SKELETONS OF THE MONOTREMES IN THE COLLECTIONS OF THE ARMY MEDICAL MUSEUM AT WASHINGTON.

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Plates XVIII.-XXII.

[Originally written for the Hobart-Melbourne meeting of the Australasian Asscciation for the Advancement of Science, January, 1921]*

(Read before the Royal Society of Tasmania, 8th August, 1921.)

Attention was recently invited to the existence in the collections of the Army Medical Museum, of the Surgeon General's Office, at Washington, of the mounted skeletons of certain of the *Monotremata;* and as these curious mammals are now becoming extremely rare, a brief account of the specimens of them will probably prove of value to the comparative anatomists of the future, and of more or less interest to those of the present time. (1)

These skeletons consist of one of an Echidna, and two of the Duckbill *Platypus* or *Ornithorhynchus*. On the Echidna skeleton the label reads:—"2496 Comp. Anat. Ser.—Spiny "ant-eater; echidna aculeata or hystrix. From New South "Wales. The jaws are without teeth; roof of mouth and "tongue covered with horny spines." This is apparently an adult specimen, prepared and mounted by the Wards of Rochester, and in perfect condition. One of their labels is pasted on the under side of the stand and bears the number 3760 and the statement that the animal was obtained in New South Wales.

The better specimen of the two Duckbills was also prepared by the Wards; it is on a large, solid black-walnut stand without trimmings, and has their unnumbered label

*Owing to the Shipping Strike, the Meeting of the A.A.A.S., which was to have been held in Hobart in January, had to be held in Melbourne. It was found impossible to bring out the usual Report of the A.A.A.S. Meeting and to print all papers. Arrangements were, therefore, made for certain papers to be read before the Society and printed in the Papers and Proceedings for 1921.

(1) SHUFELDT, R. W.—"The Section of Comparative Anatomy of the "Army Medical Museum," *Medical Review of Reviews*, New York, Feb., 1919. Vol. XXV., No. 2, pp. 85-90, 4 figs. Presents a nearly complete list of the vertebrate skeletons in the Section at the time the article appeared.

on the under side, which simply states that it is an "*Ornitho-*"*rhynchus anatinus;* Ornithorhynchus, Australia." This is the larger of the Duckbills, and its Army Medical Museum label reads:—"1304 Comp. Anat. Ser.—Duck bill platypus "from Australia: ornithorhynchus anatinus." Finally we have the smaller skeleton of the *Ornithorhynchus*, in which the skull is broken. It is mounted on a pine board, painted black, and varnished. (Figs. 1 and 2.) It is altogether too long for the specimen, and has an amateurish appearance generally. Its Army Medical Museum label is as follows:—"2639 Comp. Anat. Ser.—Duck-bill male; or ornithorhynchus "paradoxus. From Brazil. The young have functional molar "teeth, but the adult has only transverse horny ridges to "strain the food from the water." (2)

All of these species of monotremes are now being exterminated in nature, especially in those sections of their habitats where man has occupied the country in the greatest numbers. This extermination is, in fact, being effected almost entirely through man's agency, which will fully account for the certainty and more or less rapid increase of the same, and its very probable complete accomplishment in time. As in the case of all other animals, the value of their skeletal remains enhances the nearer their complete extinction is approached; and we may be well assured that, in due time, these three skeletons, should they be preserved, will come to be extremely valuable material.

Not long after the first monotremes fell into the hands of working morphologists, accounts of their anatomy, and particularly their osteology, appeared in numerous places and languages. With the passing of the years, this literature became almost voluminous; while later on the subject was scarcely touched upon.

Pictorially, the bones of the skeleton in both the echidnas and the Duckbill Platypus have been figured a good many times, Sir Richard Owen being one of the heaviest contributors to this side of the subject. When Sir Richard wrote, however, the idea dominated his mind that the vertebrate skull was composed of four metamorphosed vertebræ, and

(2) Perhaps it will be just as well to note here the errors upon this label, to eliminate any chance of the reader of the article gaining the idea that they were made either by the author or the printer. There is no necessity for the word "or" before "ornithorhynchus," which latter should begin with a capital O. The animal does not come from "Brazil," and the horny ridges on its jaws are placed longitudinally and not "transverse." It is not likely that they are intended to "strain the food from the water," as any one will be convinced of by a casual examination.

R.W.S.

