No. 91

AN

INAUGURAL DISSERTATION,

ON

The Physiology of Respiration,

SUBMITTED TO THE

PRESIDENT, BOARD OF TRUSTEES, AND MEDICAL FACULTY

OF THE

University of Nashville,

FOR THE DEGREE OF

DOCTOR OF MEDICINE.

BY

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OF

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1854

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these lines
are respectfully dedicated,
by the
Author

Physiology of Respiration

Into whatever absurdities men may be seduced by the uncertain lights of metaphysical speculations with regard to A Great Final Cause, a sober and rational survey of the Phenomina of Life, as exhibited in their twofold character of voluntary and involuntary motion, in the complex arrangement of the living machine, must fix the conviction upon the mind, that we are not only "fearfully and wonderfully made" but that every portion of the animal economy is destinded to accomplish some end, more or less important to the mysterious but harmonious operations of the whole.

Perhaps no portion of Physiology more forcibly illustrates this fact than that which it is the object of these lines to unfold.

In order to a proper understanding of this subject, it may not be out of place to glance hastily at the anatomy of the parts concerned.

The thorax is that portion of the trunk situated between the neck and abdomen; it is bounded anteriorly by the sternum and cartileges of the ribs; latterally by the ribs; posteriorly by the spine; superiorly by the muscles of the neck, trachea, oesophagus, blood vessels and cellular tissue, which block up the superior portion of the chest; and inferiorly by the diaphragm. It is lined by a serous membrane, the

pleura, which also forms an investment for the lungs.

The lungs, the pneumatic apparatus of the higher order of animals, are made up of bronchial tubes, air cells, blood vessels, lymphatics, nerves and cellular tissue; they are conical in shape, accurately adapted to the concavity of the thorax; concave internally, where they are encroached upon by the heart, which is situated in the middle mediastinum and impinges mostly upon the left lung.

The right lung is divided into three lobes, while the left is divided into only two; each lobe is divided into lobules, and each lobule into lobulae, which are formed of a conglomer

ation of air cells. The lungs are of a light pinkish grey color, mottled with black, and of a light spungy texture.

The trachea bifurcates into bronchial tubes which enter the root of the lungs in company with the pulmonary arteries, and amediately commence dividing, which division continues until they terminate by minute tubes in air passages leading to air cells. These tubes retain their cartilage nois structure until they are not more than from 1/4 to 1/3 of a line in diameter. They however maintain their tubula form for some distance, but gradually become irregular from the increased number of branches given

off. The air cells are minute sacs, of a polyhedral shape, varying from 1/14 to 1/16 of a line in diameter, being larger near the periphery and smaller near the center of the lungs; but the latter more bountifully supplied with blood. They cluster around an air passage like grapes around a stem, and with the surrounding structure constitute the parenchyma of the lungs. The air cells communicate freely with one another of a lobule, but not with the cells of a neighboring lobule.

They are formed of a thin transparent membrane, lined by a mucous membrane, which is continuous with that of the bronchial tubes and trachea.

So very delicate is the membrane forming the walls of the cells, that in some portions of the lungs there is but one layer of capillaries destributed upon its surface, and by this means the blood is exposed to the action of the atmosphere contained in opposite cells at the same time.

The lungs receive their nourishment through the bronchial arteries which ramify with the bronchial tubes.

Respiration is that function of the animal economy, which has for its object, the aeration and decarbonization of the blood.

All that is essentially necessary, is to have the blood exposed to the influence of oxgen, through the me-

dium of a membrane permeable by gases. For this purpose we have it in man, spread out upon a surface reckoned at three hundred square inches, and two hundred and fifty in the opposite sex.

Of all the substances contained in the vitalized fluid, carbonic acid gas is perhaps the most injurious. It is a substance given up physiologically by the tissues, as being no longer fit for the purposes of the animal; but is even poisonous if retained in the system, and it devolves upon the lungs to depurate the blood of it.

This however is not the only source of carbonic acid, but it is gen

erated by the direct conversion of the carbonaceous meterial absorbed by the lacteals.

The blood is brought from all parts of the system, by the ascending and descending venae cavae, to the right auricle; from thence it pasres down through the osteum venosum into the right ventricle; from which it is propelled through the pulmonary arteries to the lungs.

The arteries upon entering the lungs divide, subdivide, and ramify with the bronchial tubes, until they terminate in capillaries, which by anastimosing freely with one another form a complete net work around the cells and passages.

The blood coming there almost in contact with the atmosphere contained in the air cells, gives out its carbonic acid by exosmosis, and takes on oxygen by endosmosis, through the intervening membrane.

