A lecture upon the Zopuron : as lately delivered at the Sunderland Infirmary / by William Reid Clanny.

A

LECTURE

UPON THE

ZOPURON,

AS LATELY DELIVERED AT THE SUNDERLAND INFIRMARY.

BY

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GENTLEMEN,

AGREEABLY to the wishes of the Committee of management of this Institution, I have to explain to you the method of using the Instrument which I have devised for the prevention of death in cases of suspended animation.

I did not intend to trouble you with a formal lecture upon this subject, could I have taxed my memory with all things which I thought needful to communicate; and as some valuable facts have lately been made public upon the subject of respiration and circulation, I thought that something in a more connected form might prove serviceable to us all. From this, I trust, the most learned and experienced amongst us may derive some profit, and those who have lately commenced their studies may be prompted to prosecute these inquiries.

In the course of a long experience I have too frequently observed that the apparatus recommended by the Royal Humane Society falls short of what I expected it to perform when I commenced my professional practice. And being sensible that something more efficient might and ought to be attempted, I have contributed my mite to snatch my fellow creatures from impending death.

To enable you to understand more clearly, and to appreciate more truly, the important results to be expected from the process which I have now the honour to recommend to your attention, I shall make a few prefatory remarks:

First, on the circulation of the blood;
Secondly, on the structure and functions of the lungs;
Thirdly, on the atmospheric air; and then proceed,
Fourthly, to describe to you the method of using the Zopuron in cases of suspended animation.

First, the circulation of the blood.

In the process of circulation, the blood is conveyed from the left ventricle of the heart by the aorta, or great artery, and its branches, to the minutest and most remote parts of the body; and there, passing from the extremities of the smallest arteries into the incipient veins, circulates through them into their larger branches; afterwards into the right auricle; and, in succession, to the right ventricle. It is, with the fresh supplies that it receives from the chyle passing into the subclavian vein, forced thence into the pulmonary artery, and, after circulating through the lungs in its passage, is returned by the pulmonary vein into the left auricle, and thence into the left ventricle of the heart. The same round recurs, and this is what is called the circulation of the blood.

We next turn our attention to the lungs. The lungs are two spongy and vascular organs, of considerable size, situated in the lateral parts of the chest. Their parenchyma or substance is divided and subdivided into large and small lobes; the number, form, and dimensions of which are difficult to be explained.

An attentive examination of one of the pulmonary lobes shews that it is formed of a strong texture, the areolæ, or small cavities of which, are so minute, that a strong convex lens is requisite to discern them distinctly.

These areolæ communicate with each other, and are enveloped by a thin coat of cellular tissue, which separates them from the lobes that are

next to them. Into each small lobe, one of the divisions of the bronchia and one from the pulmonary artery, are inserted; the latter appears to be transformed into an infinite number of radicles belonging to the pulmonary veins. A part of the eighth pair of nerves and filaments of the sympathetic, are spread over the lungs.

Observe, that mercury, or even coloured water, when thrown into the pulmonary artery, passes immediately into the pulmonary veins; but, at the same time, part of the injection penetrates the bronchia, and escapes by the trachea.

Again, if an injection be thrown into a pulmonary vein, it passes partly into the artery, and partly into the bronchia. If the injection be thrown in by the trachea, it is soon seen penetrating the pulmonary artery and veins, and even into the bronchial artery and vein. I request that these facts may be held in remembrance, for it will shortly be seen how important they are, when we come to consider the process of respiration; and upon which, I am of opinion, I shall have something of importance to make known.

The lungs in a great measure fill the cavity of the chest, and which they enlarge and contract. Every time the chest expands, the lungs are distended by the atmospheric air, inhaled or inspired; and, as the air is expelled or expired, the lungs are contracted in bulk.

The atmosphere is a thin, transparent, invisible, and elastic fluid, which surrounds the earth on all sides, to the height of, at least, forty miles.

The atmospheric air is a ponderous body, as may be explained by the action of a common pump. In this process, the pressure of the atmosphere causes the water to ascend to the height of thirty-three feet in the

pump pipe, and, consequently, a column about this height is sufficient to equipoise the atmosphere.

The composition of the atmosphere is extremely uniform in all parts of the world, and at all heights above the surface; and consists of

Oxygen gas, ... 21 per cent,
Azotic gas, ... 79 per cent.

