

column in the Penguins, as compared with that of other birds, are referrible to two points. Firstly, the freely moveable character of the articulation of these with one another, and secondly, the opisthocœlous character of certain of the vertebræ.

In the majority of birds the dorsal vertebræ are more or less firmly anchylosed with one another by means of their bodies, spines, and transverse processes, whereas in the Penguins, as first pointed out by Meckel,<sup>1</sup> these structures are freely moveable upon one another, and consequently the dorsal segment of the vertebral column is devoid of that rigidity which characterises it in other birds. This arrangement is perhaps explicable, as pointed out by Owen, by the fact that, the Penguins being incapable of flight, there is no necessity for that extreme rigidity of the dorsal region which is met with in those birds in which the powers of flight are largely developed, and in which, therefore, the dorsal region "has almost exclusively to sustain the shock of the violent contractions of the principal muscles of the wings." It should, however, be remembered that as the wings are the principal agents used by the Penguin in propelling itself through the much denser medium of water, there may possibly be need of some further explanation of the arrangement referred to.

The opisthocœlous character of the vertebræ among birds is, so far as I can ascertain, confined to the Auks and Penguins.<sup>2</sup> It was first demonstrated by Owen<sup>3</sup> in *Aptenodytes*, and has since been recognised in other genera of Penguins. So far as my own observations extend, it obtains in every species of Penguin.

#### *Lumbo-Sacral Vertebræ*

Under the name of lumbo-sacral, I include all the vertebræ which are interposed between the last dorsal vertebra (characterised by articulation with the last pair of vertebral ribs), and the first moveable coccygeal vertebra. Thus defined the lumbo-sacral vertebræ are twelve in number. The bodies of all these vertebræ in the adult are anchylosed with one another as well as with that of the last dorsal vertebra, to form a single osseous mass, the composition of which is only rendered evident by the presence of the intervertebral foramina. The bodies of these vertebræ, seen from below, form a single osseous lozenge-shaped mass, the widest portion of which is situated immediately in front of the acetabulum, from which point the bodies of the vertebræ diminish in breadth both forwards and backwards. In front of the widest part the bodies form a sharp osseous keel, while behind that point the vertebræ diminish in breadth to that of the bodies of the proximal coccygeal vertebræ. The bodies of the lumbo-sacral vertebræ are altogether devoid of hypapophyses.

The apices of the *transverse processes* of all the vertebræ of this region, with the ex-

<sup>1</sup> *Traité général d'anatomie comparée*, vol. iii., partie 1, p. 38.

<sup>2</sup> *Cyclopædia of Anatomy*, Art. "Aves," vol. i. p. 271.

<sup>3</sup> Owen, *Anatomy of Vertebrates*, vol. ii. p. 16.

<sup>4</sup> *Cyclopædia of Anatomy*, Art. "Aves," vol. i. p. 270.