

## Lesson 6: Lavoisier's Law and Creation

We have all seen names of fire, and we recognise what they are, but when we see these flames soaring up do we ever stop to ask what in fact they are. Today we know that flames are composed of gases combined with oxygen from the air. But, previously some chemists had thought that there was some invisible substance in charcoal and oil which, when there is ignition, is released in the form of flames. To this substance they gave such names as "sulphur" This idea gathered many supporters, and many scientists subscribed to it, calling this invisible substance "phlogiston".

George Ernst Stahl; German scientist, chemist and biologist, who, in 1694, became professor at Hall University. (b. 1660, d. 1734) said that phlogiston was a substance, which escaped and which was the basis and essence of fire; that it was hidden inside inflammable materials; and that at the time of burning it was released in the form of flames.

He said that the reason that wood, charcoal and oil burn readily is that there is more phlogiston in them, but that in metal there is less of it. He and other followers of this idea believed that in the combustion of iron, phlogiston was released and what remained took the form of rust. They also said that when sulphur was burnt, phlogiston was released, and a colourless gas remained which was sulphur without phlogiston.

Rouelle [French scientist (b. 1703. d. 1770) a great chemist and the tutor of Lavoisier, also accepted this theory, and tried very hard to prove it. Lavoisier, the French scientist, one of the founders of modern chemistry, researched into what his teacher, Rouelle, and other scientists had said, spending much time thinking about their theory, until he realised that the belief in phlogiston was groundless.

In 1772, he effected the combustion of a piece of lead by focusing the rays of the sun on to it by means of magnifying lenses. He observed that its weight increased. He deduced that some part of the air had become combined with the metal and had added to its weight: if phlogiston had been there, the weight of the lead would have decreased. Thus, he claimed, the phlogiston theory should be abandoned.

In support of his view he asserted that if the 'burns' lead were heated it would return that part of the air which it had taken, and would again become lead.

In 1776 he performed another experiment in which he put a crucible of mercury over a heater and left it for 12 days. It was not long before a light red film was observed on the surface of the mercury. He found that the air in contact with the mercury could not support life. He deduced that a part of the air inside the crucible had reacted with the mercury, forming a light red film. In order to confirm this, he separated the light red film and heated it. He observed that a gas was released from it. This gas supported life. He came to the conclusion that there is nothing, which is given off from mercury when it is heated. But rather that there is a gas in the air which combines with the mercury to form mercurous oxide ( $\text{HgO}$ ).

Lavoisier then asserted that there was no evidence for the existence of phlogiston. In chemical reactions the total weight of all substances entering into the reaction equals the total weight of all the substances resulting from that reaction. In other words, 'Rien ne se perd, et rien ne se crea.' (Nothing perishes, and nothing is created).

In this way the theory of phlogiston lost its supporters. We know today that when something catches fire it is because it enters into combination with oxygen, and not because an invisible substance comes out of the combustion in the form of flames. The history of phlogiston and the theory of Lavoisier show us clearly that when Lavoisier said 'Nothing perishes and nothing is created.' By this he meant that in a chemical reaction nothing disappears and nothing is added, and he was not referring to the origin of the creation of the world, which is a philosophical issue.

Unfortunately, some people, imagining that Lavoisier had wanted to answer a philosophical question, asserted that the event of creation was not compatible with Lavoisier's theory, because he has said that nothing is created and nothing is lost. How, they asked, could something be created from nothing? However, by referring to the history of the two theories, it becomes clear that Lavoisier was referring only to chemical reactions, which take place in the present world, and he meant that this world is such that within its bounds nothing extra can be added and nothing can disappear. And the problem of whether the world was created or whether it is eternal is a philosophical matter about which Lavoisier's theory remains totally silent.

The point is that when we learn about scientific theories and ideas, we must look deeply into what has been said, and be careful to examine them with specialists in each matter so that the truth may become clear. Because it is possible that inattention to these matters may result in a weakening of our beliefs.

Moreover, we must not submit to a theory without carefully examining it, so that we imagine it to be an indubitably ascertained fact. There have been many theories, which have been supported through the ages by various scholars, but which were refuted later and all traces effaced. An example of this is the theory of phlogiston whose history we have just related. Even the theory of Lavoisier has lost its original form (the principle of the conservation of matter), and has become the principle of the conservation of matter and energy. For example, if 8 grams of oxygen were made to react with 1 gram of hydrogen, Lavoisier's theory would predict that 9 grams of water would be formed. But we now understand, through more exact calculations that a small part of the substance is converted into energy and that the amount

of water formed is a little less than 9 grams.

## Questions

1. What substance forms the flame in a burning fire?
2. What was people's opinion about this phenomenon before the opinion of Lavoisier?
3. Whose theory says, "Nothing perishes and nothing is created?"
4. What should be our attitude to the changing theories?
5. Should we accept some opinion without ascertaining its truth?
6. Is it true that flame is a certain form of substance that comes out of the burning materials?
7. Does Lavoisier's theory deal with whether the world is created or not?
8. What happens to the gases coming out of the burning materials and the oxygen present around?
9. Is there a difference between a philosophical and a chemical issue?
10. Is Lavoisier's theory a chemical or a philosophical issue?
11. Does the principle of the conservation of matter prove that it is not created?
12. What change has taken place in the theory of conservation of matter?

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