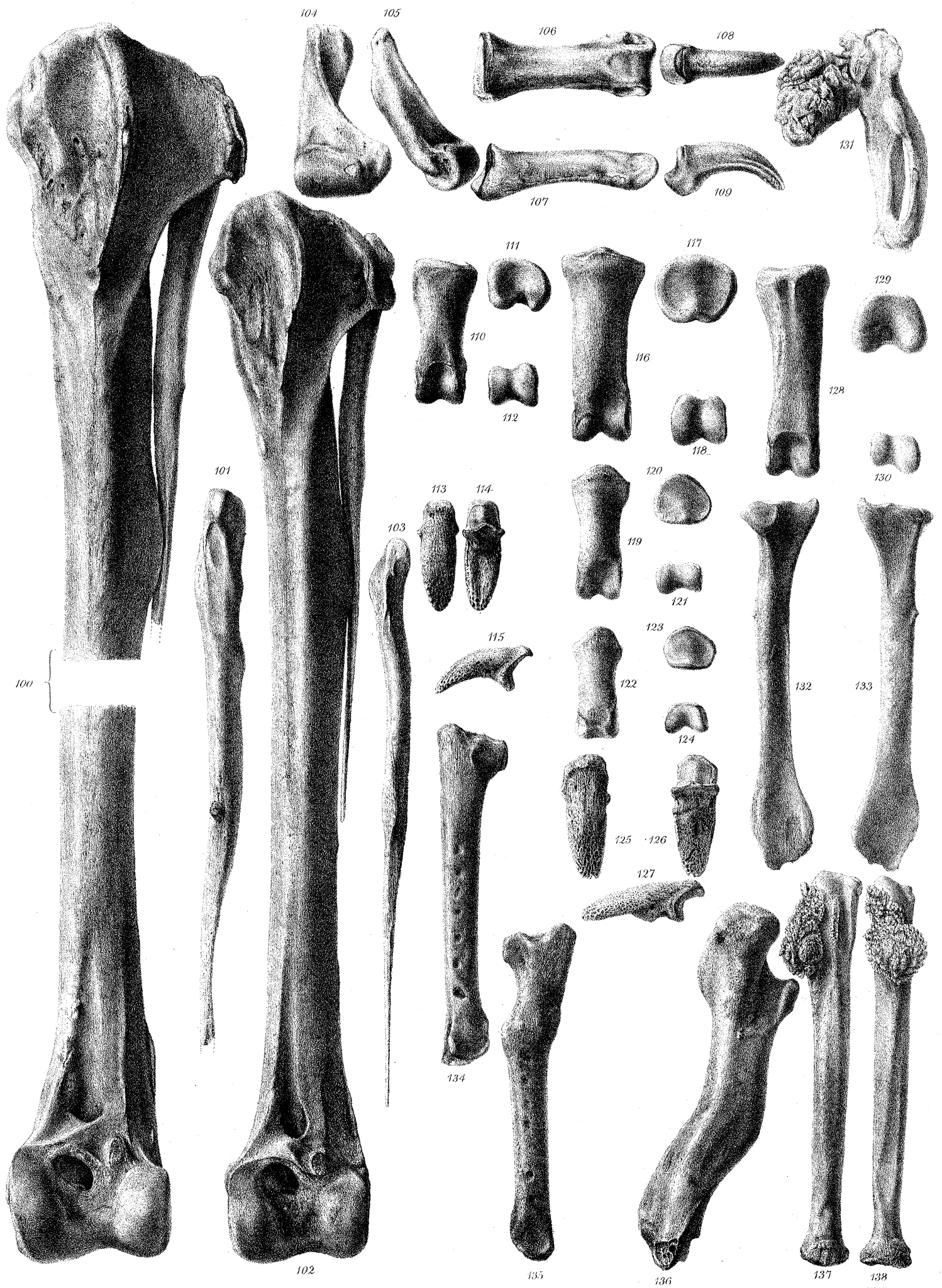
64



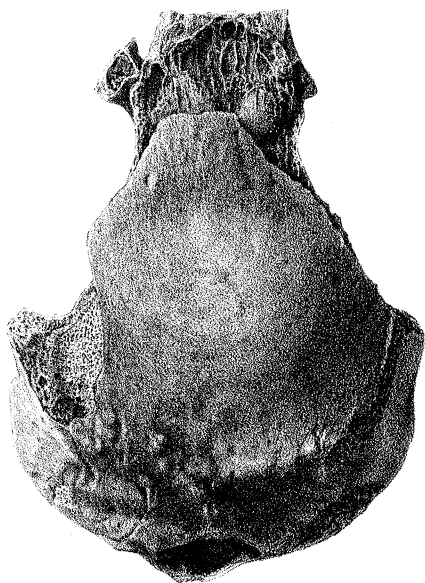




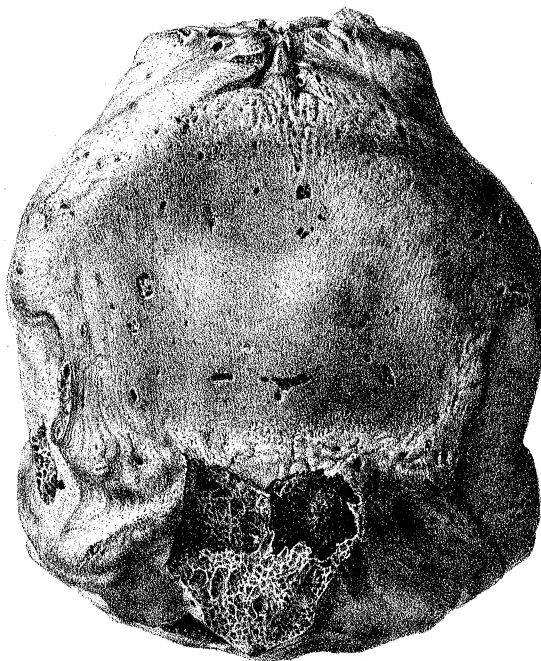