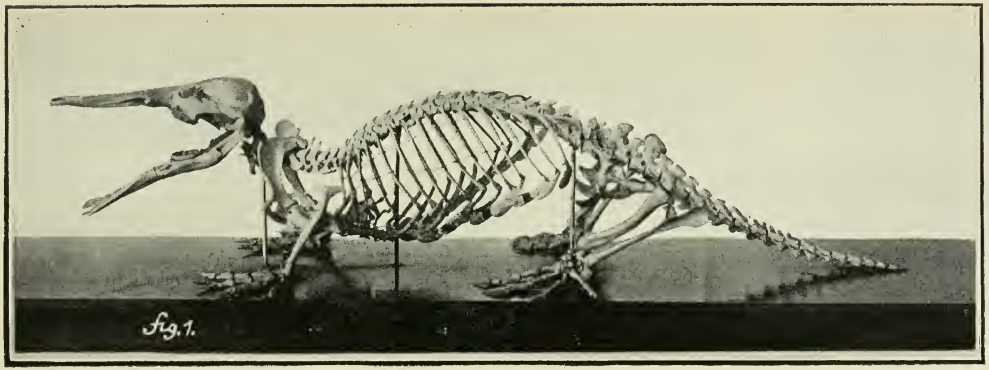

Fig. 1.

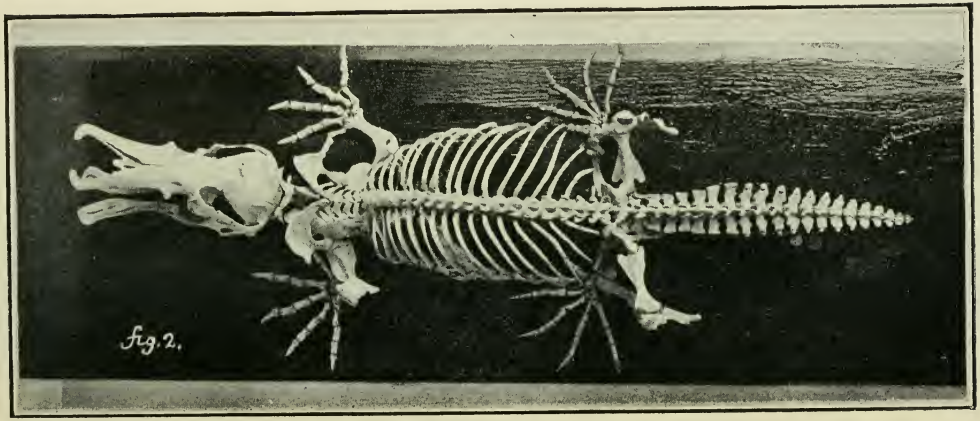

Fig. 2.

consequently ornithorhynchine osteology in his hands was duly stamped thereby. Nearly all the illustrations of these curious mammals were prepared by zoological draughtsmen, who, in many instances, knew little or nothing of osteology; the consequence was that this deficiency was reflected, to a greater or less extent, in their work. So far as my knowledge carries me, little or nothing has been done photographically with monotreme osteology; so the illustrations to the present paper should be especially acceptable to mammalian anatomists.

There is one prominent exception to this statement, however, and it is to be found in the admirable memoir by Dr. D. M. S. Watson on "The Monotreme Skull, a Contribu-"tion to Mammalian Morphogenesis." (*Phil. Trans. Ser. B.*, Vol. 207, March, 1916.)

Among the earliest works we have for consultation on the skeletology of this order of mammals, is the famous monograph by Dr. E. d'Alton, with its royal quarto plates and text matter. (3) About seventeen years after the appearance of this work, there was published in the third volume (1841) of *The Encyclopædia of Anatomy and Physiology* (1839-1847), pp. 366-407, Figs. 168-202, the extensive article by Owen on the *Monotremata*, in which he brought all the then known facts about the group up to date. In 1866, in his *Comparative Anatomy and Physiology of Vertebrates* (Vol. II., pp. 312-328), he included the revised account of the osteology of the Monotremes. We meet with various other contributions by the same author; but as they refer to other systems of anatomy of these animals, as well as to special organs and parts, and not to the skeleton, they need not be cited here.

Under the article *Mammalia*, *Platypus* and *Echidna* in the Ninth Edition of the *Encyclopædia Britannica*, Sir William Henry Flower sums up a large part of our knowledge of these animals (1883); while with respect to their skeletons, we find more detailed accounts in his *Osteology of the Mammalia* (3d. Ed., 1885).

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(3) D'ALTON, E., DR.—"Die Skelete der Zahnlosen Thiere," abgebildet und verglichen. Bonn, 1824 (In Commission bei Eduard Weber). Pt. I., No. 8. *Vorrede und Einleitung* occupies 4 pp. of text. *Allgemeine Vergleichungen des Skeletes der Zahnlosen Tiere*, pp. 4-10; p. 11, Description of Plates. Plate I., Skeleton: side view of Ornithorhynchus, nat. size. (Fairly good). II.: Bones of same and an oblique view of the skeleton. Skull to front. Right side shown. III.: Lateral view of skeleton of Echidna, IV.: Skull and other bones of Echidna. 21 figs. Large lithographic plates, and very good for the time. See also the celebrated work of

MECKEL.—*Ornithorhynchi paradoxi Descriptio Anatomica;* Fol. 1826.

