

XVI. *On some Bones of Birds allied to the Dodo, in the Collection of the Zoological Society of London.* By H. E. STRICKLAND, F.G.S.

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AN interesting series of bones, procured in the Island of Rodriguez in 1831, and presented by Mr. Telfair to the Zoological Society, which were unfortunately mislaid for twenty years, have lately been discovered by Mr. A. D. Bartlett among the Society's stores. As they throw some important additional light upon the osteology of the Dodo and other extinct birds allied to it, I considered that a description and delineation of these relics might be acceptable to the Society. It will also serve as a supplement to the work published in 1848, by Dr. Melville and myself, on 'The Dodo and its Kindred,' in which all the osteological materials, which were then available to us, were fully described and delineated.

An examination of these bones has shown that they must have belonged to more than one species of bird, and has enabled us to extend this conclusion to the other bones from the same locality, which were formerly referred to a single species. In order to show this, it is requisite to give a brief *résumé* of the entire evidence which we possess on this subject.

It will be remembered that the true Dodo, *Didus ineptus*, of which three heads and two feet are preserved in our museums, appears to have been wholly confined to the island of Mauritius. To expect a bird unable to fly or to swim, to recur, specifically identical, in the volcanic islet of Rodriguez, which is separated from Mauritius by three hundred miles of ocean, would be contrary to those views of "Specific Centres of Creation," which are now becoming generally adopted as zoological truths. On the other hand, the fact of the comparative proximity in geographical position of these two islands would lead us to expect in Rodriguez a recurrence of the same organic structures, but with specific or even generic modifications, which characterize the fauna of Mauritius. Accordingly, it is highly interesting to find, that the bones of extinct birds which have been found at Rodriguez do in fact present, at once, a close zoological affinity and a marked specific diversity, in their relations to that extraordinary bird, the Dodo, for which Mauritius has long been celebrated.

The bones of extinct birds which have been brought from Rodriguez are altogether eighteen in number, and were collected at two distinct periods.

First, is a collection of six bones found in 1789, in a cavern in Rodriguez, where they

had become incrustated with stalagmite. Five of these are in the Museum of the Jardin des Plantes at Paris, and one is in my own collection.

Secondly, we have the series of bones, twelve in number, procured in 1831 by the exertions of the late Mr. Telfair. These were found in a cavern, probably the same one in which the former series were found; but instead of being exposed, on the floor of the cave, to stalagmitic incrustations, they were buried in the alluvial soil at the entrance (see Proceedings of Zool. Soc. Part i. p. 31). They are consequently in much better preservation than the bones of the former series, and are wholly free from incrustation. Of these bones, six are in the Andersonian Museum at Glasgow, one is in my possession, and five are the property of the Zoological Society, and form the especial subject of this memoir.

The bones of the *first* series, or those procured in 1789, consist of—

1. A portion of the cranium, figured in 'Dodo and its Kindred,' pl. xiii. figs. 1, 2, 3, 4.
2. Part of the sternum, figured in the same work, pl. xiii. figs. 5, 6.
3. A left humerus, figured *l. c.* pl. xiv. figs. 1, 2, 3.
4. A left femur, figured *l. c.* pl. xiv. figs. 8, 9, 10.
5. A right tarso-metatarsus, figured *l. c.* pl. xv. fig. 3.
6. A left tarso-metatarsus, mentioned in 'Annals and Magazine of Natural History,' 2nd Series, vol. iv. p. 335.

From the similarity in appearance of the above six bones, and the uniform thickness of their stalagmitic covering, it is evident that they have all been found near together in the same part of the cavern; and from the agreement in their proportions and the absence of duplicate bones, I infer that they all belong to the same individual. This is further confirmed by the following label attached to the bone No. 6 by Prof. Bojer, Curator of the Mauritius Museum, when he sent it to me in 1849:—"Tarsus of the Dronte, being a remaining fragment of a more perfect skeleton sent by M. J. Desjardins to the Baron G. Cuvier. The said skeleton was found in a cave at the island Rodrigue by M. Roquefeuille, inhabitant of Mauritius." This proof of the individuality of the above six bones enables us to draw some important conclusions regarding those of the second, or Mr. Telfair's series.

