

the base ; inner lip subspiral, about twenty projecting teeth terminating outwardly in an even line at the edge of the aperture ; columellar sulcus broad and deep, which about eight of the anterior teeth traverse and strongly serrate its inner border, no columellar groove ; the posterior teeth, proceeding but a little distance within the aperture, terminate on the columella ; the sulcus being so deep causes a rather angular prominence of the inner side of the channel ; margins thick and round ; extremities, the external posterior broad and obtuse, the internal edge-formed concave within ; the anterior project moderately and converge ; all are dotted with very minute black points which extend in a slight degree on to the margins ; channels, anterior rather narrow and short, posterior moderately wide, both inclining towards the columella.

Length,  $1\frac{2}{10}$  inch ; width,  $\frac{7}{10}$  of an inch.

*Hab.* ———? Cab. Cuming.

This species is of the stamp of *Cyp. Isabella*, Linn.

### 3. ON THE PTERODACTYLES OF THE CHALK FORMATION.

By J. S. BOWERBANK, ESQ., F.R.S. ETC.

(Reptilia, Pl. IV.)

On the 14th May 1845 I exhibited at the Meeting of the Geological Society the snout and under jaws, extending from the point to about the middle of the cavitas narium, of a new and gigantic species of *Pterodactylus*, with some other bones, a portion of which belonged to the same individual, and others which have every appearance of having belonged to another animal of the same species\*, and I then stated my belief that the bone figured by Prof. Owen, in the 'Transactions of the Geological Society,' vol. v. pl. 39, 2nd Series, would probably ultimately prove to be that of a Pterodactyl. From the great size of the snout, and the gigantic proportions also indicated by the bones accompanying it, I was induced to give it the specific name of *giganteus*. On a subsequent occasion, June 9, 1847, I continued my remarks on these Reptile remains, in a paper entitled "Microscopical Observations on the Structure of the Bones of *Pterodactylus giganteus* and other fossil animals," in which I endeavoured to prove, by the strongly-marked peculiarities of the bone-cells in Mammals, Birds and Reptiles, that the whole of the bones described in my former paper, and those figured by Prof. Owen in the Trans. Geol. Soc., 2nd Series, vol. vi. pl. 39. figs. 1 & 2, were in truth of purely Reptilian character ; and I also figured a radius and ulnâ from the Cabinet of Mrs. Smith of Tunbridge Wells, of nearly the same gigantic proportions as the one formerly in the possession of the Earl of Enniskillen, but now in my collection (fig. 1. pl. 39, Geol. Trans.), and a bone from the Cabinet of Mr. Toulmin Smith, equivalent to that represented by Prof. Owen in the same plate, fig. 2, which bones presented the same structural evidence of their Reptilian nature, and

\* Quart. Geol. Journ. vol. ii. p. 7. pl. 1. figs. 1-6.

which description of evidence has, I am happy to say, been more fully developed and firmly established by the talented coadjutor of Prof. Owen, Mr. Quekett of the Royal College of Surgeons, who has publicly taught it in the Theatre of that Institution without question or contradiction of its truth. This great radius and ulna in Mrs. Smith's Collection I referred to my previously established species, *P. giganteus*, believing at that time that they were probably the bones of a fully developed animal, while those previously described were the remains of animals not developed to the full extent of their capability.

Since the publication of these specimens it has been my good fortune to obtain the snout of another and still larger species of *Pterodactyl*, from the same pit at Burham in Kent, and which it is probable will ultimately prove to belong to the species to which the enormous pair of bones in the Cabinet of Mr. Charles of Maidstone belongs. Should this hereafter prove to be the case, it will then remain to be shown whether the beautiful specimen of radius and ulna in the Collection of Mrs. Smith of Tunbridge Wells, and the bone nearly corresponding in size with them, and which was in the possession of the Earl of Enniskillen, belong to the newly discovered species, which I purpose designating *Pterodactylus Cuvieri*, or to the previously named species, *P. giganteus*; or whether there be yet a third species existing in the chalk, to which these bones of an intermediate size may hereafter be referred\*.

The snout of the new species, *P. Cuvieri*, differs materially in its form from the same part of *P. giganteus*: while the latter agrees as nearly as possible in that respect with *P. crassirostris* and *P. brevirostris*, the former appears to approach very closely the proportions of *P. longirostris*. Thus, if we take the length of the snout from the distal end of the *cavitas narium*, as compared with its height, at the same point of *P. crassirostris*, *P. brevirostris* and *P. giganteus*, we find the relative proportions to be,—of the first-named, 29 of height to 56 of length; of the second, 28 of height to 50 of length; and of the third, 28 of height to 58 of length; we may therefore reasonably conclude that, when perfect, the head of *P. giganteus* very closely resembled in its proportions that of *crassirostris*. The length of the fragment of the snout of *P. Cuvieri* at the upper portion of the head is 7·20 inches; at the palatal bones, 6·38 inches; and in this space there are sockets for twelve teeth on each side. The distance between each tooth is about  $1\frac{1}{2}$  of the long diameter of the sockets, which are somewhat irregularly placed, but are nearly equidistant from each other. The pair of teeth at the distal end of the snout appear, both from the position of the sockets and the tooth remaining *in situ*, to have been projected more or less forward, in a line with the palatal bones. The head appears to have been exceedingly narrow throughout the whole of its length. At the third pair of teeth from the distal