Besides the above essential component parts, the atmospheric air contains 1 per cent of carbonic acid gas, and a portion of aqueous vapour.

Oxygen gas is a little heavier than atmospheric air; it is essential to the support of combustion, as well as of animal life. The properties of azote, in the process of respiration, are purely negative.

For obvious reasons it is very difficult to ascertain the exact quantity of air taken into the lungs at each natural inspiration, as well as the number of respirations made in a given time. As nearly as I can estimate from the experiments of others, as well as my own, we may consider 20 cubic inches as the general proportion; and the number of respirations at 20 in a minute; and upon this estimation the Zopuron works. A full grown person requires 24,000 cubic inches of atmospheric air in an hour, or 576,000 cubic inches in the course of 24 hours, a quantity equal to about 40 hogsheads.

I am of opinion that the volume of air expired, is exactly equal to that inspired, and also that the only chemical change which is evident, is the saturation of a portion of the oxygen inhaled with the carbon of the lungs. It is extremely probable that the conversion of oxygen into carbonic acid gas in the lungs, differs materially at different times, and under different circumstances; at the same time we must hold in remembrance, that about one seventh of the contents of the lungs is discharged by an ordinary expiration; and, it is inferred, that in respiration, whether natural or effected

by artificial means, the air comes into immediate contact with the air-cells the moment it is inhaled or sent in; whilst a portion which has been converted into carbonic acid gas in the lungs, is, at the next expiration, exhaled, at the same time the azote undergoes no change as to quantity or quality. For, in my opinion, the azote is merely negative in the process of respiration, being the vehicle or medium by which the oxygen, in a divided state, comes more readily into contact with the air-cells of the lungs, and is, consequently, more readily convertible into carbonic acid gas; and for atmospheric air only, the lungs are fitted. Atmospheric air, after being once, only, admitted to the lungs, returns charged with 8 per cent of carbonic acid gas. During the process of respiration there is a constant exhalation of water from the lungs in the form of vapour. This vapour, when condensed, is estimated at 19 ounces per diem. Those persons who play upon wind instruments find this vapour to increase in proportion to the length of time in which they are so occupied; and frequently the quantity of vapour condensed within wind instruments, is astonishingly great.

In my opinion the carbon of the blood is given out from the lungs suspended in this vapour, and in this state it comes into contact with the inhaled oxygen of the atmospheric air, and is converted into carbonic acid gas in the air-cells of the lungs, by reason of its superior affinity for oxygen. From the recent experiments of Majendie we are compelled to admit that this vapour proceeds from the blood of the pulmonary artery; and also from those arteries which are distributed over the mucous membrane of the air-cells.

Though the experiments of Majendie have been most valuable and conclusive, I shall not take up your time, nor shock your feelings, by detailing them. All the blood of the body must pass through the lesser circulation, as it is called, or the circulation of the lungs. It is supposed by some philosophers, that oxygen gas enters into the blood vessels of the system by means of respiration, and there, meeting with carbon, is converted

into carbonic acid gas. This cannot be the case. From what I have stated above, and from recent and well conducted experiments, we are compelled to conclude, that the carbonic acid in the blood vessels has its origin solely from the food taken into the stomach; besides, the quantity which we find in these vessels is wonderfully uniform, *cæteris paribus*, increases greatly after meals, and bears no proportion to the large quantity of this gas, which is every moment given out from the lungs in the process of respiration.

From respiration originates animal heat; for it is well known, that the rapid conversion of oxygen and carbon into carbonic acid gas, is always attended by an extrication of heat in the living animal, when in a healthy state; and this animal heat, at its source, is prevented from being hurtful, by reason of the halitus or vapour which always accompanies the process of respiration. For it is well known, that the more frequently we respire, the more rapidly we shall generate animal heat, whilst the vapour keeps pace in quantity with the increased rapidity of respiration.

The following corollaries deserve our serious attention, and are, no doubt, perfectly correct.*

"The temperature of man increases in passing from a cold, or even temperate, into a warm climate.

The temperature of inhabitants of warm climates, is permanently higher than those of mild ones.

The temperature of different races of mankind, *cæteris paribus*, is much alike.