The latter consist of twelve bones, belonging to at least four different individuals. They are all evidently adult, but differ considerably in size, and may be accordingly divided into two sets.

A. Bones of the *larger* dimensions.

7. Proximal portion of a right humerus, belonging to the Zoological Society. See Pl. LV. figs. 1, 2.

8. An imperfect right femur in the Andersonian Museum, wanting both extremities, described in 'Dodo and its Kindred,' p. 117 (but erroneously said to be a *left*, not a *right* femur).

9. The distal half of a right femur, belonging to the Zoological Society. See Pl. LV. fig. 3.
10. A left tibia, wanting the proximal portion, figured in 'Dodo and its Kindred,' pl. xv. fig. 1.
11. A very perfect right tibia; exactly corresponding to No. 10; belonging to the Zoological Society. See Pl. LV. fig. 4.
12. An imperfect left tarso-metatarsus, figured in 'Dodo and its Kindred,' pl. xv. fig. 2.
13. Proximal portion of a right tarso-metatarsus, figured *l. c.* pl. xv. fig. 4.

B. Bones of the *smaller* dimensions.

14. A perfect right femur, figured in 'Dodo and its Kindred,' pl. xiv. figs. 4, 5.
15. A left femur corresponding to No. 14, but mutilated at the extremities, described in 'Dodo and its Kindred,' p. 117, line 6.
16. A nearly perfect right femur, belonging to the Zoological Society, agreeing in size with No. 14.
17. A perfect right tarso-metatarsus, belonging to Mr. H. E. Strickland, described in Ann. and Mag. Nat. Hist. 2nd Ser. vol. iv. p. 336. See Pl. LV. figs. 5, 6, 7.
18. A nearly perfect right tarso-metatarsus, similar to No. 17, belonging to the Zoological Society.

The bones which compose the series A. present a perfect agreement in size and proportions with each other, and also with those numbered 1 to 6, which I regard as members of a single skeleton. There seems therefore no reason whatever to doubt that the whole of the bones numbered from 1 to 13 belong to one and the same species of bird. So likewise the bones of the smaller-sized series, Nos. 14 to 18, agree together so completely in their size and proportions, as to leave no doubt that they likewise belong to a single species. We have next to inquire whether the larger bones Nos. 1 to 13 can be regarded as specifically identical with the smaller ones Nos. 14 to 18, or not.

At the time when Dr. Melville undertook his elaborate discussion of the Rodriguez bones (see 'Dodo and its Kindred,' p. 117), the only bones of the *smaller* series accessible to him were the two femora, Nos. 14 and 15. Being unwilling to found specific distinctions on a mere difference of size, exhibited in these two femora only, he supposed them to be either females or young birds of the same species as the bones of larger dimensions. As, however, we have now obtained an additional femur and two very perfect tarso-metatarsals, all closely agreeing in size, and unquestionably adult, presenting no signs of transition to the large-sized series, we shall probably be justified in drawing a different conclusion.

On comparing together the corresponding bones of the two series, we find that their proportions are to each other as 100 : 77, or very nearly in the ratio of 4 : 3, as the following measures will show :—

<i>Large series.</i>			<i>Small series.</i>		
Femur, No. 8.		No. 9.	No. 14.	No. 15.	No. 16.
		Lines.	Lines.	Lines.	Lines.
Smallest circumference	29	30	$23\frac{1}{2}$	23	23
Tarso-metatarsus, No. 12.			No. 17. No. 18.		
			Lines.	Lines.	Lines.
Total length	87		68	69	
Smallest circumference	$23\frac{1}{2}$		17	17	

But though the difference in size of the corresponding bones of these two series is thus considerable, I have not been able to detect any diversity whatever in the proportions of their parts. No question can possibly arise as to their *generic* identity; we have only to consider whether a diversity of size, amounting to the ratio of 4 : 3, suffices to indicate *specific* distinctness.

