Light and heat: Chemical substances

Learn from history, we're told. During 2015, the historical committee of the Swedish Chemical Society will help us do just that. We start with Light - in honour of The Year of Light.

What is light? Through the ages, scientists, chemists and physicists have come up with many different answers. However, one phenomenon which they all noticed is that light was inherent in chemical reactions.

When material bodies were set on fire, light was emitted, and when they stopped burning, the light went out.

Until mid-1800, scientists had a simple explanation. Light was a weightless material substance, a so called *imponderabilium*. Heat, magnetism, and electricity were other examples. Empirical studies indicated this. An electric spark burnt a hole in paper; hence it must possess an inherent material character.

Carl Wilhelm Scheele burnt chemical substances in a sealed space above a water surface, he noticed that the volume in the sealed space decreased, and then concluded that *"fire air"*, considered as one component of air (the other one, Scheele called *"foul air"*), somehow had been involved in a chemical reaction. In addition, he noticed that it had become warm outside the glass, and that sometimes the burning also generated light.

As Scheele was a scientist, his explanation was that phlogiston, believed to be present in any combustible body, was released in the burning and combined with fire air, generating the chemical substance heat. As heat was such an extremely fine substance, it could penetrate the walls of the glass vessel. When large amounts of phlogiston were present, the chemical substance light was produced.

During the so called chemical revolution, when the Frenchman Antoine Lavoisier was one of the leading figures (although far from the only one), the approach to combustion changed, and so too did the view of heat and light. They didn't lose their status as chemical substances, but they transformed from complex to simple chemical substances.

Now, combustion resulted in oxygen being absorbed, but the oxygen gas was in itself a chemical compound comprising oxygen and heat. The combustion decomposed the oxygen gas so that the oxygen produced an oxide, and the heat was released. As a scientist, Lavoisier was also keen to explain the origin of the heat generated during the combustion, and to him heat and light were still weightless material substances.

This explains why the chemical substances heat and light can be found at the top of the list of simple substances made up by Lavoisier. The list is sometimes, a little inappropriately, called the first list of elements (because it "almost" corresponds with the substances we regard as elements today). However, it was in line with Lavoisier's perception of what should be regarded as an element, namely "the simplest substances that one is able to chemically analyse".

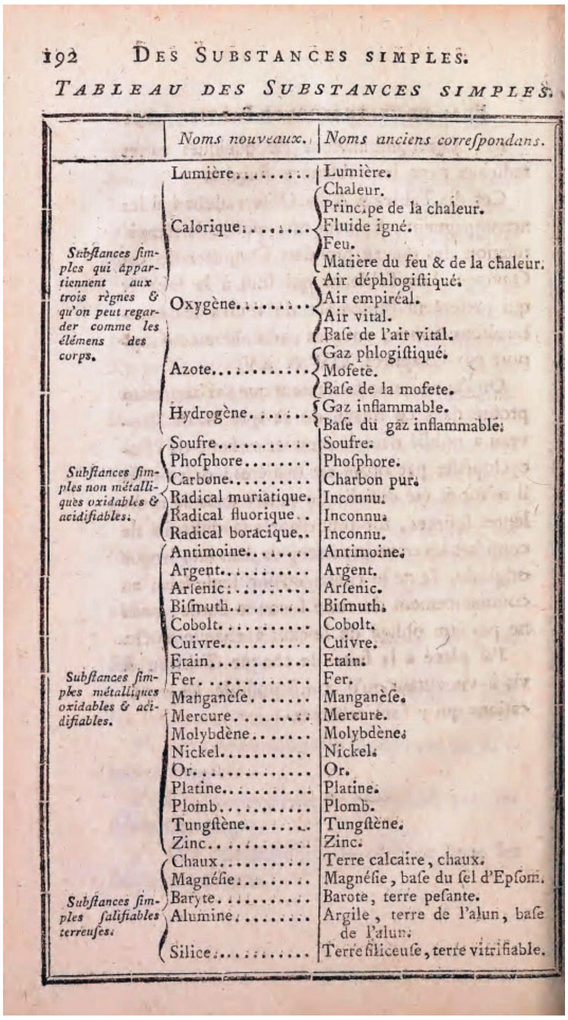
Both Scheele and Lavoisier had shown, albeit within different theoretical frameworks, that the substances heat and light could be chemically analysed. Thus, the idea of light and heat as imponderabilia was such an empirically established fact that it survived the theoretical reform that resulted in a new approach to combustion.

The first chemical nomenclature according to the new chemistry in Sweden by Anders Gustaf Ekeberg, Berzelius' teacher, was published in 1795. Not only did this contain the new names for fire air and foul air (oxygen and nitrogen), but it also kept heat and light as chemical substances.

Berzelius was also a proponent of the notion, and in 1808 he even considered whether light, heat, electricity and magnetism could be different qualities of a common, underlying substance, and that perhaps all of them "consisted of common, simpler, to us completely unknown elements". Berzelius was of course one of the greatest experimentalists in the history of chemistry.

Reflecting on the reasons for a scientist's support for a certain theory is a useful exercise. KB

Anders Lundgren, professor, department of History of Science and Ideas, Uppsala university.



192 DES SUBSTANCES SIMPLES.

TABLEAU DES SUBSTANCES SIMPLES.

	Noms nouveaux.	*Noms anciens correſpondans.*
Subſtances ſimples qui appartiennent aux trois règnes & qu'on peut regarder comme les élémens des corps.	Lumière	Lumière.
	Calorique	Chaleur. Principe de la chaleur. Fluide igné. Feu. Matière du feu & de la chaleur.
	Oxygène	Air déphlogiſtiqué. Air empiréal. Air vital. Baſe de l'air vital.
	Azote	Gaz phlogiſtiqué. Mofete. Baſe de la mofete.
	Hydrogène	Gaz inflammable. Baſe du gaz inflammable.
Subſtances ſimples non métalliques oxidables & acidifiables.	Soufre	Soufre.
	Phoſphore	Phoſphore.
	Carbone	Charbon pur.
	Radical muriatique.	Inconnu.
	Radical fluorique	Inconnu.
	Radical boracique	Inconnu.
Subſtances ſimples métalliques oxidables & acidifiables.	Antimoine	Antimoine.
	Argent	Argent.
	Arſenic	Arſenic.
	Biſmuth	Biſmuth.
	Cobolt	Cobolt.
	Cuivre	Cuivre.
	Etain	Etain.
	Fer	Fer.
	Manganèſe	Manganèſe.
	Mercure	Mercure.
	Molybdène	Molybdène.
	Nickel	Nickel.
	Or	Or.
	Platine	Platine.
	Plomb	Plomb.
	Tungſtène	Tungſtène.
	Zinc	Zinc.
Subſtances ſimples ſalifiables terreuſes.	Chaux	Terre calcaire, chaux.
	Magnéſie	Magnéſie, baſe du ſel d'Epſom.
	Baryte	Barote, terre peſante.
	Alumine	Argile, terre de l'alun, baſe de l'alun.
	Silice	Terre ſiliceuſe, terre vitrifiable.

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