the tubercles is alone present. Here there are no physical signs to aid us; and the diagnosis of the disease, previous to the setting in of decided cerebral symptoms, is confessedly a matter of great difficulty. "A few years ago," says Dr. Wilks, "I collected a large number of cases of this affection in children, and in none of them was a correct diagnosis made during the first few days of illness, the case being styled one of fever or stomach-disturbance; and this error of diagnosis, or rather want of appreciation of the real nature of the case, is the rule." Dr. Wilks, however, draws attention to one distinctive characteristic, which may serve to arouse a suspicion as to the true cause of the fever; and I am sure that his observation will be found correct. He notices the irritability of the patient in the fever of acute cerebral disease, which contrasts in a most marked manner with the torpor of the fever-patient. When the disorders "are at their height," he observes, "and the patient is extremely ill, the fact is often very striking; the one with the inflammation of the brain being distressed by the slightest movement; it is irksome for him to be spoken to; he coils himself up in bed; is peevish, and wishes only to be left alone . . . whereas a patient with fever generally suffers nothing, and he evinces no trouble or alarm when touched."

Were we but able to apply to the brain the same method of physical examination we employ in cases of disease of the lungs, no doubt the proportion of doubtful cases of this disease would be reduced to the smaller proportion observed in the instance of pulmonary tubercle.

SALE OF A MEDICAL COLLEGE. The medical college property of Castleton, Vermont, whence two thousand young doctors have been sent, has been sold, and will be known as a medical college no longer.

DONATION TO BELFAST HOSPITAL. A gentleman, who desires that his name might not be published, has handed to the Treasurer of the Belfast Hospital the sum of £2000, to be expended as Drs. W. MacCormac, Pirrie, and Murney, with the Treasurer, might think best. It has been decided to erect a wing.

EARLY BAPTISM. An inquiry was recently held respecting the deaths of two children—a boy and a girl. Mrs. Knight was delivered of three children, the two deceased and another girl. They were fine children, but there was no doctor or midwife present, and the boy died almost immediately. At ten o'clock the same morning Mrs. Knight sent the two surviving children to a Roman Catholic chapel. The witness added, "We wrapped the two girls up, and when we got to the chapel the clergyman came to her and unwrapped the child she carried, and said, 'Oh, it is gone!'" It was dying or dead. The other child was christened. It was a cold day. Dr. J. S. Belcher said that the three children were healthy, considering that they were a triple birth. The deceased girl died from exposure to the cold. The boy died from want of artificial respiration being resorted to,—in fact, from want of skilled attendance at birth. The jury returned a verdict "That the deceased female child was found dying and did die in a Roman Catholic chapel from the mortal effects of exposure through being taken out so soon after birth, and that the deceased boy died from exhaustion from the absence of skilled assistance at birth." The proceedings then terminated.

Original Communications.

ON THE PHYSICS OF DISEASE, AND THE PHYSICAL PATHOLOGY OF THE BLOOD.

By BENJAMIN W. RICHARDSON, M.A., M.D., Senior
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CHAPTER II (continued).

*Conditions of Oxygen that Modify Combination with
Blood. Oxygen as affected by Electricity. Active
Oxygen:—Ozone.*

WHEN oxygen gas is exposed to various electrical states, it assumes, I had almost said new forms, it is so singularly changed in respect to its capacity for combination. On one side, it may be made almost as irrespirable as chlorine; and on the other side, it may be reduced to the nearly negative condition of nitrous oxide. In the common air, it exists in a medium between extreme activity and negation, as a general rule; but the rule has its exceptions, and upon these exceptions much depends having relation to disease. There are times when active oxygen is present in the air, for given periods—"the ozone periods" of Moffat. There are times when, in rooms at all events, the oxygen is to an extent negative, in so far as the oxidation of blood is concerned.

I am not certain that the use of the terms, *active*, *neutral*, and *negative*, as applied to oxygen under various conditions of electricity, are really correct or good terms; because, in truth, heat also makes oxygen negative, neutral, or active, as electricity does. Oxygen reduced to very low temperature is, as we have already seen, negative in reference to the support of life; oxygen at ordinary temperatures sustains life best; and oxygen at elevated temperatures causes an over-active animal combustion. But custom has willed it, and I suppose custom must have its way, that the terms active, neutral, and negative, shall be made to apply to oxygen as existing only under differing electric states.

That oxygen should be influenced by electric force as well as by calorific force, is not difficult to understand, if it be remembered that, in fact, the two forces are one. When electrical discharge occurs in oxygen, it puts the molecules of the gas into active motion, and their affinity for other bodies with which they are brought into collision is increased. As, by the lightning flash, great waves of the atmospheric sea are put into motion, and thunder is the result, so, in the more minute divisions of that atmospheric sea, in the molecular divisions, whenever there is electrical discharge, great waves are put into active motion, the effect of which is exhibited—the conditions being supplied—in the more active combinations that occur between oxygen and oxidisable matter.