In the first place, it is evident that this difference of dimension cannot be due to age, the smallest-sized bones affording the same proofs of complete maturity as the largest. The small femur No. 16 in particular appears, from the rugose condition of its surface, to have belonged to an aged individual. Nor is it, I think, probable that these differences of size can be sexual. Were these bones referable to the Gallinaceous order, we might perhaps find examples in that polygamous group, of diversities of size in the two sexes, sufficient to justify such a conclusion. But the bones in question have been satisfactorily shown to belong to the order of *Columbæ* (see 'Dodo and its Kindred,' pp. 54, 114), a group in which the males and females present very nearly the same dimensions, and certainly never vary in so large a ratio as 4 : 3¹.

It seems to me equally impossible to believe that a difference of size amounting to 4 : 3 can come within the limits of ordinary or accidental variations in the same species. Such varieties of stature, if they ever occur to this amount among birds of the same species, are always due to peculiarities of food or climate, operating at remote localities, and never affecting the individuals inhabiting a small island, and all subjected to the same external influences. I cannot therefore avoid the conclusion, that we have here the proofs that two distinct species formerly inhabited the island of Rodriguez, differing greatly in size, and probably (like other birds) exhibiting some other distinctions of external appearance, of which no traces are left on the parts of their skeleton which have been yet discovered. Should, however, the bones of the beak of these two supposed species be ever obtained from the alluvia of Rodriguez, we may expect to find some indications of specific distinctions depending on form as well as on size.

In the work referred to, Dr. Melville and myself have uniformly spoken of the

¹ Leguat's statement regarding the *Solitaire*, that "some of the males weigh forty-five pounds," certainly indicates that the females were somewhat smaller; but as he does not mention the weight of the latter, his words prove nothing as to the amount of sexual disparity.

bones brought from Rodriguez as those of the *Solitaire*, which we now know to have existed in that island as recently as 1735 (see Ann. and Mag. of Nat. Hist. 2nd Ser. vol. iii. p. 138). That some of these bones have belonged to that extinct bird, there is no reason to doubt; but as I consider it proved that these relics indicate two distinct species, it is worth while to inquire which of these is to be regarded as the true *Solitaire* of Leguat and D'Heguerty. In this inquiry we have no other data but that of size to guide us. Now Leguat compares *Solitaires* in a general sense to Turkeys (*Meleagris gallopavo*), but adds that they are longer in the leg ("plus haut montés"). He states, that in the winter season, when they are "extraordinairement gras," some of the males weigh forty-five pounds. This statement is confirmed by D'Heguerty, who describes them as "plus gros qu'un Cygne."

It is evident from these statements that the *Solitaire* must have been larger than a Turkey, the males of which rarely exceed the weight of thirty pounds. And as the tarso-metatarsus of a large Turkey is barely 6 inches in length, that of a *Solitaire*, which was proportionally longer in the leg, must have considerably exceeded 6 inches. Now the tarso-metatarsi of the smaller series of bones are only 5 inches 8 lines in length, while those of the larger series measure from 7 inches 1 line to 7 inches 3 lines, and thus fully conform to the dimensions of the *Solitaire*, as indicated by Leguat.

I therefore conclude that it is the larger of the two supposed species which we are to regard as the *Solitaire* of Leguat and D'Heguerty, and for which therefore the names *Didus solitarius* of Gmelin, and *Pezophaps solitaria* proposed by Dr. Melville and myself, must be retained.

With regard to the smaller-sized species of which we possess bones, we may either conjecture that it had become extinct before Leguat's visit to the island, or we may suppose that in these bones we see the relics of the birds obscurely described by Leguat under the name of "Gelinottes" (see 'Dodo and its Kindred,' p. 55), and to which M. de Selys Longchamps has rather prematurely applied a scientific name, *Apterornis bonasia* (Revue Zoologique, 1848, p. 294). Our information respecting these *Gelinottes* is, however, at present too vague to justify any specific or generic identifications of them; and until our knowledge is advanced by procuring further osteological evidence from Rodriguez, I prefer to attach to the bones of smaller dimensions the provisional specific name of *Pezophaps minor*¹.

