

Effect of Oxygen upon Animal Life.

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Introductory

Oxygen

Occurrence, quantity, etc.

Function in life. Animal and plant.

Action in putrefaction

Former ideas of its effect upon animal life.

J. F. W. Johnston.

B. W. Gimmins.

T. H. Dismore (Experiments).

Plates and Photographs.

Experiments.

Bat.

Rabbit.

Chickens.

Human

Conclusion.

The writer is not the originator of this subject but one among the many that have written about it, and one among the few, according to records, that have carried on experiments as proof of stated views.

The general statement that an oxygen atmosphere is destructive to animal life is thoroly circulated, and believed to be true by many. There are professors in our institution that were of this opinion, and some of them laughed at me for repeating an experiment the result of which had been established over a century ago by the ablest scientists of that time.

However common oxygen is, there are many who would not, if they heard it spoken of, know what it is, where it is found, or what its use is. For this reason, a short account of it has been considered necessary.

Oxygen is the most abundant of all elements. Four-fifths of the air, eight-ninths of the water, and about two-fifths of the earth's solid crust is composed of it.

It is essential to life. Its action on animal life is briefly as follows:- The air is taken into the lungs thru the bronchial tubes, then into the minute air chambers in the lungs which are separated from the blood vessels only by a very thin membrane and the carbon-dioxide exchanges with or passes out thru the separating membrane into the air chambers of the lungs, and the oxygen of the inspired air passes in thru the separating membrane and loosely combines with the red blood corpuscles of the blood thus forming oxyhaemoglobin. This oxidized blood then goes thru the heart, and thence thru the system, and the oxyhaemoglobin is presumably reduced to haemoglobin in the capillaries, where the affinity of the corpuscles for oxygen is over-

come by the affinity of the tissues of the body.

That the oxygen combines with the haemoglobin has been for some time a question of considerable discussion, and the generally accepted proposition now is that the oxygen is loosely combined, because one hundred volumes of blood under ordinary conditions have the power of absorbing only one volume of oxygen from the air, while one hundred volumes of arterial blood in a normal condition contain from fifteen to twenty-five volumes of oxygen. Therefore it must be held otherwise than in simple solution. This is of vast importance for if the haemoglobin did not have the power of combining with oxygen we would require fifteen to twenty-five times the volumes of blood we now have to carry the same amount of oxygen thru the system.

Bunge says, "The affinity of haemoglobin is shown by the fact that animals can live in an atmosphere where there is only one-third as much oxygen as in our present atmosphere." That is their arterial blood contains as much oxygen as it would in the common atmosphere. Then why cannot an animal thrive in an atmosphere of pure oxygen?

Respiration also occurs in plants continuously. Oxygen being inspired, and carbon-dioxide expired, as in animal respiration. But there is, in plants, another process, "Fixation of Carbon", in which carbon-dioxide is inspired and oxygen expired. This process only occurs in the presence of direct sunlight, and usually obscures respiration.

Oxygen is the chief agent in putrefaction and decay, both processes being accelerated by an increased percentage of it. Hence it is very important in arresting contagious diseases by rapidly oxidizing carcasses. Thus it tends to rid the world of all inanimate bodies. It is becoming quite useful as a remedy or preventive of lung diseases.

The following is a sample of passages taken from scientific books of the present century, which are often quoted at the present time, both by authors and teachers.

J. F. W. Johnston, in his "Chemistry of Common Life," published 1869 says, "Animals breathe oxygen with an increase of pleasure, but it excites them, quickens their circulation, throws them into a state of fever and finally kills them, by excess of excitement."

They live too rapidly in pure oxygen gas, and burn away in it, like the fast flaring candle. Did the atmosphere consist of oxygen only, the lives of animals would be of most brief duration."

The above statement accompanied by no experimental proof, neither is any quoted. It is evident that such statements should have some proof before being published. However, Mr. Johnston, may have proven the statement by experiment and since it was generally accepted at the time, he thought it useless to publish it, which by the way is a very poor excuse.

C. W. Cummings, in his "Chemistry of Life and Health," published 1892 says "The removal

of nitrogen from the atmosphere, would be as fatal as the removal of oxygen, and universal death would be accompanied by universal conflagration."

The first of the above statement was answered in the comment on Johnston's statement. It seems hard to accept, and it is doubtful if "universal death would be accompanied by universal conflagration". No doubt combustion would be greatly accelerated if the nitrogen was removed from the atmosphere, but why should there be universal conflagration? Probably the kindling temperature would be lowered a very little, but before any thing would burn it would first have to be raised to this kindling temperature.