To prove that the two forces—heat and electricity—are the same in respect to oxygen, I may state that oxygen, heated to a temperature of 480° Fahr., ceases to be influenced by electrical discharges. To use the term common in experiment, oxygen cannot then be ozonised; this simply means that, after a time, the motion imparted by the heat is itself so great that the effect of the electrical discharge becomes unimportant. In the opposite scale, oxygen reduced to a very low temperature is not less inert

because it is present as negative oxygen; which means that, when inertia and condensation are produced by extreme abstraction of heat, the reduction of the electrical motion is not of moment.

It is well to bear in mind these analogies of action between the forces of heat and electricity; but with this remembrance it is also well to hold in distinct recollection the actual influence of electricity on oxygen, both in the simple state and as it is diluted in atmospheric air. To this part of our labours we will at once proceed.

To begin with active oxygen or ozone, we may produce it by several processes: *a*, by the manner in which we make oxygen, or rather evolve it, from bodies with which it had before been in combination;

b, by the slow decomposition of water, whereby the oxygen is set free; *c*, by the exposure of phosphorus to air in the presence of water; *d*, by electrical discharge.

For practical purposes, the production of ozone is best carried out by electricity. In the experiments which are about to be related, a large frictional machine was usually employed in cases where the quantity of ozone required was small, and an apparatus invented by Siemens in cases where the quantities required were large. With the ordinary electrical machine, all readers are familiar; but as few are acquainted with Siemens's ozonometer, I have had a drawing made of it, as it is seen in operation ready for a physiological experiment.

In this apparatus, the electric discharge is obtained by means of a large induction coil. The coil, as represented in the diagram (B), is a Ruhmkorff's, having four miles of wire, and being worked by three cells of a Grove's battery (A). A spark of two inches, which answers every purpose, is thus easily obtained. The ozonometer (C) consists of two conical glass tubes, the outer one having a bore of three inches at the widest part, and the inner one a bore of two inches. The inner tube is covered on its outer surface with tinfoil, and the outer tube is covered in the same way. The whole represents an elongated Leyden jar. When in action, one pole leading from the induction coil is attached, by means of a platinum wire, to the tinfoil on the outer surface of the inner tube of the ozonometer, and the other pole is attached, by the same means, to the tinfoil on the outer surface of the external tube. When electrical discharges are made, the sparks pass from the outer tinfoil through the glass to the tinfoil of the inner tube. Air, or oxygen, being now passed between the two tubes, becomes ozonised, so long as the coil is in action, and the ozonised air can be collected at the small extremity of the ozonometer. The air can either be driven through the ozonometer with bellows, or drawn through with an aspirator. In the diagram, a large gas-holder (E) acts as an aspirator.

By means of this apparatus, ozone can be applied either by being collected in suitable vessels, or by being used in a current through a chamber. The method of using it in current for experiments on animals was first introduced by Dr. T. Wood. In the diagram, the apparatus is shewn as fitted up either for a current or for collection. The chamber (D) may be so arranged, while holding the animal, as to receive a stream of ozonised air, which enters by two openings at the side near the bottom, and escapes at the top by the tube (F), where it may be collected for analysis. Or the chamber may be adapted so as to receive from time to time certain measured quantities of ozone: for this purpose a plan, invented by myself, is used: a graduated cylinder (G), which can be filled with ozonised air, fits into a tube in the chamber; the cylinder is supplied with a well fitting piston, and the ozone, by the depression of the piston, is driven into the chamber as may be required.

In experimenting with ozone, it is necessary for the operator to proceed with caution, so as to protect himself from the danger of long inhalation of ozonised air. When ozone is being produced by means of Siemens's ozonometer, it is next to impossible to prevent diffusion of active oxygen through the apartment, and in a very short time the effects are manifested on the body. The inhalation of ozonised air, even

when I can scarcely detect its presence by the odour, produces in me, after a time, intense headache and pulsation. If I breathe it a few times from the ozonometer, it creates irritation of the lining membrane of the nasal cavity, and distinct injection and soreness of the throat.

One other little matter of fact in respect to the carrying on of experiments should be carefully noted. It is useless to attempt to carry the ozonised air through India-rubber tubing of any kind, or through gutta percha, for both these forms of tubing are destroyed by ozone as they would be by heat. The ozone should therefore be passed through glass tubes, and the connections, which ought to be as short as possible, must be made by quills cemented in with sealing-wax varnish. This excellent contrivance for joints is by Dr. Wood.