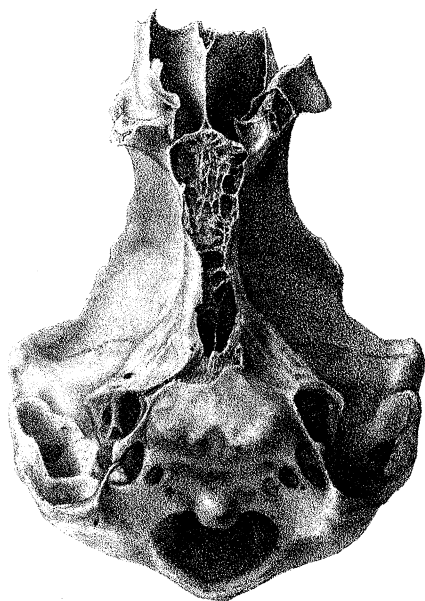
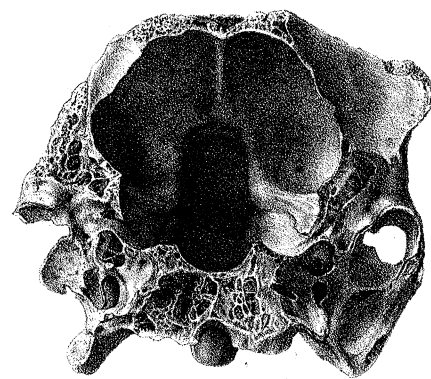
139



