

oxygen of the atmosphere on the spinal cord, the paralysis of the blood-vessels of this organ, and the state of rest of the muscles and motor nerves of the limb.

If we compare the side of the face where the sympathetic has not been divided, with the posterior limb on the uninjured side of the spinal cord, we find that they also have a great many points of resemblance. They both receive less blood than usual, their temperature diminishes, their nutrition is less active, and their vital properties also diminish.

IV. "Experimental Researches on the Influence of Efforts of Inspiration on the Movements of the Heart." By E. BROWN-SÉQUARD, M.D. Communicated by JAMES PAGET, Esq., F.R.S. Received June 25, 1857.

A very interesting fact, of which many circumstances have been carefully investigated by Professor Donders and Dr. S. W. Mitchell, has received a wrong explanation from those physiologists. This fact consists in a diminution of either the strength or the frequency of the beatings of the heart, when an energetic effort at breathing is made and maintained for half a minute or a little more. Professor Donders thinks that this influence of inspiration on the heart is due to a mechanical agency of the dilated lungs on this organ.

They admit that the state of the lungs has a great influence on the heart, but the principal cause of the diminution in the movements of this organ is very different from what has been supposed by Professor Donders, by Professor J. Mueller, and others. It is known that when the medulla oblongata, or the par vagum are excited (either by galvanism, as the Brothers Weber have discovered, or by other means, such as a mere compression, or a sudden wound, as I have found), the heart's beatings diminish or cease entirely. Whether this stoppage be due to the cause I have attributed it to or not, is indifferent to my present object. What is important is, that in these cases an irritation on the origin of the par vagum acts through it on the heart to diminish or to destroy its action.

I thought that it would be interesting to decide, if, at the time that there is an effort at inspiration, there is not also an influence of the medulla oblongata on the par vagum, more or less similar to that which exists when we galvanize or otherwise irritate the medulla oblongata. To ascertain if it is so, I have made experiments on newly-born animals, and on birds. As I have already published some of the results of my researches on newly-born animals, and as these results are not so completely decisive as those of my experiments made on birds, I will merely give here a summary of what I have seen in these last animals. I have found the same facts in ducks, geese and pigeons, but as I have repeated the experiments more frequently on the last-mentioned animals, I will speak of them only. When their abdomen has been widely opened and their heart exposed to sight, pigeons may live, as it is well known, for a long while. I wait until they are almost dying, having only one, two, or three inspirations in a minute, and then, if the weather is cold, and if the animal has lost many degrees of its temperature, I find that, at each effort it makes to inspire, the heart either almost suddenly stops, or beats much less quickly.

I have frequently seen the heart completely arrested for five or ten seconds, and twice for twenty or twenty-five seconds, in cases where there was only one respiration in two minutes. This stoppage of the heart's movements was the more remarkable, as they were at the rate of more than two hundred in a minute, when the effort at inspiration took place. To decide that it was in consequence of an influence of the par vagum that this occurred, I divided this nerve in the neck, and then found that there was no more influence of the inspiration on the heart, or if there was, it consisted in an augmentation of the frequency of the movements of this organ—an augmentation due to the shaking of the heart when the chest dilated.

Sometimes, when the heart was very irritable, and when the efforts at inspiration were still frequent and not energetic (the par vagum being undivided), these efforts were accompanied, or rather immediately followed, by an increase in the strength of the heart's movements, probably caused by the shaking. But always when the inspiratory efforts were energetic and rare, they co-existed with a diminution or a momentary cessation of the heart's contractions; and always in these cases the section of the par vagum has destroyed

the diminishing influence of the respiratory efforts on the heart. It would be easy to show that the influence of the inspiratory effort on the central organ of circulation is comparable to the change taking place in the pupil when the globe of the eye is drawn inwards : it is an associated action.

From the facts I have found in the case of newly-born animals and birds, and from the facts observed in man by Professors J. Mueller, Donders, and others, it results that, during efforts at inspiration, a nervous influence passes along the par vagum from the medulla oblongata to the heart, diminishing the movements of this organ. And as by an action of our will we may inspire with energy, it follows that we can by an influence of our will diminish the action of our heart, just as we can contract our pupil by drawing our eyes inwards.

V. "Summary of a Paper (to be presented) on the Influence of Oxygen on the vital properties of the Spinal Cord, Nerves, and Muscles." By E. BROWN-SÉQUARD, M.D.
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The influence of oxygen and carbonic acid on the living tissues, has been very little investigated, either by physiologists or practitioners of medicine. I have made a great many experiments on this subject, but will relate here merely a few of them, which are sufficient to show that oxidation of the spinal cord and nerves, as well as that of muscles, increases their vital properties, sometimes in a high degree.

After the opening of the spinal canal, the dura-mater being laid bare, we find that an evident hyperæsthesia appears after a short time in the parts of the body which are behind the opening, and also on the same level with it, and a little above it. I think this increase of sensibility depends on the absorption of oxygen. To ascertain that it is so, with the help of a special apparatus, immediately after laying bare the cord, I pump out the air in contact with the dura-mater, and substitute for it hydrogen. Then I find