Previous to studying these three skeletons of the monotremes in the Army Medical Museum collection—or in connection with their study—the works of Cuvier on the same subject were examined (Leçons d'Anat. Comp. 1837, II., p. 455), as well as the works of Mc. Eydoux and Lament, (4) Geoffrey (Mem. du Museum, tom. XV., p. 32); De Blainville on the Spur and Poison Gland (Bull. Soc. Philomatique, 1817); Blumenbach (Philos. Trans., 1800); Shaw (Naturalists' Miscellany, 1798, Gen. Zool., Vol. I., 1800); Voigt; Home (Philos. Trans., 1802, pp. 67, 356, 1819); Symington and Johnson, who wrote on the homology of the dumb-bell shaped bone in Ornithorhynchus (separate papers under the same title); and the various writings of Carl Gegenbaur. (5)

Of all the general manuals on the osteology of mammals, perhaps no two of them are in more constant use among the researchers of Great Britain, her Colonies, and the United States, than the second volume of Owen's *Comparative Anatomy and Physiology of Vertebrates*, and the last

(4) Voyage de la Favorite, 1839, tom. V., pl. 9, p. 161.

(5) The following are some of the works that appeared after the third edition of Flower's *Osteology of the Mammalia* in 1885; and through the kindness of Mr. Newton P. Scudder, the Librarian at the United States National Museum, these have all been carefully examined.

RUGE, GEORG, Prof. Dr. (Amsterdam)—"Das Knorpelskelet des aus-"seren Ohres der Monotremen—ein Derivat des Hyoidbogens." Mit 6 Figuren im Text. *Morph. Jahrb.* Leipzig, 1898; pp. 202-223, Figs. 1-6.

This memoir is very complete on the ear-bones.

FRETS, G. P.—"Uber die Entwicklung der Wirbelsaule von Echidna "hystix" (2 Teil), 14 figs. I Teii—Uber die Varietaten der Wirbel-saule bei erwachsenen Echidna, 1908, pp. 608-649. This is a very complete work, and on pp. 649-653 an excellent bibliography of the Monotremes is presented.

EMERY, C.—"Ueber Carpus und Tarsus der Monotremen." (Bologna). Pp. 222-223. Verhandlungen des Gesellschaft Deutscher Naturforchen und Arte. Leipzig, 1900.

Van BEMMELEN, J. F. (Communicated by Prof. C. K. Hoffman).—"Further results of an investigation of the monotreme skull." The Hague. I. Palate. Koninklijke Akad. van Wetenschaffen te Amsterdam. Proc. Sect. of Sciences. Vol. III., pp. 130-133. (June, 1901.) *Ibid.* (July, 1900), pp. 81. Zool. Mr. Hubrecht presents on behalf of Dr. J. F. Bemmelen "The results of comparative investigations "concerning the palatine, orbital, and temporal regions of the Mono-"treme skull." (This paper preceded the one last given.) *Ibid.* (pp. 405-407). Third note concerning detail of the Monotreme skull. The Hague. Comm. by Prof. A. A. W. Hubrecht. (Ethmoid and maxillo-turbinate). On p. 133 of the June, 1901, paper, there is presented a figure of "Echidna hystrix; floor of the cerebral cavity, "left side, inner aspect, 2/1." (This is an excellent wash drawing, giving bones, sutures, etc.) On pp. 405-407 in this series, the writer quotes O. Seydel and W. N. Parker "On some points in the struc-"ture of the young *Echidna aculeata*." (P.Z.S., 1894.) He also quotes Symington's paper "On the nose, the organs of Jacobson, "and the dumb-bell-shaped bone in the Ornithorhynchus." P.Z.S., 1891, p. 575. (See also Gegenbaur, Harwood-Wiedermann and Zuckerkandl.) See also Verhandlungen des V. Inter. Zool. Cong. zu Berlin, vom. 12-16 Aug., 1901, pp. 596-597. (Discussion). "Ueber das "Ospraemaxillare der Monotremen." Von J. F. van Bemmelen.

fig. 3.

fig. 6.

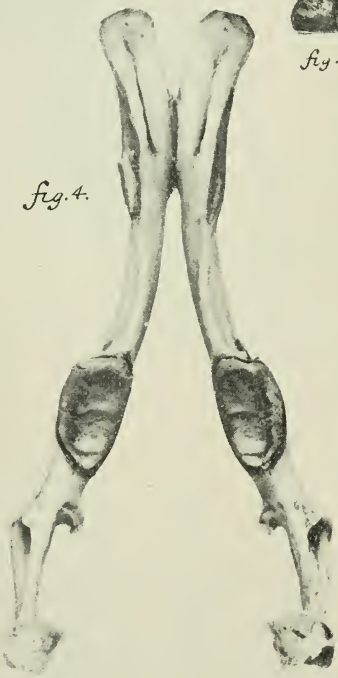

fig. 4.

d

fig. 5.

edition of Flower's *Osteology of the Mammalia*. To be sure, there are a great many special monographs on the skeletology of mammals that are constantly consulted in this line of investigation; but these are not in the same class with a *manual* on the subject—one that essays to give succinct accounts of the bones of the skeleton of mammals in general, such as do the two works mentioned above.