I will admit that certain materials would burn in an atmosphere of oxygen that will not burn in our present atmosphere. But this only implies that some of our present mechanisms would have to be constructed from other materials, e.g. stores furnaces etc., which could be made of earthen-ware. But most common machinery could be made as usual, for kindling

temperature is never reached.

If a building or anything else should take fire, the flames could be suppressed with substances that were oxidized to a maximum, i.e., water would suppress flames by displacing the oxygen and also from its cooling effect.

Carbon-dioxide (CO_2) would also prevent combustion.

Gray says "The Creator has adapted the atmosphere to the support of life, and any thing which destroys the relation thus established renders it deleterious to the animal constitution."

If the Creator did "adapt the atmosphere to the support of life", why did he not adapt other things to their support. - Plains, deserts, poisonous plants etc. I should say from all sources of reliable information relating thereto, that the atmosphere seems to be a general result of the earth's gradual change from a ~~mottled~~ mass to our present state.

Our relation to other planets may also have had an influence on our atmosphere.

T. H. Dimmore Jr. tested (1886) the effect of oxygen upon animal life, but in a very crude

way. This experiment consisted in placing kittens and mice in large jars of oxygen without any inlet or outlet. This would not give satisfactory results, because of the excreted (CO_2) carbon-dioxide, and organic substances that are injurious to life. Also because of the dilution which would necessarily follow.

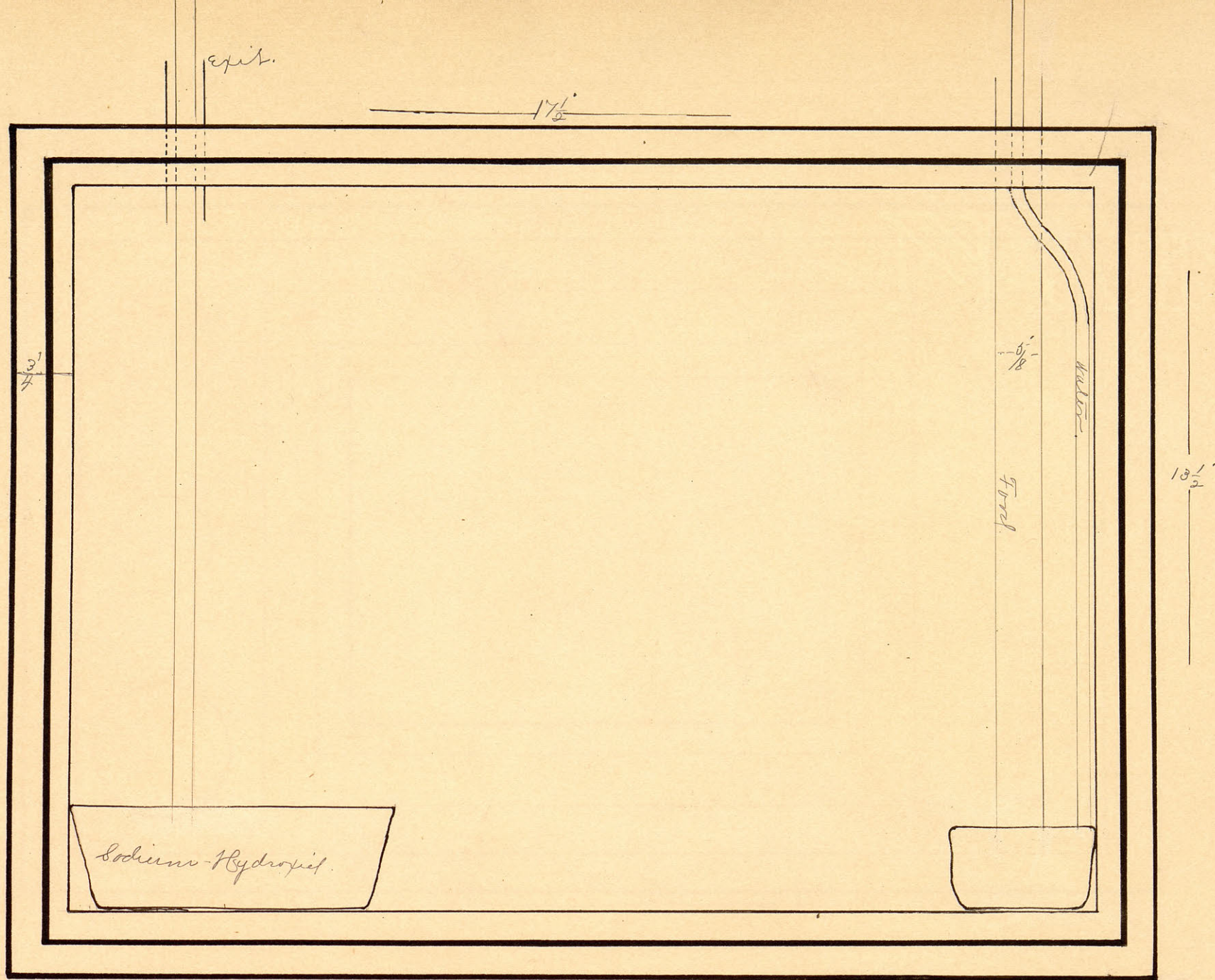
Benjamin Ward Richardson M.D. conducted some experiments in which he confined mice in two chambers, one containing simple oxygen the other oxygen - the results of the oxygen only will be given.