\* A third species, *C. compressirostris*, has since been described by Prof. Owen, page 95, Part III. of 'The Fossil Reptilia of the Cretaceous Formations,' published by the Palæontographical Society, and to which species the bones in question have been referred.

end of the snout it measures  $\cdot 66$  inch, and at the eleventh pair of teeth,  $\cdot 78$  inch wide. Opposite the seventh pair of teeth the skull curves upward suddenly and considerably, which is not the case at any part of the corresponding portion of the skull of *P. longirostris*; it is therefore probable, that although in the number and disposition of the teeth in the upper jaw, as far as our evidence goes, it strongly resembles *longirostris* in its structure, yet in the length of its skull it is probably shorter in proportion than that species, apparently in that respect being intermediate between *longirostris* and *crassirostris*; thus uniting the long-nosed with the short-nosed species of *Pterodactyls*.

There are no remains of the *cavitas narium* in the new species, but it is not to be expected that it should make its appearance so near to the termination of the snout, as in *longirostris* the distal portion of that cavity is situated as far backward from the last of the dental series of the upper jaw as that tooth is from the end of the snout. The number of teeth on each side of the upper jaw in *P. longirostris* is twelve, and the like number of sockets are apparent in our specimen; it is therefore probable that we have the whole of that portion of the head.

If we estimate the size of the head on the scale of *P. longirostris*, it would appear to be  $25\cdot 52$  inches in length; but as we have observed that the skull curves upward considerably at the seventh pair of teeth, it is probable that its length may not be so much.

The length of the wing of *P. crassirostris* in proportion to the length of its head is  $3\cdot 91$  times. The length of the wing of *P. longirostris* compared with the length of its head is  $2\cdot 51$ ; if therefore we assume, from the peculiar form of the snout of *P. Cuvieri*, that the head as regards length is intermediate in its proportions between *P. crassirostris* and *P. longirostris*, it should be  $3\cdot 21$  parts of the length of the wing.

The snout contracts in width gradually upwards from the sockets of the teeth, so that its upper portion forms a narrow ridge, and this is its form as far backward as it can be traced. The palatal bones are depressed, the suture forming a prominent ridge as far as it is visible, but not in so great a degree as in *P. giganteus*.

One of the first pair of teeth remains in its socket; the whole of the other large teeth are displaced, but there are two of them imbedded in the chalk, one within an inch and the other an inch and a half of the sockets, and in the fifth right and eighth left socket there is a rudimentary tooth *in situ*. The largest of the displaced teeth exceeds  $1\cdot 32$  inch in length, and has been buried in the socket for nearly an inch; the second large tooth, which is imbedded near the third pair of sockets, does not exceed an inch in length; both teeth are slightly curved, smooth, and are hollow at the base.

The great diversity in the size of these remarkable Reptiles will render a short review of some of the known species interesting; and if we arrange them in order, as they increase in size, the following will be the series:—1. *P. brevisrostris*, 2. *P. longirostris*, 3. *P. crassirostris*, 4. *P. Bucklandi*, 5. *P. grandis*, 6. *P. giganteus*, 7. *P. Cuvieri*; and to these may be added the bones in the possession of Mrs. Smith, the

Earl of Enniskillen, and Mr. Charles. Of these, *brevirostris*, *crassirostris* and *giganteus* are short-nosed species, *longirostris* and *Cuvieri* long-nosed. With regard to relative length and proportions of the other parts of the skeleton we have ample means to arrive at tolerably correct conclusions, in consequence of the nearly perfect condition of *brevirostris*, *crassirostris* and *longirostris*. In the former two we find the cervical vertebræ short and thick, the length being about equal to the height in the latter of the two, while in *longirostris* they vary in length from three to five times their own diameter at the middle. Very uncertain results therefore would arise from finding single bones of this portion of the skeleton, excepting that a long and attenuated cervical vertebra would seem to indicate a corresponding length of snout; but from the other bones of the animal, more especially those of the wing, much more satisfactory results may arise. Upon a careful measurement of the casts in the British Museum from the original specimens, I find the following to be the length of the bones of the wing of *P. longirostris*:—

	inch.	
Humerus . . . . .	1·25	= 8·55 of length of wing.
Radius and ulna . . . . .	1·90	= 5·57        "
Carpus . . . . .	0·13	= 0·82        "
Metacarpus . . . . .	1·34	= 7·97        "
1st Phalange . . . . .	1·90	= 5·57        "
2nd    "    . . . . .	1·75	= 6·10        "
3rd    "    . . . . .	1·25	= 8·55        "
4th    "    . . . . .	1·17	= 9·13        "
10·69		
		inches.
The length of the head . . . . .		4·25
From the tip of the nose to the commencement of the cavitas narium . . . . .		2·10
Height of the skull at the commencement of the cavitas narium . . . . .		0·38
Length of the femur . . . . .		1·34
Length of the tibia . . . . .		1·90
Smallest diameter of the radius near the distal extremity . . . . .		0·14