The Skull in the Adult Duckbill:—As has already been pointed out by a number of writers on this part of the skeleton in *Ornithorhynchus*, the sutures among the several bones composing it are almost entirely obliterated in the adult, and this is distinctly the case with respect to the skulls of these specimens in the Army Medical Museum. Owen gives us the superior view of the skull of a young Duckbill, wherein the sutures among the bones are in evidence, and it is a very useful cut. (Fig. 205, p. 321).

At *d* in Figures 5 and 9 we have a full view of the much discussed "dumb-bell shaped bone" of authors. Owen speaks of this as a "small prenasal ossicle" (p. 322); while Flower states that "There is a distinct median dumb-bell shaped "ossification in the triangular interval between the diverging "premaxillary bars, placed in front of the anterior extremity "of the mesethmoid cartilage, on the palatal aspect of the "jaw. This bone is not the homologue of the so-called pre-"nasal of the Pig"; but "it corresponds with that part of "the intermaxilla which lies between the incisive canal and "the mesial palatal suture." (6) (Pp. 243, 244.)

The distal ends of the *premaxillaries* are turned inwards, toward each other and almost at right angles, the interval being about a centimetre. This interval is spanned by a strong, flat ligament, and it is joined, posteriorly, by another ligament, running from the dumb-bell-shaped bone in the median line as shown in Figure 5 of Plate XIX.

On the ventral aspect of the anterior moiety of either maxillary, there is, upon either side, a very shallow, longitudinal groove about two centimetres in length. Horny, pseudo teeth are attached to either of these as shown in Figure 9 of Plate XX. The far more formidable pair is situated considerably further back, each occupying the ventral surface of a *maxillary* upon either side. In the dried skull these structures can easily be pried off, whereupon

(6) TURNER, W.—"The dumb-bell-shaped Bone in the Palate of Orni-"thorhynchus compared with the prenasal Bone of the Pig." (Journ. Anat. Phys., XIX., 1885, p. 214.)

ALBRECHT, P.—"Sur la Fente Maxillaire et les quatre Os Intermaxil-"laires de l'Ornithorynque." Bruxelles, 1883.

each has the appearance of Figure 6 of Plate XIX. They take the place of the molar teeth, which, as Flower states, upon either side rest upon the zygomatic process of the maxilla, which is widened inferiorly into an oblong, concave, roughened surface for their attachment. Owen claims that *Ornithorhynchus* has no true malar bone. (P. 322.)

Viewed superiorly, it will be seen that for the most part the cranium of this monotreme is smooth and flat, especially the part anterior to the orbits. There is a conspicuous foramen, on either side, piercing the nasal with a groove leading from it to the front. Laterally, and opposite the broad, thin, and transversely compressed zygoma, the side of the cranium is marked by the temporal fossa; it is shallow, and of equal depth throughout its extent. The narrowest part of the cranium is immediately anterior to this fossa. In the post-basitemporal region there is a pair of large, elliptical foramina, with another smaller pair between them and the posterior nasal apertures.

Between the molar teeth, the surface of the basis cranii is smooth and concaved. On either side may be seen the posterior palatine foramina (Fig. 9), which, next to the interorbital diameter, is the narrowest part of the face. This latter is much flattened, and from behind, forwards, becomes gradually broader, to terminate distally as described in a previous paragraph and here well shown in Figure 5 of Plate XIX. "The infraorbital foramen," as Flower points out, "is "very large, corresponding to the large size of the nerves "distributed to the sensitive sides of the beak. The periotic "has a wide and deep floccular fossa."

The skull belonging to skeleton No. 2639 of the Army Medical Museum has long been broken in two—a fracture that now admits of a view of the interior of the brain case through the absence of the entire anterior wall.

With respect to the general form of the cranial casket, the figures on the plates present more than can be gained through any amount of description. In its interior there is to be noted, however, the small olfactory fossa, pierced at its base by twin foramina, placed side by side transversely. The anteriorly concaved wall rises behind this, the outer angles of which exhibit well developed, posterior *clinoid processes*. Falx cerebri are faintly pronounced and well ossified, especially the postero-median one, which is more or less prominently produced. There appear to be considerable differences in the outline of the *foramen magnum* of the *Ornithorhynchus;* for in the smaller specimen of these two

