oxygen inhaled in the presence of 5% CO_2 did not produce any significant changes in threshold. Control experiments with inhalation of 5% CO_2 in air showed no change in threshold. These experiments are in agreement with the earlier work of Gellhorn and collaborators on the effect of oxygen deficiency and CO_2 on cortical and subcortical reflexes.

The pupillary reaction on the normal and the sympathectomized side was observed independently and simultaneously by 2 observers. The threshold was the same on both sides. The humoral excitation of the pupil occurs only with far stronger and more prolonged stimulation and is distinguished from the quick reaction observed in our experiments by its longer latent period and duration. Therefore it may be concluded that the pupillary reaction under the conditions studied is due to an inhibition of the parasympathetic center of the third nerve. The experiments show that excitatory and inhibitory processes are altered in a similar way under oxygen deficiency.

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Rôle of Afferent Nerves in Response of Vasomotor Center to Oxygen Deficiency.*

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Through numerous investigations it is known that the increased respiratory response to CO_2 is due less to its effect on peripheral receptors than on the respiratory center itself, whereas a similar response to oxygen deficiency occurs only when the carotid sinus nerves are intact. The removal of the afferent fibers by elimination of all known "buffer nerves" results in a failure of respiration during O_2 deficiency (Selladurai and Wright,[1] Schmidt,[2] v. Euler and

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1 Selladurai, S., and Wright, S., *Quart. J. Exp. Physiol.*, 1932, **22**, 233.

2 Schmidt, C. F., *Am. J. Physiol.*, 1932, **102**, 94.

Liljestrand,[3] Smyth,[4] Gemmill and Reeves,[5] and Wright,[6] but *cf.* Dautrebande and Wegria[7]). Under such circumstances the blood pressure reaction to O_2 deficiency may also be converted from the rise obtained in the intact animal to a fall (Selladurai and Wright,[1] and Brewer[8]). However, the question whether the organization of the vasomotor center is similar to that of the respiratory center can only be investigated when the respiration is kept constant and thereby secondary effects of a reduced respiratory volume eliminated.

Such studies were carried out on narcotized dogs (Na-barbital, Na-amytal, chloralosane) with pneumothorax and artificial respiration. O_2-N_2 gas mixtures (1.0 to 9.8% O_2) were prepared by means of flowmeters, analyzed and inhaled from Douglas bags for periods of from 1 to 3 minutes and the blood pressure effects were recorded. After the control reaction consisting of a rise in blood pressure was obtained both vagi were cut in the neck and both carotid sinus regions were denervated. Hereafter the same O_2-N_2 mixture was inhaled and invariably an immediate fall of blood pressure was observed which occured regularly no matter whether the blood pressure level was unchanged, higher or lower than under the control conditions.

It was then attempted to show the importance of the various buffer nerves to account for this reversed reaction. Several experiments were carried out in which the effect of low oxygen on the blood pressure was studied, (1) in the normal animal, (2) after bilateral vagotomy, (3) after bilateral denervation of the carotid sinus. It was found that neither the elimination of the carotid sinus nor the bilateral vagotomy alone brought about a reversal in the blood pressure response to oxygen deficiency but that this was the case only when the two procedures were combined. The sequence was immaterial. Some experiments indicated that bilateral denervation of the carotid sinus region plus section of the nerves of Cyon reversed the blood pressure response to low oxygen, but even in these cases additional bilateral vagotomy produced a still greater fall in blood pressure.‡

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3 v. Euler, U. S., and Liljestrand, G., *Skand. Arch. Phys.*, 1936, **74**, 101.

4 Smyth, D. H., *J. Physiol.*, 1937, **88**, 425.

5 Gemmill, C. L., and Reeves, D. L., *Am. J. Physiol.*, 1933, **105**, 487.

6 Wright, S., *Quart. J. Exp. Physiol.*, 1937, **26**, 63.

7 Dautrebande, L., and Wegria, R., *Arch. int. de Phys.*, 1937, **44**, 425.

8 Brewer, N. R., *Am. J. Physiol.*, 1937, **120**, 91.

‡ Undoubtedly, a variable number of aortic fibers are not restricted to the depressor nerve, but run in the vagus and cervical sympathetic as in the rabbit and cat (Koch, E., *Die reflektorische Selbsteuerung des Kreislaufes*, Dresden and Leipzig, 1931).

Under all the above circumstances inhalation of air containing an excess of CO_2 (4-15%) caused a rise in blood pressure and not infrequently after denervation the reaction to excess CO_2 was even increased.

Furthermore, it was ascertained that the vagus fibers which account for the maintenance of the blood pressure rise in response to low oxygen even after bilateral denervation of the carotid sinus region carry impulses from the thorax and not from the abdominal cavity. This is shown by the fact that the division of the vagi at the level of the diaphragm does not interfere with the normal blood pressure response to oxygen deficiency in a dog with both carotid sinus regions denervated.

A crucial experiment may be described briefly. A rise in blood pressure was observed after inhalation of 5.5% oxygen for 2 minutes in a normal dog, after bilateral denervation of the carotid sinus region, and after section of one vagus nerve. The significance of the remaining intact vagus was demonstrated by the observation that the cooling of these fibers produced a reversal in the response to low oxygen. When the conduction in these fibers was restored by a gradual restoration of the normal temperature the original response was reëstablished. This procedure could be repeated several times with equal success. If finally the vagus was cut, the fall in blood pressure was still greater than that observed when the nerve was blocked by cooling.

The experiments prove that the rise in blood pressure on inhalation of low oxygen is due to the effect on the chemoreceptors in the carotid sinus regions and the thorax. After these receptors are eliminated the vasomotor center is depressed by oxygen deficiency in a manner similar to that of the respiratory center. Neither the respiratory nor the vasomotor center, when investigated after exclusion of afferent fibers, react differently from cortical and subcortical centers which show in general a decrease in excitability under the influence of low oxygen.[9]

[9] Gellhorn, E., and Spiesman, I., *Am. J. Physiol.*, 1935, **112**, 519, 620, 662.