The temperature of birds is the highest of all animals; mammalia next; amphibia, fishes, &c. next; and, lowest of all, the mollusca, &c.

* Dr. John Davy.

There appears to be a decided connection between the quantity of oxygen consumed by an animal, and the animal heat, as far as has yet been ascertained by experiment and observation.

If animal heat be owing to nervous energy, why, it may be asked, are birds so much hotter than mammalia, and why is the temperature of most quadrupeds higher than that of man? Or if it be owing to digestion and secretion, and animal action, why is the temperature of amphibia and fishes so low, whose powers, in respect to those functions, are so considerable? Or if it be connected with muscular energy, why are the animals, whose muscular powers are so remarkable, equally noted for the lowness of their temperature? Or, lastly, if animal heat depended, at all, upon peculiarities of structure or of organization, why, it may be asked, is not the temperature of the amphibia elevated, like that of birds—the structure of the respiratory, digestive, and secreting organs of the one class being so much alike to those of the others?"

It has been stated that the whole of the venous blood is propelled through the vessels of the lungs, where it is subjected to the action of the air, and whence it returns to the left side of the heart by the pulmonary vein; having undergone a considerable change in its appearance, its dingy colour being changed into a fine florid red; and in this *finishing* process the chyle has also become blood. This change of colour is evidently owing to the action of the air. The manner in which that is affected, I have just mentioned, viz. by parting with its carbon; and, I may add, that through the thin coats of the circulating vessels on the air-cells, this end is also attained to a certain degree; for here the oxygen of the atmosphere removes the carbon from the venous blood in a most wonderful manner, as may be seen when parts of the lungs of dead animals are submitted to the action of oxygen, or even of atmospheric air. The only chemical difference then, which can be detected between venous and arterial blood, or blood which has not had the advantage of purification, by the process of respiration, and

that which has been so acted upon, is, that the venous blood will be found to be charged with carbon, and is of a dingy colour, whilst the arterial, or purified blood is more free from carbon, is of a bright red colour, and is now fitted for the renovation of parts, for the formation of secretions, and for the sustenance of life, by its action on the cerebral system; for though the heart does not directly refuse to circulate venous blood, *paralysis* and *torpor* ensue, when blood, which has not had the advantage of aeration in the lungs passes into the vessels of the brain. Respiration is therefore the link uniting the phenomena of organic and animal life. And blood, which has passed in a suitable manner through the lungs, is thereby fitted for the important processes of formation, reproduction, and secretion, and with it carries the animal heat to the whole body.

Many cases are upon record of spontaneous resuscitation without the smallest aid having being afforded. This fact, and the records of the Royal Humane Society loudly call for our exertions, by every means in our power, to avert a fatal termination in the most desperate cases, and under the most unfavourable circumstances.

The Instrument which I have now the honour to present to the Sunderland Infirmary, will, I trust, be found adequate to the end proposed, and deserve the name which I have ventured to give it,—ZOPURON, a compound Greek word, which may be expressed in the vernacular tongue, REVIVER.

The bellows manufactured for the service of the Humane Society, are not of sufficient size to inflate the lungs; nor is it necessary to employ double bellows for this purpose, for the air will escape from the lungs in a suitable manner without being withdrawn by the bellows; besides, the forcible exhaustion of the lungs by bellows, or other apparatus, would be liable to occasion pulmonic hemorrhage; and, also, as great strength and steadiness in blowing are requisite, it cannot be expected that any thing

approximating to natural respiration can be effected by bellows, as I have too frequently experienced in the course of the last thirty years. In using the bellows, a portion of air will sometimes find its way into the stomach through the œsophagus, and we well know how hurtful such inflation of the stomach would be, from the painful and sickening effect of atmospheric air when swallowed: besides, when the stomach is distended with air of any description, the descent of the diaphragm is prevented, and, consequently, a perfect inspiration cannot be accomplished. Should an attempt be made to inflate the lungs, by making an aperture in the trachea or windpipe, the bleeding from the wound might find its way into the lungs, and occasion death.

I am well assured that with the Zopuron such unfavourable circumstances cannot take place. I may remark, *en passant*, that there is no necessity whatever for heating the air previously to its being used for artificial respiration. Nor ought mixtures of gases to be used instead of atmospheric air; for when we reflect upon what I stated a short time ago, such mixtures can never be of the smallest use, and, in some cases, would be highly deleterious.