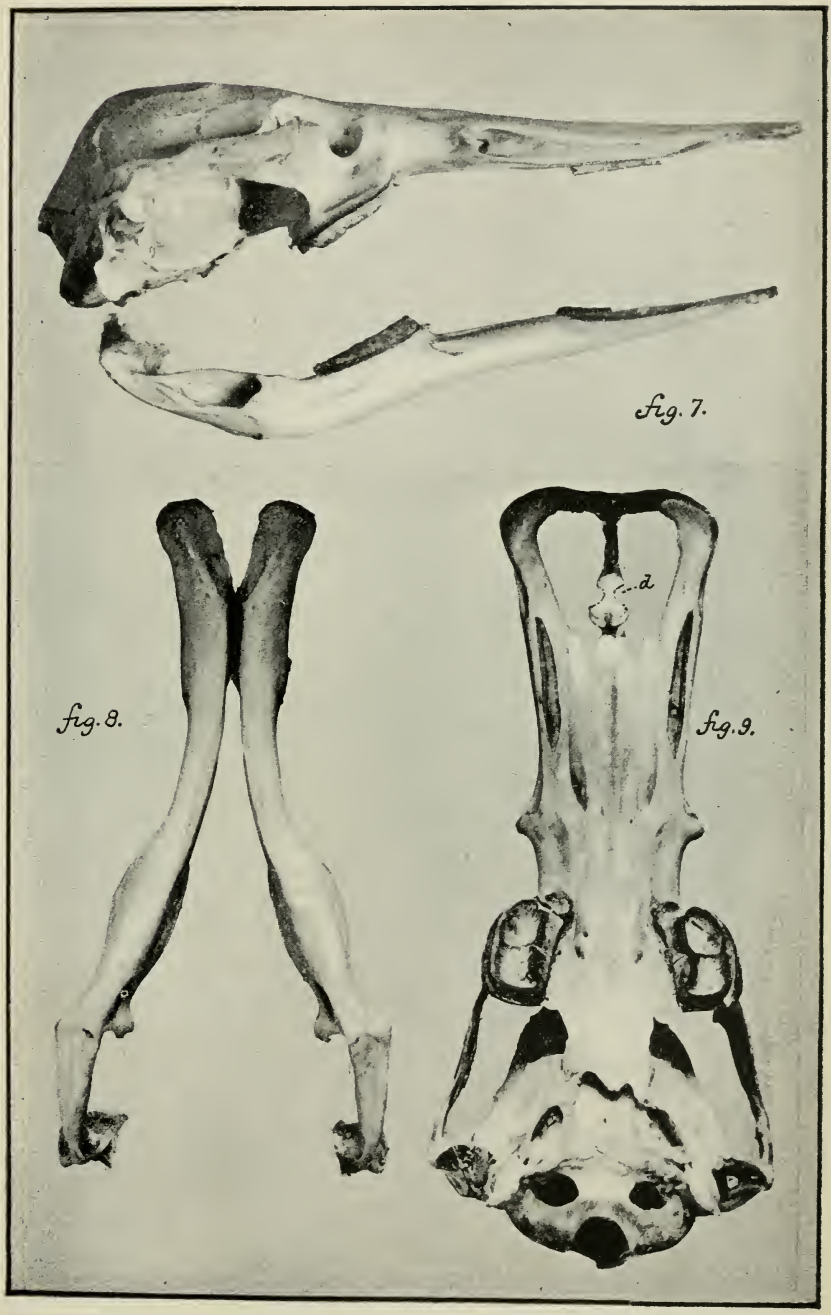

fig. 7.

fig. 8.

fig. 9.

(2639) this is broad and elliptical, with the major axis horizontal, while in the other specimen it is almost circular. More than this, in the first specimen mentioned there is a well-marked "supraoccipital foramen" present, which is pierced by an elliptical foramen, placed vertically, that opens mesially below by an extremely narrow strait into the superior arc of the foramen magnum. At either side of the cranium the *glenoid fossa* is very pronounced and markedly concave transversely.

As Owen has pointed out, "the *vomer* forms a bony, ver-"tical septum, dividing the nasal cavity from the presphenoid "forward."

Whoever prepared these Army Medical Museum specimens failed to preserve the *hyoidean apparatus* in either of them, so no description of it can be furnished here. Sir Richard Owen does not appear to have described this for either the Echidna or the Duckbill; while Sir William H. Flower, in his "Manual," gives a very excellent cut of the lower surface of the hyoid of the Echidna *(E. aculeata)*, and briefly describes it in the text (pp. 242, 243). At this writing I have not at hand a figure and description of the hyoid in *Ornithorhynchus*.

Figures 4, 7, and 8 of the accompanying plates present the three principal views of the *mandible* of the Duckbill; and these, taken in connection with the admirable description by Owen of this remarkable bone (p. 321), leave practically nothing to be desired on this point.

The Shoulder-girdle and Sternum:—Both Owen and Flower, in their above-cited work, give quite full accounts of the *shoulder-girdle* and *sternum* in an Echidna and the Duckbill; these accounts are illustrated for the last-named animals, the differences being given in the text. Upon carefully comparing these two descriptions with the corresponding bones of the skeletons at hand, I find that they practically agree in all essential particulars. These parts, in fact, have long been known to comparative anatomists—that is, since Flower published on the subject, for Owen's description is very meagre and unsatisfactory.