In considering the action of ozone on animals, I commence with the simplest experimental position, viz., the influence of electric discharges on pure oxygen which an animal is made to breathe; and if the reader will not weary in following the narrative, I will lead him to as perfect a knowledge as I can of all the facts. Up to the present time no systematic inquiry has been carried out on this subject; but records of numerous experiments, mostly reported second-hand, are scattered abroad. I shall not dwell on these experiments, but shall detail my own simply and solely, placing them forward in such manner that any one may with ease repeat them, and reject or confirm them.

On pure oxygen at a temperature of 55°-60° Fahr. faint electrical discharges, creating ozone in quantities just sufficient to be appreciated by the sense of smell, give such motion to the oxygen as enables it to support life, after the same manner as an elevation of temperature. I took two large mice, and placed one each in a chamber containing oxygen at 55°. The chambers were of the same size, and the oxygen was from one source. When the animals were in their respective chambers, the chamber containing one of them was so placed that sparks from a pointed rod of a frictional electric machine could be discharged into the gas. The chamber containing the second animal was placed in the same temperature, but was not connected with the machine. At the end of two hours, the animal in the simple oxygen was comatose and was breathing with difficulty, while the other animal, breathing the ozonised oxygen, was moving about and breathing rapidly but freely. Two hours later, the animal in simple oxygen was dead, and half an hour later it was rigid from rigor mortis: at this time the animal in the chamber into which the sparks were passing was sleepy but living, and so it continued to live for an hour more, when, on removal from the jar, it speedily recovered.

In another experiment, an animal in an oxygen chamber at 55° was placed in communication with an electrical machine, so that the air could be ozonised. At the same time, a similar animal of the same weight was placed in an oxygen chamber of equal size, and was removed to a temperature of 70°-75°. The animal in the ozonised air lived on for nine hours, until, in truth, I was tired of working the electrical machine; the animal, merely exposed to a temperature of 70°-75°, was then also alive. The animals, on being removed from their chambers and brought into the air, were semi-comatose: they both readily recovered after removal.

We may thus consider that heat and electrical force exert an analogous action upon oxygen; but, in watching the last-named experiment, I was wonderfully struck with the power I possessed over the oxygen by the electrical spark: I held as it were the life of the animal in my hands, and by the rotations of

the electric wheel could quicken or reduce the respirations at pleasure. If I surcharged the gas, discharging the sparks rapidly, the animal began to breathe with immense haste: if I held back the motion for a long time, then the animal fell into a low comatose state, and would soon have died, had not motion been imparted again to the molecules of oxygen.

I performed another experiment by placing two animals (mice) of the same weight in chambers of equal size. One chamber was charged with oxygen in the form of ozonised oxygen, the jar being saturated with ozone: the other chamber was charged with simple neutral oxygen, and both animals were placed in a temperature of 60°. The animal in the ozone commenced at once to breathe very quickly, became comatose in an hour and twenty minutes, and died in two hours and forty minutes. The animal in simple oxygen also became comatose in an hour and twenty minutes, but it continued to live for four hours and forty-two minutes.

In this experiment we witness the effect of ozone as applied by the animal at once. The heat in this experiment was sustained throughout uniformly, and the animal that was subjected only to the motion produced by the heat lived long; but the animal that was at first subjected also to the motion added by electricity lived at first too rapidly, and the added motion, not being sustained, it died more speedily.

Next week I shall continue the record of these researches on ozone; but, before I conclude now, I would point out a fact which appears to my mind of much moment. This is, that animals are not all equally affected by oxygen. As I shall show, carnivorous animals are soon made to feel the effects of ozonised air; it induces in them so-called inflammatory states, and kills with comparatively quick action. But herbivora, such as rabbits, will live in it for long periods with little injury. It is as though those animals which live altogether on the vegetable world, and which prepare food so derived for the carnivora, do not, in active oxygen, oxidise so readily as the carnivora. I will not dogmatise on this point, but submit the evidence. If the evidence is satisfactory, it will stand without dogma, and will throw a flood of light over a region heretofore unexplored. It will show why diseases communicated from the carnivora to the herbivora change in form; why variola, for instance, in man, is vaccinia in the cow; and why some diseases are only communicable amongst special classes of animal life. For if disease be, as I have said, nothing than the phenomena of perverted motion; and if, in differing classes of animals, there be a special oxidation or generation of motion natural to them,—then must the phenomena of disease differ according to the class of animal through which it is presented.

CASE OF OCCLUDED VAGINA: RETAINED MENSES: OPERATION: CURE.

By W. J. TUBBS, M.R.C.S. Eng., Upwell, Cambridgeshire.

SARAH H., aged 16, residing at Outwell, had always enjoyed good health, with the exception of the usual diseases incidental to childhood. Her mother stated that, when the patient was two years old, she suffered from pain in micturating, and had a copious discharge from the vulva; that she brought the child to me, and had some black wash, and was ordered to poultice the parts. In the course of a week or two, the child was quite well.

About the middle of May last, the patient walked to Emneath, a distance of four miles, and, as she