I will now conclude by briefly describing the five bones belonging to the Society, pointing out such structural peculiarities as their more perfect condition enables us to

¹ In a communication respecting these bones, made by Mr. A. D. Bartlett to the Zoological Society on Dec. 9, 1851, of which an abstract is given in the Literary Gazette, 1851, p. 923, it will be seen that he refers them to *three* distinct species—the true *Didus ineptus*, the supposed *D. nazarenus*, and the *Solitaire* of Leguat. I have, however, endeavoured to prove that they belong to *two* species only, neither of which can be referred to the Mauritian *D. ineptus*, nor to the *D. nazarenus*, which is merely a synonym of that bird, based on the erroneous description of Cauche (see 'Dodo and its Kindred,' p. 21).

add to our pre-existing information. I will also append a notice of the single bone in my own possession (No. 17), which has been obtained since the publication of Dr. Melville's chapter on the osteology of the Solitaire. The Nos. used in the list, p. 188 *supra*, are here retained.

No. 7. Proximal portion of the right humerus of *Pezophaps solitaria*. The conformity in size of this fragment to the humerus No. 3, proves that it belongs to this species, and not to *P. minor*. The perfect state of its surface exhibits several characters which in No. 3 are concealed by incrustation. In its general form it closely agrees with the humerus of the *Columbidæ*, but differs in the non-development of the anterior crest, to which the great pectoral muscle is attached. In Pigeons and most birds of strong flight this crest is expanded into a narrow ridge, projecting forwards and outwards, while in this bird we find only an obtusely rounded surface for the insertion of the pectoral muscle. In the incrustated humerus No. 3, the absence of this ridge induced Dr. Melville to suppose that it had been broken off before the bone became incrustated; but the specimen before us proves that its non-development is a characteristic feature in the structure of the bird.

As it is the projection of this crest in volatile birds which supplies the pectoral muscle with a powerful lever for producing the downward stroke of the wing, and thus sustaining the bird in the air, so we can see the probable reason why in the Solitaire, which we know from historical sources to have been incapable of flight, this ridge should remain entirely undeveloped.

I may add, that the small size of the humerus in this bird is alone sufficient to prove its inability to fly. In the volatile *Columbidæ* we find the humerus to be slightly *longer* than the femur. Thus in *Columba palumbus* the humerus is to the femur as 13 to 11, and in *Goura coronata* as 20 to 17. But in the species before us, the humerus No. 3, which I consider to belong to the same individual as the femur No. 4, is *shorter* than it in the very considerable ratio of 47 to 73.

The pneumatic foramen of this humerus is large, and proves that air was admitted into its interior,—a fact, however, quite consistent with inability to fly, as is shown in the case of the *Struthio* and *Rhea*, which, though non-volatile birds, yet possess a certain amount of pneumaticity in their bony skeleton.

The transverse fracture of the shaft enables us to see that its interior cavity is filled towards the upper part with coarsely interlacing cancellous fibres.

The measurements of this humerus are as follows:—

	inch.	lin.
Extreme width from the anterior to the posterior crest	1	5½
Smallest horizontal diameter of shaft	0	6
Smallest vertical diameter of shaft	0	5½
Horizontal diameter of medullary cavity	0	4
Vertical diameter of medullary cavity	0	3

Proceeding to the hinder extremities, we have next to notice the bone No. 9, a fragment of a right femur, comprising the distal half, of which the articular extremity is much injured. From the rugged condition of its surface, it seems to have belonged to a very aged individual. Its dimensions appear to correspond exactly with those of the femur No. 4, allowing for the thickness of the incrustation on the latter bone. The only measurements which the broken condition of this fragment enable us to take, are the following :—

	lines.
Transverse diameter of the shaft	10
Antero-posterior diameter of the shaft	8
Transverse diameter of medullary cavity	7½
Antero-posterior diameter of medullary cavity	5½

We will next speak of the very perfect right tibia, No. 11, which, from its precise conformity to the broken left tibia, No. 10, is probably a portion of the same individual. The distal portion of the tibia, No. 10, has been already fully described by Dr. Melville in ‘Dodo and its Kindred,’ pp. 116, 117.