Attention is invited to the different way in which the *scapulæ* have been mounted in the two skeletons of the Duckbill. The bones are far apart in No. 1304, while in No. 2639 the upper thirds of these bones have not only been brought, upon either side, flat against the cervical ribs, but actually *wired* in that position. It would appear from the articulations that neither of these is quite correct, and doubtless it is

a point that can only be settled through an examination of an adult specimen in the flesh. Personally, I very much doubt that the bones are closely adpressed to the cervical ribs as in the skeleton 2639 (see Fig. 11 for the Echidna).

"In the Monotremata the *Ornithorhynchus*," says Flower, "has a broad presternum, with a small, partially "ossified *pro-osteon* in front of it; three keeled mesosternal "segments, which commence to ossify in pairs, and no xiphi-"sternum, which in *E. bruijni* consists of three metameric "portions.

"The T-shaped bone, *interclavicle* or *episternum* in front "of the presternum, which connects it with the clavicle and is "often completely fused with it, appears to have no homo-"logue among the other Mammalia, and belongs more pro-"perly to the shoulder-girdle than to the sternal apparatus" (pp. 104, 105).

The Vertebral Column and Ribs:—Judging from the accounts of various anatomists, the vertebræ and the ribs in the Echidnas and the Duckbill are subject, with respect to number, to very considerable variation in different individuals. (7)

In the work of G. P. Frets, cited above, there are tables presenting the great variation in the number of vertebræ in the Echidna—and so it goes for other authorities.

Flower gives us the following table (p. 89):—

MONOTREMATA.

Species.	Cervic.	Thorac.	Lumb.	Sacral	Caudal
Echidna—					
Aculeata . . .	7	16	3	4	11
Bruijni	7	16	4	3	10
Ornithorhynchus anatinus	7	17	2	3	20

Owen makes a brief statement to the effect that "both "the genera have twenty-six 'true vertebræ,' of which seven "are cervical; but the Ornithorhynchus has seventeen and "the Echidna sixteen dorsals, the lumbar vertebræ being "three in the latter, and reduced to the lacertian number two "in the *Ornithorhynchus*," to which statement he makes no exceptions (p. 316).

(7) BROWN, R., M.B., B.Sc.—"Note on an Echidna with eight vertebræ." *Proc. of the Linn. Soc. of New South Wales*, 1900. Vol. XXV., Sydney, 1901. One cut. "Dorsals vary from 14 to 17; lumbars 2 to 4; "sacrals 3 to 4; caudals 10 to 14." This authority also gives some important notes on the *ribs* of the monotremes.

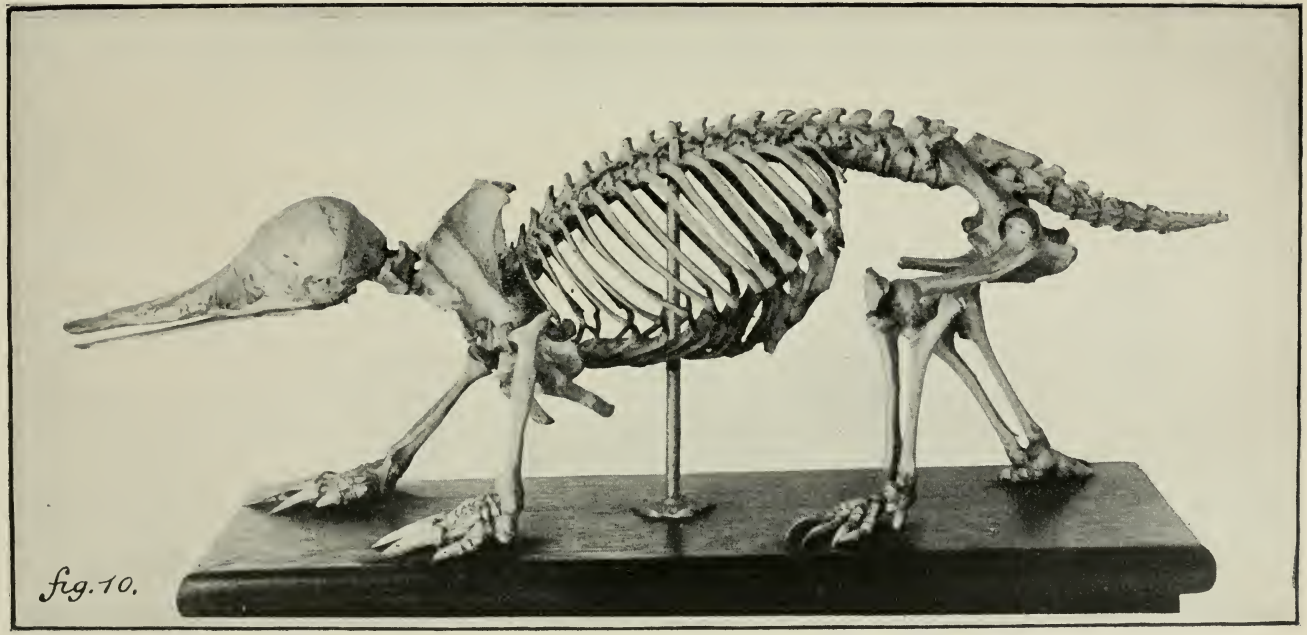

fig. 10.

