—immediately diminishes,* and does not retrun when the bleeding has ceased. What has caused this paleness? It is not simply that the leeching has partially emptied the engorged vessels, and thus relieved tension (which in this case, I think, is analogous to impeded action of the lungs when inflamed); because the very small quantity of blood that two leeches have abstracted can have produced little or no effect on the strength of the general circulation; and blood would be immediately forced, on the cessation of the bleeding, into the vessels, and the inflammation return as previously. But it does not. The paleness always remains for hours—sometimes is permanent. Evidently, some other and a more direct effect on the inflammation than the mere abstraction of the superabundant blood, thus affording relief to tension—to impeded circulation—has taken place. What is it?

Into a forearm, affected with severe inflammation of the cellular tissue and skin, before pus has been formed, make free incisions. Tension is at once relieved. But observe the change in the redness as the blood flows from the wounds. Immediately around the incisions a white margin appears; then pale spots here and there through the bright red; these rapidly enlarge, coalesce, and transform the brilliant into a pale dingy red. What had been severely inflamed one minute before is so no longer. Introduce lint into the wounds, so as to stop the bleeding effectually: the bright redness does not return, as it would do if the engorged vessels had been simply relieved of their superabundant blood. Manifestly, some other effect on the inflammation has taken place. What is it?

The explanation of the cause of the paleness given by Mr. Lister is, I believe, the correct one. The blood-vessels in the immediate vicinity of the incisions contract, as it were in defence of the loss of blood; this contraction by nervous influence spreads rapidly to the smaller arteries around; and the supply of blood to the inflamed parts becomes almost as effectually cut off as if pressure had been applied to the main artery of the limb. The parts now have the benefit of *rest*, and, before the contraction of the arteries yields, have so far recovered that they do not in many cases again inflame. But does general blood-letting act in the same manner in internal inflammations—viz., by affording *rest* in some degree to the inflamed parts? I think it does. When a man with an inflamed brain is bled till he is faint, the first effects must be to relieve the brain in some degree of its superabundant blood, and thus diminish tension; and the second, to induce general pallor, then syncope; *i. e.*, to cause contraction of the arteries of the body in general, including those supplying blood to the brain, and thus diminish the quantity of blood sent to the inflamed parts, and afford them *rest*. When a patient suffering from rheumatic ophthalmia is bled freely, we can absolutely *see* that the inflamed parts participate in the general contraction of the arteries of the body—in the general pallor. And if this be the case with the eye, surely it must be so with the brain, lungs, heart, or any other inflamed organ.

The *facts*, then, concerning blood-letting are: that it *does* in many cases produce a most marked, immediate, beneficial effect upon some inflammations; that it relieves tension—impeded circulation—impeded action—by causing diminution of the quantity of the circulating fluid, by enfeebling the heart's action; that, when used locally, it causes an immediate paling of the redness, which does not return when the bleeding is stopped. When used generally, it causes universal pallor and syncope. The *inference* naturally is, in the first, that it has caused contraction of the arteries supplying blood to the inflamed parts; and in the second, that it has caused contraction generally of the arteries of the body.

The *theory* of its action I deduce from the above facts and inferences is, that by diminishing tension, and cutting off in a great measure the supply of blood, it gives the inflamed parts *physiological rest*—that most powerful of all remedial agents.

ON THE PHYSICS OF DISEASE,

AND THE PHYSICAL PATHOLOGY OF THE BLOOD.

By Benjamin W. Richardson, M.A., M.D., Senior Physician to the Royal Infirmary for Diseases of the Chest.

Chapter III.

Conditions which Modify Oxidation of Blood (continued). Further Researches on Ozone.

At the close of my last chapter, I adverted to the effect of ozone, or active oxygen, on carnivorous as distinct from herbivorous animals. The remarks there made, I will ask the reader kindly to bear in mind as the subject progresses.

In the year 1852, I constructed an apparatus by which freshly made oxygen could be passed in current over animals confined in chambers properly constructed so as to allow them freedom of motion, and at the same time prevent them from receiving any air save that which was specially supplied to them. By sending oxygen through the chamber in free quantities, perfect ventilation was sustained, and no accumulation of carbonic acid could take place. The oxygen, as it was used, was in the active state; but the quantity of ozone present was small. Arrangements were made by which the animals subjected to the oxygen could be supplied both with liquid and with solid food.

A cat was first placed in the oxygen chamber; no attempt was made to save the gas; and the current of gas was sustained so steadily, that at any time a partly extinguished taper could be re-lighted at the escape-tube. For an hour and a half the animal breathed the gas, the temperature being 65° Fahr., without signs of derangement. Then the breathing became quickened and harsh; and thirst was a prominent symptom. After breathing the oxygen seven hours, there was slight convulsive movement; the animal was, therefore, set at liberty in the open air, but it continued to sink, and died at the end of three hours. On examination, the lungs were found to be intensely red in colour, but no organ had undergone structural change. The cause of death was separation of fibrine in the right side of the heart; the right auricle was choked with a firm fibrinous mass, which was of a pure white colour, and adhered closely to the muscular wall.

In another experiment, results of a like kind were produced in a guinea-pig. In a pigeon exposed for nine hours to the gas, symptoms resembling those of croup were induced; the animal breathing with a

* If Dr. Marshall will refer to the British Medical Journal of April 2nd, 9th, 16th, 23rd, 30th, and May 7th, 1864, he will find that Dr. Markham has, in his Lectures delivered before the Royal College of Physicians, referred to the excellent effects of the *local* abstraction of blood from inflamed parts, and has explained it in part by reference to its *local* action over the vaso-motor nerves. Dr. Markham has there shown, or endeavoured to show, that venesection and the local abstraction of blood are remedies totally different in their effects as regards inflammation; that to bleed a man for inflammation of the conjunctiva, for example, and to draw blood immediately from the conjunctiva by leeches, are to perform two distinct and essentially different operations—to use two distinct and essentially different remedies. Editor.

distinct croupy inspiration. In this animal, the blood was found firmly coagulated in the cavities of the heart; and in the upper and the lower segments of the trachea there was distinct fibrinous exudation.