The proximal extremity is nearly perfect, with the exception of the internal ridge, which is broken off. In general form it agrees with the same bone in the *Columbidæ*. The fibula is absent, but the rugose ridge to which it was attached is distinctly shown.

The dimensions of this bone are as follows :—

	inch.	lin.
Total length	10	1
Transverse diameter of proximal extremity	1	7
Antero-posterior diameter of proximal extremity	1	9
Length of fibular ridge	2	3
Distance from distal extremity of fibular ridge to intercondyloid groove	6	2½
Smallest transverse diameter of shaft	0	8
Smallest antero-posterior diameter of shaft	0	6½
Breadth of lower extremity	1	4
Antero-posterior diameter of lower extremity	1	3½

The discovery of this nearly perfect tibia has now enabled us to compare the dimensions of the three principal bones of the hinder extremity in the larger species of Solitaire. We are thus enabled to draw approximate conclusions both as to its absolute stature, and as to the proportions of its parts, as compared with other species of birds.

We may now therefore adopt as the maximum length, in *Pezophaps solitaria*, of the

	inch.	lin.
Femur	7	2
Tibia	10	1
Tarso-metatarsus	7	0

In a skeleton of *Goura coronata* now before me, we find the

	inch.	lin.
Femur	3	4
Tibia	4	10
Tarso-metatarsus	3	7

The proportion between the three bones is nearly the same in these two birds. Now the measurements of the *Goura* are very nearly half those of the *Pezophaps*, and as the *Goura* when living measures about 19 inches from the ground to the crown of its head, we may assume the Solitaire to have been about 38 inches in height, a stature which sufficiently corresponds with the descriptions of Leguat and D'Heguerty.

Proceeding from these larger bones to the smaller series on which I have based the specific name of *Pezophaps minor*, we have, first, the right femur, No. 16. This differs from the femur No. 14, figured in 'Dodo and its Kindred,' pl. xiv. figs. 4, 5, 6, 7, only in being of rather smaller dimensions (a quarter of an inch shorter), though the rugose state of its surface indicates an aged individual. As it is less perfect at the extremities than the femur No. 14, which has been already figured and fully described by Dr. Melville, I need not notice this bone further than to append its dimensions:—

	inch.	lin.
Length from the intercondyloid notch to the upper surface of the neck	5	0
Transverse diameter of the shaft	0	8
Antero-posterior diameter of the shaft	0	$6\frac{1}{4}$
Transverse diameter of superior extremity	1	$5\frac{1}{2}$
Transverse diameter of inferior extremity	1	$4\frac{3}{4}$

The right tarso-metatarsus No. 18, belonging to the Zoological Society, is an almost exact duplicate of the bone No. 17, sent to me by M. Bojer, and noticed in 'Annals and Magazine of Nat. Hist.' Ser. 2. vol. iv. p. 336. As the latter bone is rather the more perfect of the two, I have given a figure of it (Pl. LV. figs. 5, 6, 7) in preference to the former. The only noticeable difference between these two bones consists in the form of the concavity beneath the proximal extremity, which is rather shallower and more expanded in No. 18 than in No. 17. This is especially the case in its lower part, beneath the internal interosseous foramen, at the insertion of the *tibialis anticus* muscle. So slight a modification in form must not be regarded as indicating any specific distinction. It will be seen from the following Table that the bone No. 18 is slightly the longer of the two.