Owen further states that "the sacrum consists of two "vertebræ in *Ornithorhynchus* and three in the *Echidna*. "There are thirteen caudal vertebræ in the Echidna, Fig. "201. The first is the largest, with broad transverse pro- "cesses, the rest progressively diminishing, and reduced, in "the six last, to the central element. The *Ornithorhynchus*, "Fig. 199, has twenty-one caudal vertebræ, of which all but "the last two have transverse processes, and the first eleven "have also spinous and articular processes" (p. 317). The cuts cited are the old figures that illustrated Owen's article on the Monotremes in the third volume of the *Cyclopædia of Anatomy* (1841); they are very crude, especially the one of the Echidna, wherein the number of vertebræ do not agree with the number for the Echidna given in the text, and the cervico-dorsal regions of the spine are altogether too straight.

Flower, in his above cited table, points out that one species of Echidna has eleven caudal vertebræ, and another ten; while in the text in the same work (p. 77) he says:— "The Echidna has 12 caudal vertebræ." Again, in the table, he states that the *Ornithorhynchus* has 20 caudals, while in the text—same page—he informs us that this monotreme "has 20 or 21 caudal vertebræ."

On page 68 he again says that "the Ornithorhynchus has "2 ankylosed sacral vertebræ, and the Echidna 3 or 4." In the table he gives the Ornithorhynchus 3 sacral vertebræ. These discrepancies occur throughout the literature of the subject.

Turning to the vertebræ and ribs of these three Army Medical Museum specimens (Figs. 1, 2, 10, and 11), we find, in the specimen No. 1304, 17 pairs of ribs, the six anterior ones of which articulate with the sternum through sternal or costal ribs. The leading pair of these costal ribs articulate with the extreme outer angles of the presternum; while the last pair, which are very thick for their anterior moieties and more or less flattened posteriorly, articulate with the ultimate joint of the true sternum. Following these, we have 8 ribs that articulate below with costal ribs, the latter being free, very broad, and compressed from above, downwards. Finally, in the last three pairs of these thoracic ribs are "floating ribs," the last pair being but half the length of the first pair, while the midpair is intermediate in length between these and the first pair. This specimen has *seven* cervical vertebræ; seventeen dorsals; two lumbars; four sacrals; and twenty caudals (counting the terminal one which has been lost).

Turning to the smaller skeleton of these two Duckbills (No. 2639), it is to be noted that the sternal and costal ribs and the vertebræ agree entirely with those of No. 1304, with respect to number and characters.

In his *Osteology of the Mammalia*, Flower has quite fully described the vertebræ of the entire spinal column in the Echidna and the Duckbill; and I find that the specimens here under consideration in no way depart from those descriptions. In these two specimens of *Ornithorhynchus* the *odontoid process* has thoroughly united with its proper vertebræ, which is very good evidence that they are well along in life; and notwithstanding the fact that No. 1304 is much the larger of the two, both having highly developed *spurs* would point toward their both being males.

The *Skull* in the Echidna at hand departs in no way from the descriptions of that part of the skeleton as given by Flower, Owen, and other eminent comparative anatomists, and this is also true of the *sternum* and *shoulder girdle*. The general outline of an Echidna's skull is well shown here in Figures 10 and 11. It is noted for its very feeble and delicately constructed mandible and the general lack of character of the cranium, which is quite devoid of the usual salient apophyses, marked fossæ, and conspicuous foramina.

In the *Ornithorhynchus* the sacrum is of much feebler build than it is in the Echidna, while in both its hinder portion makes an acute angle with the chain of caudal vertebræ. All that Owen has to say about this bone is that "the "sacrum consists of two vertebræ in the *Ornithorhynchus*, "and of three in *Echidna*" (p. 317).

