PROCEEDINGS OF

THE ROYAL SOCIETY.

Section B.—Biological Sciences.

The Causes of Absorption of Oxygen by the Lungs in Man. (Preliminary Communication.)

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(Received February 23,—Read March 23, 1911.)

In a previous communication* we gave a short account of experiments on mice, showing, by the carbon monoxide method of determining the partial pressure of oxygen in the arterial blood, that when want of oxygen is produced by administering to these animals a relatively high percentage of carbon monoxide in the air breathed, active secretion of oxygen inwards through the lung epithelium occurs, although in resting animals the passage inwards of oxygen is apparently due to nothing but simple diffusion.

It was very desirable to extend these experiments to man, as the main chemical factors in respiration can be much more satisfactorily investigated in man than in lower animals, and we have now succeeded in obtaining a number of results in man. In the case of a man it would require many hours to complete an experiment made by exactly the same method as was employed for mice and rabbits. We have therefore adopted the plan of first rapidly administering sufficient carbon monoxide to bring the blood to the required degree of saturation with the gas, and then allowing the subject to breathe into a closed space of about 15 litres, in the air of which the carbon dioxide is absorbed and the oxygen kept constant on the principle of Regnault and Reiset. The partial pressure of carbon monoxide in this air becomes equal in a few minutes to that in the blood, and part of this air is thereafter used for saturating the sample of the subject's blood,

* 'Roy. Soc. Proc.,' B, 1910, vol. 82, p. 331.

the principle of the experiment being otherwise the same as in the experiments on animals.

The following results have been obtained:—

(1) During rest under normal conditions, and provided that the blood is not more than about 25 per cent. saturated with carbon monoxide, the partial pressure of oxygen in the arterial blood is practically identical with that in the alveolar air. This result accords completely with the theory that under these conditions the absorption of oxygen is by diffusion alone.

(2) When the percentage of oxygen in the inspired air is lowered sufficiently (or the saturation of the blood with carbon monoxide is increased sufficiently) to cause appreciable symptoms of want of oxygen, the partial pressure of oxygen in the arterial blood becomes very considerably higher than in the alveolar air. Active secretion of oxygen inwards is therefore occurring, as was formerly concluded by Haldane and Lorrain Smith from experiments on mice. We find, however, that Haldane and Lorrain Smith's results require a considerable and at present somewhat uncertain correction.

(3) During muscular work also, unless the work was of a comparatively gentle kind, a similar result was obtained, and muscular work with the inspired air poor in oxygen seemed to produce a specially striking effect.

Taken together, the results indicate that the lung epithelium is excited directly or indirectly to active secretion of oxygen inwards by products of metabolism proceeding from the muscles and other tissues when their oxygen supply is insufficient to meet ordinary requirements. That such insufficiency actually occurs during muscular work, and when air with a low partial pressure of oxygen is breathed, has already been shown.* These results are of special interest in connection with the phenomena of adaptation to very high altitudes, and throw a new light on the physiology of mountain climbing and balloon ascents, and of ordinary muscular work.

* Geppert and Zuntz, 'Pflüger's Archiv,' 1888, vol. 42, p. 189 ; Boycott and Haldane, 'Journ. of Physiol.,' 1908, vol. 37, p. 355 ; Ogier Ward, *ibid.*, vol. 37, p. 378 ; Haldane and Poulton, *ibid.*, vol. 37, p. 390 ; Douglas and Haldane, *ibid.*, 1909, vol. 38, p. 420 ; Ryffel, *ibid.*, vol. 38, p. 29 ; Boycott and Chisolm, ' Biochemical Journ.,' 1910.