By these measurements it is apparent that the tibia, radius and ulna and 1st phalange are equal in length. The humerus and 3rd phalange are also equal to each other, and so likewise are the metacarpus and femur equal to each other. If we also compare the smallest diameter of the radius, 0·14 inch, with its length, 1·90 inch, we find that the bone is  $13\frac{9}{14}$  diameters long, and in *P. Macronyx* (*Bucklandi*) it is  $13\frac{9}{14}$ . We may therefore be enabled, by keeping these comparative measurements in view, to predict with a tolerable degree of certainty the spread of wing of any Pterodactyl of which we may find one or more of the principal bones of the wing, and especially if

we take into consideration the comparative length of each bone with regard to its total extension, as exhibited in the table of the dimensions of *P. longirostris*. In the case of the great specimens of radius we may arrive at their length in many cases, although the bone may be imperfect at even both terminations. Thus the diameter of the smallest portion of the bone formerly in the possession of the Earl of Enniskillen and figured by Prof. Owen, is .81 inch at the smallest portion of the shaft: this bone therefore, on the scale of  $13\frac{1}{2}$  diameters to its length, should be 10.93 inches in length. The measurement of the smallest portion of the bone belonging to Mrs. Smith (Geol. Journ. vol. iv. pl. 2. fig. 1 *a*) is .77 inch: we may therefore, by the same rule, conclude that its length was 10.39 inches when perfect. The length of the imperfect ulna beside it is 9.25 inches in the specimen. The diameter of the smallest portion of the bone (Geol. Journ. vol. ii. pl. 1. fig. 6) is .45 inch, which, in the proportion of  $13\frac{1}{2}$  diameters to its length, will give 6.07 inches for its length. The width of the corresponding bone in the possession of Mr. Charles of Maidstone is 1.25 inch at the smallest diameter: by the same rule, therefore, the approximate length should be 16.87. The remains of the bone alongside of it is, although imperfect at both ends, actually 12.25 inches in length.

Upon these grounds therefore, in every case derived as much as possible from direct measurements from the skeletons of the respective species, I have given the following table of the dimensions of a series of species of Pterodactyls, the most interesting either from the state of perfection in which their remains have been found, or from the gigantic proportions which they present; and thus have endeavoured to realize to the mind an idea, as nearly as possible correct, of the dimensions of the animals when alive.

Table of the relative proportions of known species of *Pterodactylus*, with the length of each of the wing-bones and half of the width of the body.

	Humerus.	Radius and Ulna.	Carpus.	Metacarpus.	1st Phalange.	2nd Phalange.	3rd Phalange.	4th Phalange.	Half width of body.	Total expan- sion from tip to tip of wing.
	in.	in.	in.	in.	in.	in.	in.	in.	ft.	in.
<i>P. brevirostris</i> ...	0.48	0.75	0.06	0.52	0.82	0.76	0.48	0.35	0.19	0 9
<i>P. longirostris</i> ...	1.25	1.90	0.13	1.34	1.90	1.75	1.25	1.17	0.47	1 10
<i>P. crassirostris</i> ...	2.08	4.42	0.34	1.32	2.83	2.53	2.08	2.32	1.10	3 2
<i>P. Bucklandi</i> .....	3.25	4.25	0.40	3.75	3.91	4.83	3.25	3.00	1.06	4 7
<i>P. grandis</i> .....	3.75	5.70	0.39	4.02	5.70	5.50	2.75	3.51	1.42	5 5
<i>P. giganteus</i> .....	4.43	6.74	0.46	4.75	6.74	6.21	4.43	4.14	1.68	6 7
<i>P. (Mrs. Smith's)</i>	6.76	10.39	0.70	7.26	10.39	9.49	6.76	6.33	2.59	10 2
<i>P. Cuvieri</i> .....	10.99	16.87	1.14	11.79	16.87	15.56	10.99	10.29	4.22	16 6

In the above table I have presumed that the largest bones should be associated with the snout described as the type of *P. Cuvieri*, but the truth of this assignment of the bones belonging to Mr. Charles

can alone be determined by the acquisition of more complete specimens of the animal than those at present known.