As all three of these skeletons are of adult specimens, it is not possible to decide whether in any of them an *os acetabuli* is present or not. Flower evidently entertained the opinion that the Monotremata lacked this "fourth pelvic "bone," and says of it in general that "its morphological "meaning is as yet unknown, but it can scarcely be consid- "ered as an epiphysis." This authority's description of the *pelvis* in the monotremes agrees with that bone as exemplified in these Army Medical Museum skeletons; he states that "in "the *Monotremata* the pelvis is short and broad. The ilia "are short, distinctly trihedral and everted above. The "ischia are large, and prolonged into a considerable back- "ward-directed tuberosity. The symphysis is long, and "formed about equally by pubes and ischium. The thyroid "foramen is round. The acetabulum is perforated in *Echidna* "as in birds, but not in *Ornithorhynchus*. The pectinal

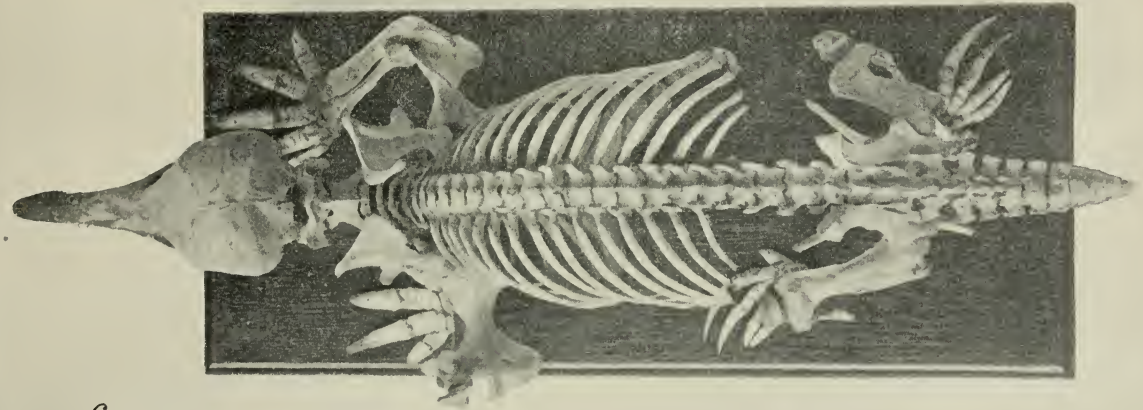

fig 11.

"tubercle is greatly developed. There are large 'marsupial' "bones in both genera." These in *Echidna* are longer, narrower, and more divergent than they are in the Duckbill, where they are triangular and broad at their bases. The *sacral vertebræ* fuse with the pelvic bones in these monotremes, and the suture of the pubic symphysis is almost obliterated.

The *Bones of the Limbs* in the *Ornithorhynchus* and the *Echidna* are very fully and quite accurately described by Owen (pp. 323-328), while Flower gives us scarcely anything on the long bones of the pectoral and pelvic limbs, having devoted the most of his space and descriptive matter to *manus* and *pes*, the bones of which are touched upon more or less fully.

In another connection later on it is my intention to take up more in detail some of the special skeletal characters, as exemplified in the *Monotremata*—that is, those that do not fall especially within the scope of the present contribution.

LEGENDS FOR THE FIGURES.

Plate XVIII.

Fig. 1. Left lateral view of the skeleton of an adult *Ornithorhynchus anatinus*, No. 2639, Army Medical Museum Collection; male; reduced.

Fig. 2. The same skeleton as shown in Fig. 1, seen directly from above.

Plate XIX.

Fig. 3. Superior view of the skull of the specimen of the *Ornithorhynchus* shown in Figure 1 of Plate XVIII. (No. 2639, Army Medical Museum Collection.) Lower mandible removed. Zygoma of right side missing. Reduced.

Fig. 4. Mandible of the adult *Ornithorhynchus* viewed directly from above; reduced; male. Specimen No. 1304, Army Medical Museum Collection.

Fig. 5. Superior view of the skull of an adult male *Ornithorhynchus anatinus;* reduced. Specimen No. 1304, Coll. Army Medical Museum. This is the skull to which the mandible here shown in Figure 4 belongs. The "dumb-bell-"shaped" bone is plainly shown at *d*, between the premaxillary bones, which latter are nearly out of sight below the nasals.

Fig. 6. Horny "tooth" from the left side of the mandible of the specimen shown in Figures 1 and 2 of Plate XVIII.; reduced; superior aspect.

Plate XX.

Fig. 7. Right lateral view of the skull and detached mandible of an adult male *Ornithorhynchus anatinus*. Specimen 1304 Collection Army Medical Museum. Compare with Figure 4 of Plate XIX. (above), Figure 8 of this Plate for the mandible, and Figures 5 and 9 for the skull.

Fig. 8. Inferior or ventral aspect of the mandible shown in Figure 7; reduced. (See Fig. 4, Plate XIX.)

Fig. 9. Ventral view of the skull of *Ornithorhynchus;* reduced. Same skull as shown in Figure 5 of Plate XIX. (Collection Army Medical Museum.)

Plate XXI.

Fig. 10. Left lateral view of the skeleton of an *Echidna* (*Tachyglossus*) *aculeata*. Sex? Slightly less than one-half natural size. No. 2639, Coll. Army Medical Museum.

Plate XXII.

Fig. 11. Direct view from above of the skeleton of an *Echidna* (*Tachyglossus*) *aculeata*. Slightly less than one-half natural size. Same specimen as shown in Figure 10 of Plate XXI. of the present article.