	No. 17.		No. 18.	
	inch.	lin.	inch.	lin.
Length from lower border of middle trochlea to summit of intercondyloid tubercle	5	8	5	9
Transverse diameter of the shaft	0	6	0	6
Antero-posterior diameter of the shaft at the upper portion of articular surface for posterior metatarsal	0	4	0	4
Transverse diameter of lower extremity	1	3½	1	3¾
Distance from upper border of posterior metatarsal articular facet to internal intertrochlear notch	1	3	1	3¾
Length from external trochlea to external condyloid fossa	5	1½	5	2½
Length from internal trochlea to internal condyloid fossa	5	2½	5	3½
Breadth of upper extremity	1	2	1	2¼
Antero-posterior diameter of upper extremity	1	1		
Projection of ento-calcaneal process	0	5½		

The tarso-metatarsus is the only bone of the genus *Pezophaps* (with the exception of the very imperfect fragment of the cranium No. 1) which we are at present able to compare with its corresponding member in the genus *Didus*. Fortunately also it is one of the most characteristic bones in the ornithic skeleton, presenting peculiarities of structure in each of the orders and families which enable us in most cases to identify with certainty the group of birds to which any example of this bone has belonged.

On comparing the bones Nos. 17 and 18 with the tarso-metatarsus of the Dodo, described at p. 102, and figured in plate xi. figs. 1, 2, 3, 4, 5, 6, of the work above referred to, we are struck at once by the much slenderer proportions of this bone in *Pezophaps* than in *Didus*. Although the tarso-metatarsus of the former is longer by 6 lines than the latter, its transverse diameter is one-sixth less. The width of both extremities of the bone is also considerably less in the *Pezophaps* than in the *Didus*.

These differences of proportion all indicate that the *Pezophaps* was a taller bird, but of lighter weight and more active movements than the *Didus*—a distinction, to which the historical accounts of the Solitaire and of the Dodo bear ample testimony.

With the exception, however, of this difference in the proportions of its length and breadth, the entire details of structure are almost identical in the tarso-metatarsus of these two birds. The elaborate description given by Dr. Melville of the tarso-metatarsus of the Dodo ('Dodo and its Kindred,' p. 103) would apply almost word for word to the bones before us, and afford the most convincing proof of their close affinity. There are indeed some very slight modifications of form which distinguish the tarso-metatarsus of the Solitaire from that of the Dodo, which are carefully pointed out by Dr. Melville, *loc. cit.* p. 118, and which I need not now adduce. I may, however, refer to two points, which the perfect state of the specimens Nos. 17 and 18 has now for the first time

brought to light. These are, first, the considerably less development of the inner or longest calcaneal process in *Pezophaps* as compared with *Didus*. Thus, while the antero-posterior diameter of the proximal extremity in the tarso-metatarsus of *Didus* amounts to 1 inch 4 lines, the same measurement in *Pezophaps minor* reaches only 1 inch 1 line. Again, at the lower extremity we find that the three trochleæ are placed more nearly in the same vertical plane in *Didus* than they are in *Pezophaps*, in which latter bird the two lateral trochleæ are placed more obliquely and more posteriorly in reference to the middle one than they are in *Didus*. This arrangement seems to imply a greater divergence in the lateral toes of *Pezophaps* than in those of *Didus*, which would probably enable the former bird to run with a speed never attained by the latter.

The peculiar position of the calcaneal canal on the *outer* side of the posterior ridge, which distinguishes the Pigeons, and the allied group of *Pteroclidæ*, from all other birds, and which forms one of the strongest proofs of the Columbine affinities of the Dodo, is well seen in the bone No. 18. It fully justifies our former conclusions not only as to the proximity of *Pezophaps* and *Didus*, but as to the position of both these birds, showing that they are a peculiar and exceptional, yet in all essential points a genuine sub-family of that great and isolated family the *Columbidæ*.

The views of ornithic structure, which the examination and comparison of these scattered relics have thus gradually developed, render it more than ever desirable to search for other portions of the skeleton of the different members of the group *Didinæ* which once inhabited the Mascarene Islands. Of the two species of *Pezophaps* from Rodriguez, many important parts of the skeleton, and especially the cranium, have yet to be discovered. Of the *Didus* of Mauritius we still want the femur, the tibia, and all the bones of the body and anterior extremities, while of the so-called "Solitaire" of Bourbon not even a fragment has yet been brought to Europe. After the success, however, which has attended similar researches in New Zealand, we cannot doubt that an active naturalist, by excavating the alluvia of these different islands, might restore the entire skeletons of these extraordinary birds.