1st, Experiment, temperature 65°F , mouse dead at the end of the fourth hour.

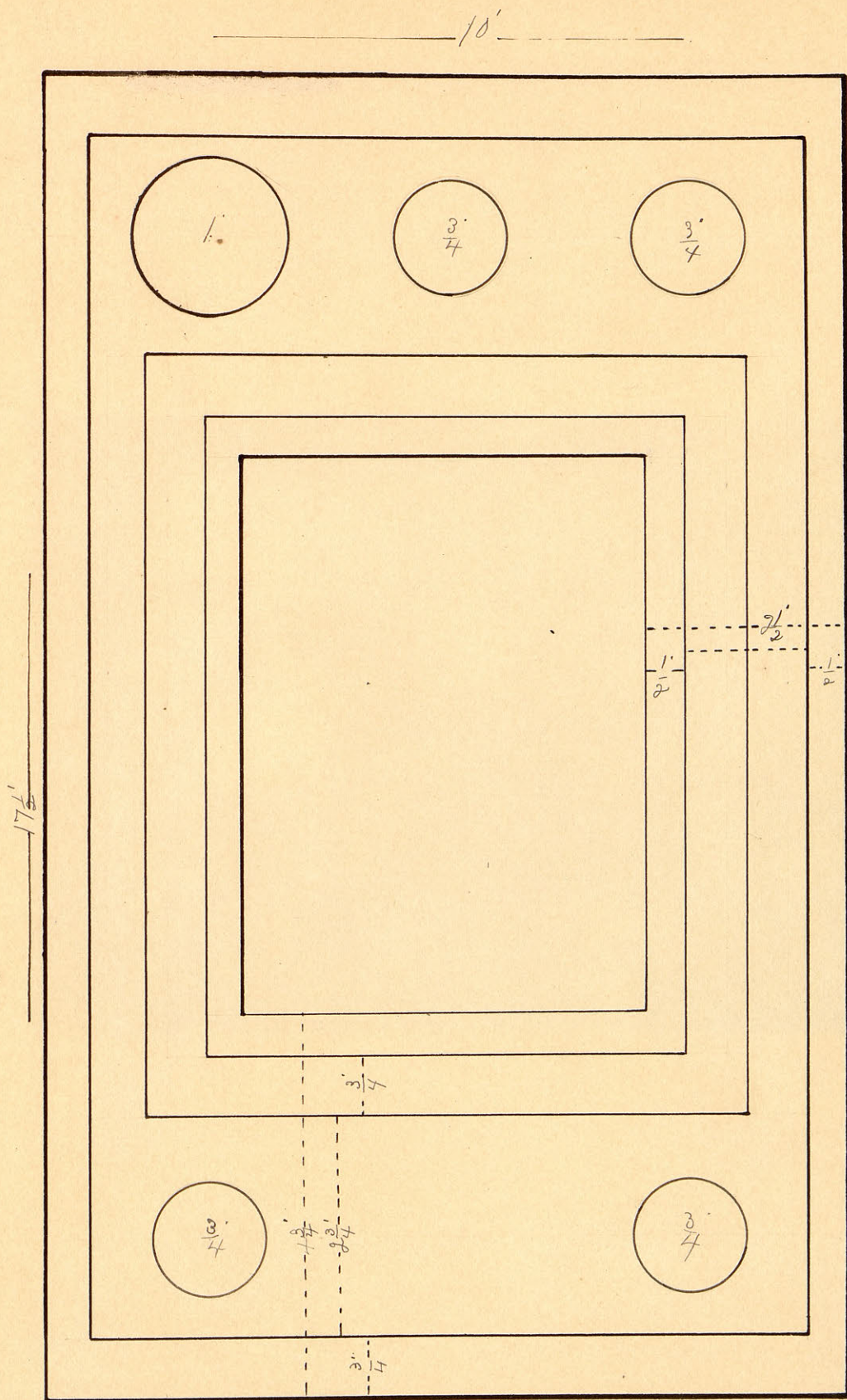
2nd Experiment, temperature 70°F mouse taken out at the end of the ninth hour in a deep sleep.

