

terially to the lightness of the fabric.* All these cells are very large and numerous in birds which perform the highest and most rapid flight, such as the eagle. The bill of the *Toucan*, which is of a cellular structure, and also the cells between the plates of the skull in the *owl*, are, in like manner, filled with air, derived from the lungs: the barrels of the large quills of the tails and wings are also supplied with air from the same source.

In birds, then, the air is not merely received into the lungs, but actually passes through them, being drawn forwards by the muscles of the ribs when they elevate the chest, and produce an expansion of the subjacent air-cells. The chest is depressed, for the purpose of expiration, by another set of muscles, and the air driven back: this air, consequently, passes a second time through the lungs, and acts twice on the blood which circulates in those organs. It is evident that if the lungs of birds had been constructed on the plan of those of quadrupeds, they must have been twice as large to obtain the same amount of aeration in the blood; and consequently must have been twice as heavy, which would have been a serious inconvenience in an animal formed for flying.† The diffusion of so large a quantity of air throughout the body of animals of this class presents an analogy with a similar purpose apparent in the conformation of insects, where the same object is effected by means of tracheæ.‡

* In birds, not formed for extensive flight, as the gallinaceous tribes, the humerus is the only bone into which air is introduced.—Hunter on the Animal Economy, p. 81.

† I must mention, however, that the correctness of this view of the subject is contested by Dr. Macartney, who thinks it probable that the air, on its return from the large air-cells, passes directly by the large air-holes into the bronchia, and is not brought a second time into contact with the blood.

‡ The peculiarities of structure in the respiratory system of birds have probably a relation to the capability we see them possess, of bearing with impunity, very quick and violent changes of atmospheric pressure. Thus, the Condor of the Andes is often seen to descend rapidly from a height of above 20,000 feet, to the edge of the sea, where the air is more than twice