view the apoplexy as influencing the production of the diabetes, ending in the recovery. And otherwise, whatever might be the danger incurred in treating similar cases in younger persons, in this aged female's case the practice may have led to a more fortunate result than could have been anticipated in such circumstances.

ARTICLE VI.—*Experiments on the Influence of Ozonised Air upon Animals.* By W. W. IRELAND, M.D. Edin.

THE first means used to produce ozone was by burning phosphorus in closed vessels. The gas was then passed through water, in order to get rid of the phosphoric acid. This, however, did not separate it completely: the air was still charged with the white vapours of phosphoric acid, which, of course, would tend to vitiate the experiment. Moreover, by producing ozone in this way, the relative proportion of oxygen to the nitrogen in the included air was notably diminished by the large amount of oxygen taken up in the oxidation of the phosphorus. I then tried another way to procure ozone—two parts of powdered hypermanganate of potash with three parts by weight of sulphuric acid were introduced into a glass bottle. The sulphuric acid acts slowly on the hypermanganate, setting free some of its atoms of oxygen in the form of ozone, which is thus added to the enclosed air. The permanganate of potash and sulphuric acid were introduced successively into a glass bottle, the cork of which was fitted with two tubes; one of these communicated with a smaller double-necked bottle containing water; the second neck gave passage to a tube which communicated with the spout of a glass jar. This jar had a short broad neck and a large wide shoulder, which became like a balcony when turned upside down in a plate of water. This jar received the ozonised air when pushed through the water, which was done by a pair of bellows communicating with the other cork tube of the first bottle. If the action was allowed to go on too rapidly, the ozone became mixed with a violet-coloured vapour,¹ which, after some days' use, gave a rose tint to the pipes down nearly to the water, but not to those that received the ozone after passing through the water, which ozonised air, as before said, was collected in a jar turned upside down in a plate with water slightly heated.

¹ No doubt the same mentioned by Berzelius as produced by the action of sulphuric acid on hypermanganate of potash at a temperature of 130° Centigrade, and found to be a mixture of permanganic and sulphuric acids. Professor Fresenius, to whose kind advice and encouragement I owe much, approves of my apparatus, but remarks that, to purify the produced gas, "tubes filled with powdered pumice-stone are more efficacious than water alone." I imagine, however, that the Professor refers more particularly to the ozone produced by phosphorus.

The animal introduced took refuge from the contact of the thin stratum of water into the shoulder of the jar. In all the experiments, save No. I., hypermanganate of potash was used.

Experiment I.—A mouse exposed to ozonised air for one hour—very much excited, leaping and running about—did not appear much diminished in vigour at the close of the experiment, but gradually became weaker, and died in about an hour and a half after being withdrawn.

Experiment II.— $3\frac{1}{2}$ grammes of hypermanganate of potash.—A mouse kept in one hour—respiration accelerated—much excited—leaped and ran round about the jar; when taken out, strong enough to try to escape—warmed, and offered food—died in about ten hours after, of gradual exhaustion.

Experiment III.— $3\frac{1}{2}$ grammes of hypermanganate used.—A frog kept in for two hours—respiration accelerated—eyes fixed and starting—no excitement; seemed exhausted, but recovered quickly, and did not appear to be the worse next day.

Experiment IV.— $3\frac{1}{2}$ grammes.—A sparrow shut in half-an-hour—passed the stream of ozonised air through fresh calves' blood instead of water; it caused the blood to coagulate a little more quickly, but had no other visible effect. The respiration of the sparrow became hurried; it looked pert and bold and much excited, but soon became exhausted—number of respirations increased by somewhat less than one-third. The little animal seemed much fatigued when let out, but quickly recovered. The same sparrow was introduced next day—did not appear so readily affected as before, and was allowed to escape.

Experiment V.— $3\frac{1}{2}$ grammes.—A sparrow shut in one hour—great excitement—respiration accelerated by one-third—symptoms of sinking, with occasional convulsions; very much exhausted when taken out, but recovered in an hour or two. The sparrows recovered better than the mice, probably owing to the greater extent and activity of their respiratory apparatus.

Experiment VI.—3 grammes.—A mouse; at first seemed exhilarated—respirations short and quick, difficult to count. In an hour appeared weak and exhausted, but excitement increased—running and leaping about. In three hours it died in the jar.

I examined the bodies of the three mice that died; the venous blood appeared to be lighter in colour than usual. In No. II. the lungs appeared to be congested, but pieces of them floated in water; the hearts still contained blood. No other changes could be made out, so I determined on an experiment with a larger animal.

Experiment VII.—5 grammes.—A rabbit shut in a hermetically sealed box with two little glass windows—respiration accelerated exactly one-third—no excitement observable; temperature before being put in 36° Centigrade, but temperature only 31° . When let out surface felt warm, and it ate the very moment it was out. Kept two days longer under observation; it appeared to be quite well.

Experiment VIII.—12 grammes.—A rabbit kept in four hours—respiration much accelerated—no visible excitement, save a very little which appeared towards the end—evidently did not suffer much uneasiness. When let out, dull and exhausted, but able to walk—stunned with a blow on the back of the neck, thorax opened, heart still beating—blood coagulated instantaneously in the pericardium when the aorta was cut—clot very firm and tenacious. A little more blood collected in a shallow dish coagulated at once. Arterial and venous blood retained their distinguishing hues—perhaps venous blood a little redder, but I could not be certain. No other changes noticed—stomach, intestines, and bladder full. Portions of the blood, brain, lungs, liver, kidneys, and contents of stomach, put into closed phials, and tried with the ordinary ozone test-paper as well as that of Houzeau, but no ozone could be detected save in the lungs, and a trace in the contents of the stomach.

These, as might be expected, resemble the results of the exposure of animals to oxygen gas, which, however, is described as bringing on comatose symptoms, and, when the animals are withdrawn, as leaving less deleterious after-effects than in Nos. I. and II.

I never observed any coma, and I failed to produce “bright scarlet blood in the veins”¹ with ozonised air as has been done with oxygen.

These experiments were most carefully performed, and all sources of complication avoided as carefully as possible; and, as I felt satisfied of their correctness, I saw no reason to sacrifice the lives of more animals in repeating them. I submit to the reader the following conclusions:—

I. Ozonised air accelerates the respiration, and, we may infer, the circulation.

II. Ozonised air excites the nervous system.

III. Ozonised air promotes the coagulability of the blood, probably by increasing its fibrin. In the blood, however, ozone loses its peculiar properties, probably entering into combination with some of the constituents of the circulating fluid.

IV. Animals can be subjected to the influence of a considerable proportion of ozone in the air for hours without permanent injury; but in the end ozone produces effects which may continue after its withdrawal and destroy life.

AVIGNON, 18th December 1862.

¹ Carpenter's Physiology, 1853, p. 543.