3rd Experiment, temperature 66°F , mouse dead at four hours and forty two minutes.

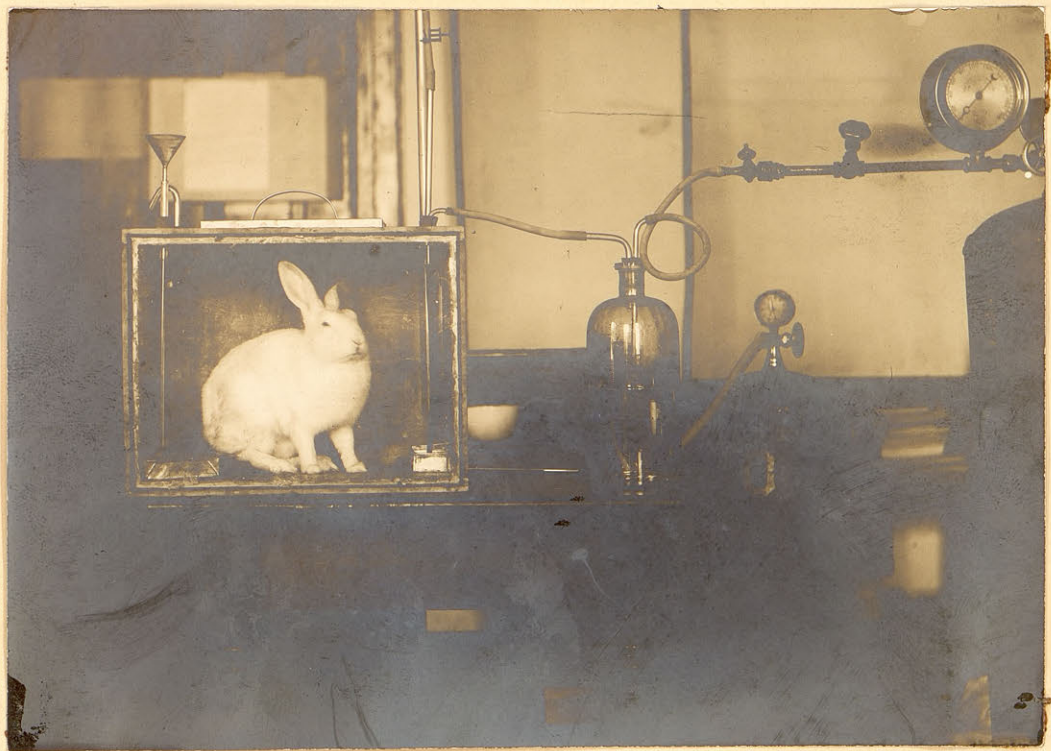
These experiments appear quite satisfactory and they seem to reveal the fact that oxygen is destructive to animal life. However a mouse is very delicate, and the confinement may have been sufficient cause to bring about death. But to have a



Side View



Top View



fair test, animals of average vitality should be used as subjects.

In my experiments, an air tight box (see plates and photo) of one cu. ft. capacity, with a glass front. There were holes thru the top, thru which, food and water were given to the animal. The animal was put in the box thru an opening in the top which was sealed during the experiment. The holes were also closed with rubber stoppers, so there was no means of air going into the box.

The air in the box was gradually displaced by oxygen after the animal had been placed in it, by passing a current thru a wash bottle then by rubber tubing into the lower front corner. The exit tube being at the top, diagonally opposite this, a current was produced in the box and thus the expired carbon-dioxide and other substances that would dilute the oxygen, were driven out. There was also a pan partly filled with sodium-hydroxide (NaOH) and covered with screen wire, placed in the bottom of the box, which would tend to absorb carbon-dioxide.

The oxygen was made from potassium

chlorate ($KClO_3$) and manganese-dioxide (MnO_2) and stored in gasmeters a week previous to the experiment.
First Experiment.

In this experiment a grown male cat was confined in the box (see plates and photograph) 5:00 P.M. April 15th. A record was made of all noticeable changes which follows. Experiment closed 10:45 A.M. Apr. 16th.