In the construction of this table I have taken the proportions of *P. longirostris* as the foundation, as it is the only species from which I could get the measurements of all the bones of the wing from the same animal; but it must not be supposed that the restorations effected in the table will be absolutely correct at all times in its application, for we see that in *P. longirostris* the radius and first phalange are equal, but in *crassirostris* and *Bucklandi* this is not the case: the greatest discrepancy rests with *crassirostris*, while *Bucklandi* and *brevirostris* accord much more nearly with the proportions of *longirostris*; and if we may judge by the comparative difference between those bones in *longirostris* on the one part, and *Bucklandi* and *crassirostris* on the other, it may perhaps be fairly surmised that the greater length of wing would be found to exist in the long-nosed species, and consequently that *Bucklandi* will prove to belong to the short-nosed ones; and this also would seem to be indicated by what remains of the cervical vertebræ in the original specimen in the British Museum.

Prof. Owen, in treating of these animals in my late friend Mr. Dixon's work 'On the Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex,' has thought proper to re-name *P. giganteus*, and designate it *P. conirostris*, Owen. I certainly did not lend my specimens to my late friend Mr. Dixon for the illustration of his work, with a view of having the name which I had assigned to this new and gigantic species subverted, and without in the slightest degree being consulted on the subject. Nor can I concur with the reasons given by Prof. Owen for thus re-naming it, as the name *giganteus* was not given, as stated by the learned Professor, "because certain bones of another and larger animal, of a different species, have been erroneously referred to it;" but, in truth, from its being the largest distinct species at that time known, exceeding *P. Bucklandi* (or *Macronyx*) by two feet in the spread of its wings, and *P. grandis* of Cuvier by above a foot. The beautiful specimen of radius and ulna in the possession of Mrs. Smith, and subsequently figured in my second paper, was at that time unknown to me, and the bone then in the possession of the Earl of Enniskillen was claimed by the Professor as that of a bird. I had therefore no other material than that in my own possession on which to base my name of *giganteus*.

If the learned Professor's reason for the proposed change of name is to hold good, that of exclusive fitness in specific nomenclature, then the one he proposes is also inappropriate, as it might be with equal propriety given to either *crassirostris* or *brevirostris*; or if specific names, based on comparisons of size, are to be extinguished, and new names given on the discovery of new species, there would be no end of the confusion generated; thus, as *P. brevis* is thicker in its proportions than *crassirostris*, they would require to exchange names, or the latter at least to be re-named; *medius* would no longer be *medius*, with the addition of our new species, and *grandis* would no longer be grand in comparison. Into what an unenviable state of confusion

should we not plunge nomenclature if we were to adopt the *practice* of the learned Professor, instead of the precepts so judiciously laid down by himself and others of the Committee of Nomenclature of the British Association, and which I quote as a justification on my part for my refusal to adopt the learned Professor's exchange of my name for the one he has proposed !

In page 4 of the Report, under the head of "Law of Priority the only effectual and just one," we find the following passages :—"It being admitted on all hands that words are only the conventional signs of ideas, it is evident that language can only attain its end effectually by being permanently established and generally recognized. This consideration ought, it would seem, to have checked those who are continually attempting to subvert the established language by substituting terms of their own coinage." . . . . . "Now in zoology no one person can subsequently claim an authority equal to that possessed by the person who is the first to define a new genus or describe a new species ; and hence it is that the name originally given, even though it be inferior in point of elegance or expressiveness to those subsequently proposed, ought, as a general principle, to be permanently retained. To this consideration we ought to add the injustice of erasing the name originally selected by the person to whose labours we owe our first knowledge of the object." To these excellent principles the learned Professor has given the sanction of his signature. Prof. Owen, in the article on *Pterodactylus* in Mr. Dixon's work, has not quoted my observations on those Reptiles so fully as I could have wished ; inasmuch as he has adverted to the strongly-marked peculiarities of the bone-cells, which are the principal characters in the question at issue, in so slight a manner, as almost to induce me to imagine that he must have forgotten them entirely. I shall simply content myself in challenging Prof. Owen to produce any such general structure and proportions of the bone-cells from the skeleton of any recent or extinct bird as those existing in the long bone described as *Cimoliornis*, or to produce any such radius and ulna of a bird containing similar bone-cells as those in the possession of Mrs. Smith, and figured by me in my paper in the 'Quarterly Journal of the Geological Society for February 1848,' vol. iv. pl. 2.

On the subject of the strictures with which Prof. Owen has favoured me at the conclusion of his observations in Mr. Dixon's work, and how far I have been "wanting in a due comprehension of the subject, and have been a hindrance instead of a furtherance of true knowledge," I am content to leave to the judgement of those who may feel a sufficient degree of interest to induce them to peruse what I have written in my former papers on the Pterodactyles of the Chalk.

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