The body of the apparently dead person is to be placed in the suitably fitted steam-bath, (which also I present to the Infirmary) to the leaden tube of which, steam, from a common boiler or tea-kettle, is conveyed by means of one of tin or copper; and this may be done without the smallest trouble or inconvenience. But should the fire be so low that steam could not be raised so soon as desired, pillow-slips of heated common salt, or of sea-sand, may be placed round the body, and then the cover of the steam-bath may be laid over all. The strap is to be buckled at the crown of the head, having been passed under the jaw directly above the thyroid cartilage, so as to close the communication between the pharynx and œsophagus, which will prevent the atmospheric air, from the flexible tube of the Zopuron, passing into the stomach. One of the nostrils is to be plugged

with any convenient soft substance, such as tow, flax, or surgeon's lint, and the ivory top attached to the flexible tube of the Zopuron, is to be passed into the other nostril. The first operation of the Zopuron is to send twenty cubic inches of air into the lungs in a gradual and gentle manner, similar to a natural inspiration. At the moment the Zopuron draws into the working cylinder a fresh supply of air from the atmosphere, a proportionate quantity of air issues from the mouth, which is effected by the elasticity of the ribs and of the lungs, and by the pressure of the abdominal muscles and viscera. In this manner twenty cubic inches of air are sent into the lungs twenty times per minute, and thus natural respiration is closely imitated, and may be continued for many hours; during which time the medical attendants and other persons are at liberty to employ all other subordinate means in endeavouring to restore animation.

This operation of the Zopuron may readily be understood and imitated in the following manner. Press the finger upon the nose so as to close one nostril, and draw in a full inspiration through the other; after this is accomplished, press upon both nostrils and allow the air to escape from the lungs, by the mouth, whilst the teeth are firmly closed together. This may be continued without fatigue or inconvenience.

This is the only Instrument which has hitherto been offered to the public, that can effect a process similar to natural respiration, and from this the intelligent professional man may at once form an idea of the very extensive application and value of this apparatus.*

Some new facts upon the subjects of circulation and respiration have lately been presented to us by Dr. Barry, who read a memoir on the motion of the blood in the veins, before the Academy of Sciences at Paris, a short time ago. Messieurs Cuvier and Dumeril were appointed by the

* This Zopuron is so portable, that it may be rapidly conveyed, in a common wheel-barrow, to any part of the town.

Academy to see Dr. Barry repeat his experiments, and to report upon the subject. Those Gentlemen accordingly reported to the Academy, upon the 28th of August last. The following is an extract from the Paris Journals, which bestow high commendations upon Dr. Barry.

"In truth, Dr. Barry has shewn by means of experiments, entirely new, very ingenious, and perfectly conclusive:

First, that the blood in the veins is never moved towards the heart, but during the act of inspiration; and,

Secondly, that all the facts known, with respect to this motion in man, and the animals which resemble him, may be explained by considering it as the effect of atmospherical pressure.

Dr. Barry goes further, for he attributes the dilatation of the heart itself to the effort of a vacuum, which takes place in the thorax at the moment of inspiration, and verifies his opinion by direct experiments."

Apply these new discoveries to the operation of the Zopuron—reflect that if with common bellows decapitated animals have been kept alive for some hours, what may we not anticipate from the operation of the Zopuron, in many cases of suspended animation? Some persons are impressed with a fear that there may be a possibility of their being buried alive; and we know that such cases, though exceedingly rare, have occurred, where too much haste had been made to perform the ceremony of sepulture. Those dreadful ideas may be obviated, by such persons directing that, after their apparent death, the Zopuron be employed to ascertain their actual state.

The Zopuron is recommended in cases of apoplexy; syncope, or fainting long continued; suffocation by drowning, or suspension by the cord; smothering; or from the inhalation of air deprived of oxygen gas, or

being of a noxious quality; exposure to cold or to extreme heat; lightning; exhaustion, from whatever cause; in cases of still-born children; and in poisoning or drunkenness, after the deleterious substances have been extracted from the stomach by the stomach pump.

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Dr. Craigie M. D.

with the Author's

compliments and

best wishes.