The blood having been brought to the lungs impure and of a dark venous color, is now returned to the left side of the heart duly vitalized and of a bright scarlet color, fit for all the purposes of nutrition and secretion, except that of bile, which is secreted from venous blood.

The movements of the chest in respiration, are twofold, those of

inspiration, and those of expiration.
In inspiration the diaphragm is drawn down from its arch to almost a plain; the abdominal muscles are relaxed, and consequently the abdomen is protruded; at the same time the intercostal muscles contract and elevate the ribs, the Scaleni muscles fixing the chest above.
Thus the chest is enlarged in all of its deameters; the air rushing down the trachea and overcoming the elasticity of the lungs, forcibly expands them, their external surface gliding freely upon the lubricated walls of the chest.
The thorax being now fully expanded,

expiration follows almost as a consequence, by the relaxation of the inspiratory, and contraction of the expiratory muscles, aided by the inherent contractility of the lungs, the air is forced back through the trachea into the external atmosphere, bearing with it the carbonic acid in accordance with the law of diffusion of gases.

In ordinary tranquil breathing, especially in children, the diaphragm alone is almost sufficient to carry on respiration; but in laborious breathing the patient seizes hold on some firm object instinctively as it were, and fixing the scapula and clavicle,

brings all the thoracic muscles into play.

One lung is sufficient to carry on respiration for a time, when the other is from any cause incompetent to perform its function.

The cerebrum may be pared away, and the spinal cord divided, in some of the lower order of animals without entirely suspending respiration, as it would be carried on by the diaphragm through the agency of the phrenic nerves.

The pneumogastric nerves perform an important part in respiration. They transmit from the lungs to the medulla oblongata, a sense of suffocation when the blood is not prop-

evly aerated, the impression is received there, and transmitted through the motor nerves to the respiratory muscles.

This fact is illustrated by a case mentioned by Professor Eve, in which a wagon wheel passed over the neck of an individual, dividing both pneumogastoic nerves; the consequence of which was the abdomen became greatly distended with gas, respiration almost entirely ceased and death followed in a short time.

The pneumogastric nerves however, are not the only afferant nerves, concerned in respiration, as may be proved by the fact, that a slap on the nates will frequently excite

the first inspiratory movement in a newborn child.

The first act of the infant after birth is that of respiration. So soon as the child is born, the atmosphere makes an impression upon the trifacial, or fifth pair of nerves, which is recieved by the Medella Oblongata and reflected, as in the pneumogastric.

This act has been known to be delayed by preventing the cold air from coming in contact with the face of the child.

All the atmosphere is not forced out of the lungs by the most forcible expiration; for when an animal once breathes, there remains a portion so long as the lungs retain their

organization. It is thus that causes them to float on water after death.

The quantity of atmosphere changed in the lungs, by each act of natural breathing is dificult to ascertain correctly, as it would be almost impossible for one to breathe naturally, while another was attending to the experiment of ascertaining.

Mr Coathupe estimates it to be from twenty to twenty five cubic inches.

The air changed in quiet breathing, is called by Mr Hutchinson, breathing air; that which can be drawn in over and above this, he styles

complemental air. After expiration there remains some that may be expelled by a forced expiration; this he terms reserve air. The quantity that a man can force out of his chest after the deepest inspiration, is termed by the same author, vital capacity.

This varies according to height and other circumstances. The average capacity of a healthy adult male, five feet seven inches high, is two hundred and twenty five cubic inches, and for every inch above this height, it is increased eight cubic inches, and below it decreases in the same ratio. As age advances however, the thorax becomes ossified,

and respiration is carried on by the diaphragm; consequently the vital capacity would not be so great.

From the greater length and mobility of the superior ribs of the female; their respiration has been very appropriately styled thoracic, while that of the male is styled diaphragmatic.

A consideration of the effects of a cessation of Respiration, and the consequent retention of carbonic acid in the blood, will throw some light on the importance of this function. If respiration be suspended for a sufficient length of time, a state of insensibility insues, to which

the term asphyxia has been applied.

When the blood is not properly aerated in the lungs, either by the exclusion of atmosphere, or the inhalation of a gas that does not contain oxygen, the circulation is checked in the capillaries of the lungs, the blood collects in the venous system, the right side of the heart becomes distended with blood and the patient sinks gradually into a comatose state.

The length of time that a man can suspend these movements, is for a few minutes only, as the stimulus of the carbonic acid upon the pneumogastric nerves

would be so great as to produce involuntary respiratory movements. This power is possessed to the greatest extent by the divers of Ceylon, who are in the habit of diving for pearls, and who can remain under water from three to five minutes.