From these experiments, it seemed to me conclusive that oxygen administered in the manner I have described was generally destructive of animal life by increasing waste and causing separation of fibrine in the blood. The inference was not just, as the following experiments will show.

On July 9th, a rabbit was placed in the same chamber in which a number of the experiments, described above, had been performed. The oxygen was made in the same way, and transferred in the same way. At first the animal seemed excited, and often thirsty; but it also ate voraciously of green food. During nine days it was kept in the stream of gas; and no material change followed. It was now removed from the oxygen. It weighed four ounces less than before the commencement of the experiment; but otherwise it was unaltered.

After the lapse of a week the rabbit was replaced in the chamber, and the administration of the gas recommenced. This time the exhibition was kept up for twenty-one days, without any indication of dying or even of suffering on the part of the subject. Once more the animal was placed in the common air, and it lived many months. It continued always thinner than it was before being submitted to the action of the gas; but that was all.

One or two special changes which occurred during the inhalation of oxygen, should not escape notice. There was often a brilliant vermillion tint of the ears; and when the creature wanted food, the breathing was more hurried, varying from fifty to even one hundred respirations a minute. On two or three occasions it became oppressed, and the alæ of the nose worked rapidly. Then the current of gas was supplied a little more swiftly, and at once the animal became as alert as before.

I witnessed in this experiment the results obtained by Lavoisier, and by that section of observers who have considered that the inhalation of oxygen is not attended with danger, even though sustained for long periods of time. What was more, whenever I repeated these experiments on the same kind of animals, I obtained the same results to the letter. Dogs, cats, pigeons, and Guinea-pigs died; but rabbits lived on. The fact, so often repeated, led me to think that the differences arose from the animal employed. To settle this point, I made the following experiments.

I constructed a chamber of a cubic capacity of two feet. I made a perforated false bottom as before, and put beneath this potash for taking up carbonic acid. I arranged so that I could change the potash at pleasure. The chamber was then divided into stalls by perforated zinc; and a neat and effective plan was made for introducing food into each division. Eighty gallons of oxygen gas were then made in two reservoirs; and the chamber was tubed for a current as in the one already described.

There were now placed in the chamber in the different stalls, a dog, a kitten, a rabbit, a pigeon, and three frogs; and the oxygen-current was turned on. The pigeon began to suffer from rapid breathing in two hours, and its legs, previously pale, became vermilion red. The dog suffered more; the kitten less. At the end of twelve hours, the dog was nearly dead; the pigeon was drooping; and the kitten was suffering considerable excitement. The rabbit was as well as ever. The frogs were also uninfluenced. On removing the animals, the dog died almost immediately. The other animals slowly recovered.

On a succeeding day I repeated this experiment on other animals of the same kind, continuing it for thirteen hours. The result was the death of the pigeon and of the kitten; great prostration of the dog, which, however, recovered on removal into the air; and entire escape of the rabbits and the frogs. The temperature in all these experiments was from 60° to 65° Fahr.

We gather from these experiments the fact, that in carnivorous animals and in birds ozonized oxygen, at ordinary temperatures, produces what would be called pathologically a general inflammatory condition, with death from separation of fibrine, as is common in inflammatory diseases. We see also that in one experiment local inflammatory mischief was induced in the trachea. In rabbits, the circulation is quickened by the same process, and waste of tissue results, but the animals are enabled to live. In a succeeding chapter, I shall show the effects on similar animals of common air charged with ozone.

TINCTURE OF DIGITALIS IN DELIRIUM TREMENS.

By James Pollard, Esq., Torquay.

J. M., aged 46, a strong muscular man, much addicted to drinking, was kicked by a horse in the leg, which became inflamed, and confined him to his bed. On being sent for on Friday evening, January 6th, I found him very restless, tossing about in bed, fancying that dogs were biting him, and other delusions. His wife informed me that he had not slept for the last two nights, and that she had had great difficulty in keeping him in bed. I at once gave him a strong glass of brandy and water, with half a grain of muriate of morphia.

Jan. 7th. He passed a troublesome night without any sleep. I prescribed for him two cathartic pills to be taken immediately; a saline mixture during the day; and in the evening, half a grain of morphia and half a drachm of tartar emetic wine every two hours, which was given regularly until 10 P.M. on the 8th without any good results.

About 2 A.M. the following morning, I was requested to see him immediately, as it took three men to keep him in bed; and on my arrival I found this to be the case. I then gave him four drachms of tincture of digitalis. He very soon afterwards became tranquil and slept for an hour.

At 4 A.M., three drachms more of the tincture were given (about half an hour afterwards he became very sick), which kept him quiet until 10 A.M., when, as he became again disturbed, the draught was repeated containing four drachms of the tincture. He did not sleep, though he was quiet till evening, when I again saw him, and found him as bad as ever. Four drachms more of the tincture were given, with the best results, as he slept the whole of the night and the greater part of the next day; and from that time he rapidly progressed.

I believe that, if I had given him the fourth dose at a shorter interval, a more satisfactory result would have been earlier produced.

The Irish Medical Man, says Dr. Mackesy, "is exposed to great risk from contagion. He has to combat fever in all situations and at all seasons. It is a startling fact that the mortality—the proportionate deaths of the medical officers of Irish charitable institutions, exceeded by more than one-half the proportionate deaths of the officers of the British army during the Peninsular war."