Time.	Respiration.	Remarks.
P.M. 5:00	24	Before putting in box.
5:30	24	Asleep.
6:00	29-30	Awake lying still
6:30	32	Asleep.
7:30	30-32	Awake lying quiet.
8:00	31-32	Asleep.
9:00	---	---
9:30	---	---
10:00	32-33	Asleep.
12:00	32-33	Up looking around.
A.M. 3:30	34-35	Asleep.
4:30	---	Moving around - Breathing a little short.
5:00	34	Sitting up.
6:00	41-42	Breathing short and jerky.
7:30	38	Sit on haunches and eat some.
8:30	35	Asleep.
10:30	27	Looking around.
10:40	---	Explosion.

The cause of the explosion is a mystery. It appears that there was some explosive gas formed in the box, for when a splinter with a spark on it was held near the exit tube a flame immediately ran into the box - the explosion followed blowing off the lid, breaking out the glass front, and singeing the cat a little. This was all the change noticeable in the cat except that he was a little stiff, due to the close confinement. It is true the cat's respiration increased, and probably oxygen was the cause, yet it had diminished almost to the normal before the explosion occurred. I believe if the explosion had not happened the cat would have lived in the oxygen indefinitely without any apparent change, if some means had been employed to supply the oxygen.

Second Experiment

A white rabbit was placed in the same box and under the same conditions (referring) that the cat had been in, and a similar table of results would have been given if there had been any noticeable change, but the rabbit was taken out after fifty three hours

in just as good a condition, apparently, as it was when the experiment began. Grass and clover were eaten heartily during the experiment.

Third Experiment.

In this experiment abantaher and a young chicken four weeks old, were placed under the same conditions as the rabbit and cat, had been in. It was not a fair test on the young chicken, because the hen would occasionally pick and interfere with it. However they were both apparently in as good a condition, at the end of the experiment as in the beginning.

There was some effect, gasping and dumpish actions, about three hours before the experiment closed. This was probably due to the expired air, as there did not seem to be a very strong current of oxygen passing thru the box, and hence there was nothing to drive the expired air out.

When the peculiar gasping and dumpish actions were noticed, but on turning on a full current these actions were no longer present. The hen became quite lively and began to chase the little chicken again and abused it severely, and did this until the

close of the experiment.

The experiment was continued for forty four hours, and will be repeated for a longer period.

Fourth Experiment.

The rabbit that was used in the second experiment was confined again for twenty hours. Then immediately dissected, and the only change noticeable from the normal was in the blood. It seemed to clot very rapidly when exposed to the air, and the arterial blood was of a brighter red, the venal blood probably was also a very little changed in color.

Fifth Experiment

In this experiment, two faultless hens were placed in the box, under the same conditions as, the chickens in experiment third. They were kept, in the box, for six days and twenty-one hours, and were not affected in the least. When they were taken out they were in just as good a condition as when they were put in.

An observer was present in the first experiment continually, and in the second one for the first nineteen hours, and it was never left alone more than four hours at any one time. The other three were continually watched.

It will be admitted that more experiments would be better to establish this fact. But in general it seems that oxygen is not destructive to animal life.

If some weak, frail animal was taken immediately from ordinary atmosphere and confined in an oxygen atmosphere, other things being equal, it would soon die. As when some consumptive or unhealthy person goes immediately from an eastern city to a location where the conditions are most favorable to suppress consumption or improve health. Keeping all other conditions the same, he usually loses strength and soon passes away.

But if the weak, frail animal is gradually accustomed to the change, other things equal, it would no doubt grow stronger. And would soon thrive in an atmosphere of pure oxygen. As when a consumptive or unhealthy person goes gradually to a location, other things equal, where the

Conditions are favorable to suppress Consumption or improve health, he usually grows stronger. This applies to either animals or man, of average or strong vitality. But not so much as in the weaker ones.

Likewise a frail or delicate plant is usually killed by too sudden or too great a change, but if the change is gradual its vitality will be increased. This is also true of a strong plant.

The effect of oxygen was also tried on myself, but in a rather crude way. By placing the delivery tube into my mouth and closing my nose while breathing nothing but oxygen was inspired. Expiration was thru the nose. This was continued for thirty minutes. The first time with no effect. The second time it was continued for an hour, and the only effect, if any was a drop of about six pulsations per minute. However this may have been caused, in part, at least, by remaining quiet. It was found, both on myself and on another person, that a full breath of oxygen would last about one third longer than common atmosphere.

It seems as tho the world would be very similar to what it now is, if we had an atmosphere of oxygen.

There would probably be a decrease in respiration and probably a decrease in lung capacity. But it is hard to believe that there would be Universal death accompanied by universal conflagration."

From the experiments the following conclusions have been drawn.

First, that oxygen does not cause high life, fast living etc.

Second, - It does not cause any unnatural sleep or unconsciousness.

Third - It is not destructive to animal life.