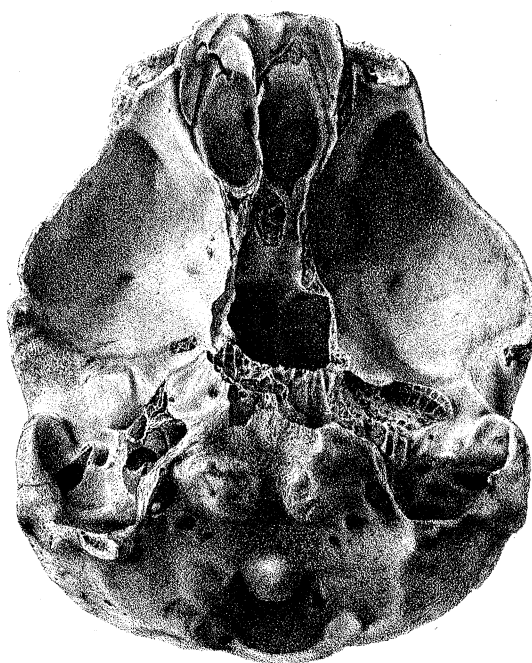
142



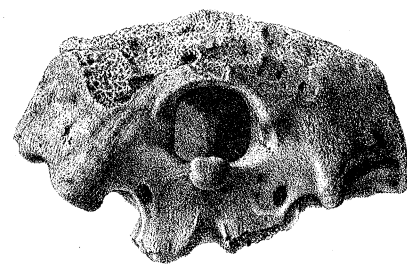
145



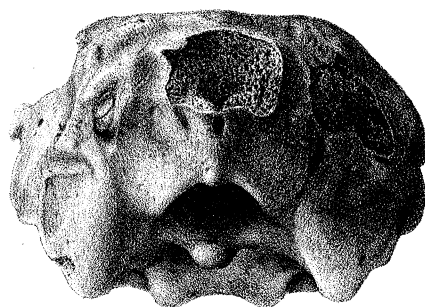
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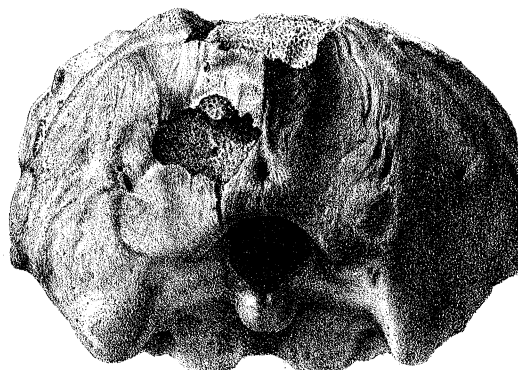
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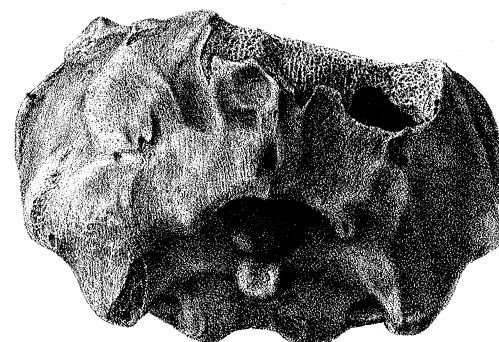
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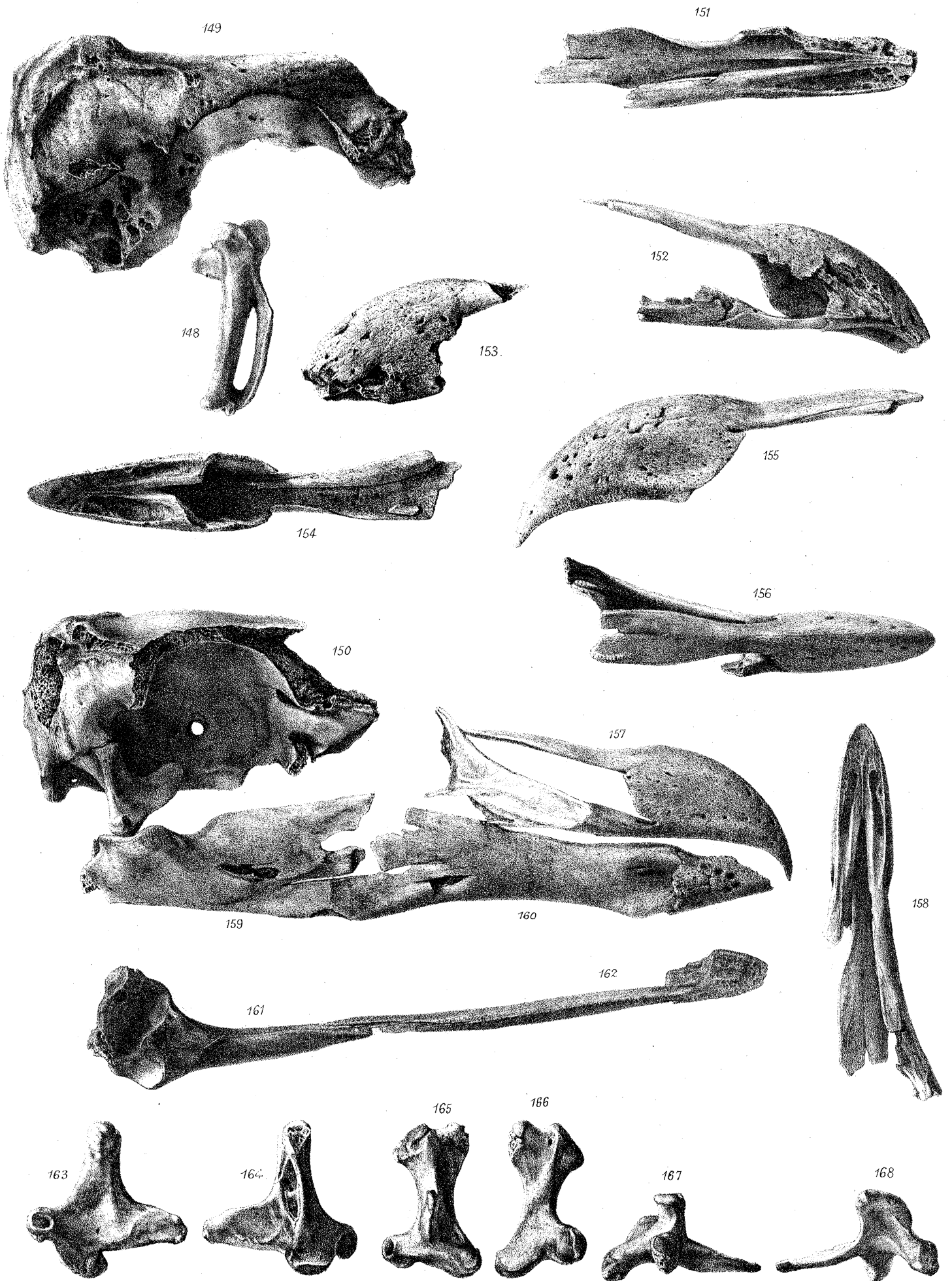
141

