Lectures 10, 11 (follow Bensaude-Vincent 2002 for reference)

Lavoisier and a New Language of Chemistry

Importance of language in constructing a scientific community: 1. Mutual understanding across cultures; 2. Organization of specific worldviews. Names should follow nomenclature.

1782: Guyton undertook a project to come up with a chemical nomenclature. He was still a supporter of the phlogiston paradigm:

* Denomination must reveal the nature of things.
* He Preferred Greek terms than Latin.
* Method: simple names for pure substances and compound names for compounds to reflect upon the chemical compositions.
* If the composition is uncertain, a meaningless term could provisionally refer to the substance.

1782: Lavoisier with his French interlocuters publishes “Methods in Chemical Nomenclature”: New way of naming chemicals based on the oxygen theory. How did it work?

1. A substance that could not be decomposed further: carbon, iron, sulfur>elements: the basis of the naming system.
2. Calxes =oxides> taken to be combining simple elements with oxygen, giving in oxides of carbon, iron, or zinc, for instance.
3. Acids: to be named after their elements according to the amount of oxygen involved in their formation> sulfurous acid and sulphuric acid.
4. So, the new chemical vocabulary is based on two things: a) substances involved in their compositions; b) the ratios in which they occur>Instance: Calcium Nitrate and Calcium Nitrite: ate has higher oxygen content than ite.
5. Metals and the bases of various salts along with hydrogen and oxygen.
6. Another gas: azote>nitrogen.
7. Two other elements: caloric and light.

Based on this principle, Lavoisier develops his fundamental ideas:

1. Common air is a mixture and not a compound, nor is it an undifferentiated substance.
2. In a chemical reaction, no matter is created or destroyed: conservation of mass.
3. Substances should be named for their constituent parts.
4. Every chemical reaction is like an equation involving matter, and the balance establishes its validity.
5. The measure of Matter is its weight. In every reaction, the weight of all reactants before and after will always be equal.

1787:

* Guyton went to Paris to submit his nomenclature to the Royal Academy at the high noon of the phlogiston/oxygen tussle.
* Before he did so, he had a meeting with Lavoisier, Berthollet (1748-22) and Fourcroy (1755-09) who convinced him to modify this method of naming substances in favor of the oxygen paradigm.
* Oxygen and Hydrogen replaced phlogiston formally

Basic philosophical assumptions:

* Nature was identified with the products of chemical manipulations done in laboratories>each compound would be named in accordance with its decomposition in a controlled environment of the laboratory.
* Chemical compounds were the combination of two elements or two radicals acting as elements (a dualistic theory of compound).
* Algebraic analytic representation of reactions calling for a structural system of nomenclature.

Effects:

* The separation between the lifeworld of these elements and compounds in artisanal traditions and academic chemistry>chemistry was abstracted from the dyers, pharmacists, glass-makers.
* Names such as iron sulfate and iron sulfite did indicate the nature and proportion of the constituents in compounds>this became the academic chemistry.
* The marginalization of qualitative data in favor of balance. The sensory descriptions of substances took a backseat. Examples: ‘white of lead’>lead oxide; Prussian blue>prussiate of iron; stinking air>sulfurated hydrogen gas
* The work of abstraction explained.

Quantification is premised upon the introduction of an army of scientific apparatuses.

1. Borrowed instruments from other disciplines, most notably from Geology. The 1760s: he mastered the use of thermometric and barometric measurements in geological surveys and developed hygrometric methods for analyzing mineral water.
2. 1783: Calorimeter in collaboration with Laplace. Measuring device for heat exchange in reactions.
3. Balance: Compounds are characterized by constant composition. The proportion of the weight of one constituent to another is always constant in any pure compound: The new weighing machine capable of weighing to one part in 4000000 could demonstrate and confirm this theory.
4. Balance as a regulatory instrument: To show that the weight of reactants was the same as the weight of products in any chemical reaction.

Lavoisier: “The usefulness and accuracy of chemistry depend entirely upon the determination of the weight of the ingredients, and products both before and after experiments, too much precision cannot be employed in this part of the subject; and for this purpose, we must be provided with good instruments.” >><https://ebooks.adelaide.edu.au/l/lavoisier/antoine_laurent/elements/chapter18.html> (read this).

He called the phenomena of heat and light as imponderables as these two sets of phenomena couldn’t be measured by weight or volume.

A few observations about Lavoisier’s corpus:

1. Took a much longer time for the scientific community to accept the new demonstrative culture of Experiment. Priestley, for instance, articulated a radically different model of scientific practice and condemned Lavoisier’s supposed accuracy as the spurious result of excessively elaborate experimental contrivances. >>a normative difference>the way science should be practiced. An overall quantitative turn in the French philosophical circle was critical in this regard. Follow Schaffer 1986 (if interested)
2. A decade following Lavoisier’s death: Already by 1800s scientists would start rejecting some of the essential foundations of his corpus:
3. Humphrey Davy:
4. casts radical doubts as to if Oxygen is the cause/source of acidity>HCL with no oxygen.
5. argues against the existence of caloric. Heat is not an immaterial fluid: Rather a form of motion. Neither oxygen nor caloric plays the critical part in chemical reactions that Lavoisier had us believe.
6. John Dalton: Lavoisier’s pragmatic approach toward elements challenged (discussed elaborately in class)

So, was chemical revolution a revolution in chemistry or into chemistry?>discussed in class.

How far do lessons in lectures 8 (1,2), 10 and 11 interrogate Kuhn’s model? >discussed in class. <Also follow Schaffer 1986>

In this segment of the course, we revisited the foundational myths associated with discoveries. Instead of an individual-centric model of discovery, we considered a narrative that historically situates discovery into its material, local and global contexts of connections and disjunctions. The more critical question turned out to be how discoveries are made (instead of “who discovered?”). We considered a number of late 18th century discoveries (attachment 1: we concentrated more on two discovery controversies: Uranus and Oxygen, and then singled out oxygen controversy to understand the so-called Chemical Revolution) that in many ways marked the end of the era of Natural Philosophy and the beginning of the modern experimental culture [and institutional practices associated with it] in science and cautioned ourselves against the great men driven mentalist history of science. Finally, discovery appeared to us to be a **process** (stretching over time and space: NO single discoverer/author/organizer/legitimate proprietor) rather than an **event** (a one time-one space phenomenon with a specific discoverer/author/organizer/legitimate proprietor) that involved convergence of ideas and instruments, humans and machines, ideas and materialities of the time. It was the **emergence** of scientific discourse (again, emergence doesn’t have an author) rather than its **origin** (origin can be attributed to a person or a group) that mattered.

In short, we tried to liberate scientific discovery from the egoistic “I” of the discoverer. From this angle, HoS is the study of how certain scientific practices emerged, what the conditions of their emergence and limits were. In this course, we [so far] remained more interested in the history of scientific practices rather than scientific ideas, which is arguably a departure from Kuhn’s framework (we discussed this issue while reconsidering Kuhn’s cycle in debunking the traditional discovery model).