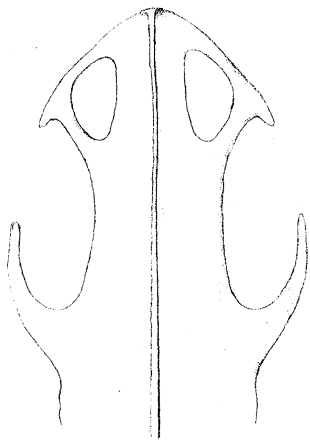


144

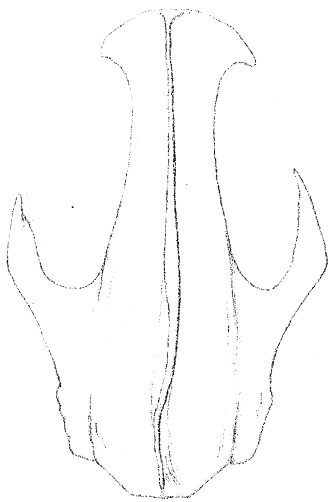


147

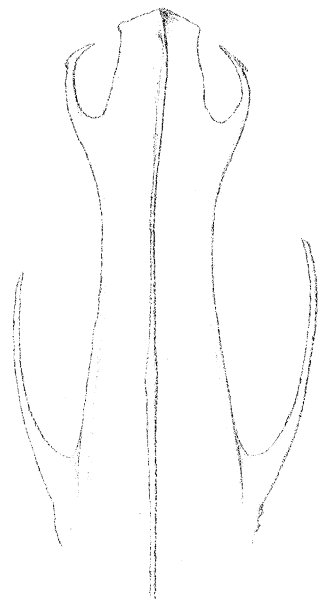




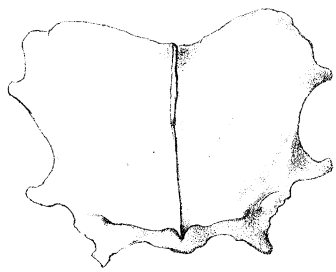
169



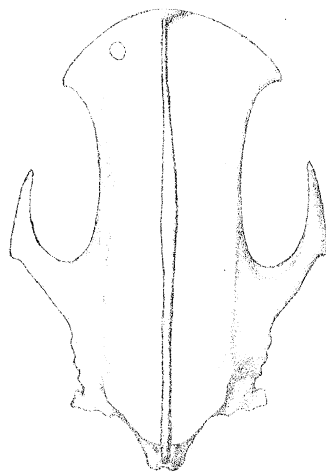
170



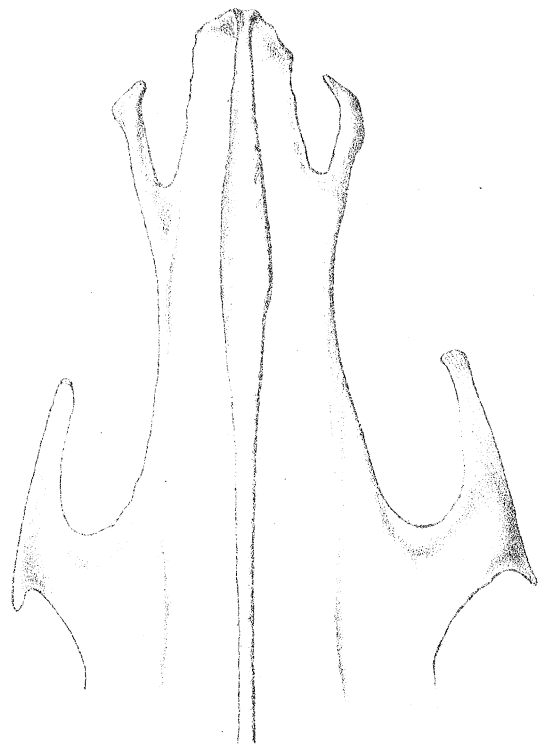
171



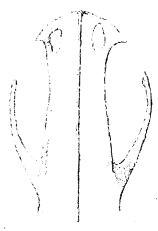
172



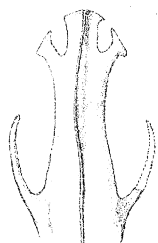
173



176



174



175

