On Lavoisier, Fourier, Faraday and the ambition of science

Author : Ellis Washington

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Tesla Coil, Faraday Cage

I consider nature a vast chemical laboratory in which all kids of composition and decompositions are formed.

~ Lavoisier

Profound study of nature is the most fertile source of mathematical discoveries.

~ Fourier

Within the laws of Nature, nothing is too wonderful to be true.

~ Faraday

Biography of Lavoisier

Antoine-Laurent de Lavoisier (1743–1794) was a French aristocrat, a pioneering chemist and central figure of the 18th-century Chemical Revolution and a primary innovator on both the histories of chemistry and biology. He is extensively celebrated in literature as the "Father of Modern Chemistry." However, despite his prodigious scientific skills particularly in chemistry, his *nom de guerre* title is the result of his legendary abilities as a self-promoter and understates his dependence on the inventions, experiments and concepts of other chemists.

It is commonly believed that Lavoisier's prodigious activities in chemistry mainly stem from the fact that he transformed the science from a qualitative to a quantitative one. Lavoisier is celebrated for his innovations regarding the association of oxygen in the combustion process. He documented and named oxygen (1778) and hydrogen (1783). Lavoisier helped create the metric system, wrote the first detailed list of elements, and facilitated to reform chemical

terminology. He anticipated the presence of silicon (1787) and was also the first to recognize sulfur as an element (1777) rather than a compound. He revealed that, even if matter may change its form or shape, its mass always remains the same.

Lavoisier's innovations are considered the most significant in developing chemistry to the level achieved in physics and mathematics during the 18th century. Lavoisier was a commissioner of the *Ferme Générale* and an influential member of a number of other aristocratic councils. All of these political and economic accomplishments allowed him to finance his scientific research. Tragically, during the French Revolution, he was falsely indicted by the radical newspaper publisher, Jean-Paul Marat for selling contaminated tobacco and of other contrived corruptions, and was ultimately guillotined a year after Marat's death.

Biography of Fourier

Jean-Baptiste Joseph Fourier (1768–1830) was a French physicist and mathematician most celebrated for originating the investigation of Fourier series (a way to represent a wave-like function as the sum of simple sine waves) and their uses to problems of vibrations and heat transfers. The Fourier transform and Fourier's Law are also named in his honor. Fourier is also credited with the discovery of the greenhouse effect. In a series of articles and experiments published in 1824 and 1827, Fourier ultimately suggested that astronomical radiation may be responsible for a large rise in average global temperatures. Fourier's thought of the likelihood that the Earth's atmosphere may in essence work as an insulator of some kind and he is thought to be the first scientist to discover what is now known as the greenhouse effect.

Biography of Faraday

Michael Faraday, (1791–1867) was an English scientist who pioneered the fields of electromagnetism and electrochemistry. His principal innovations consist of those of electrolysis, diamagnetism and electromagnetic induction. While Faraday had little formal education, he became known as one of the most important scientists in history. His pioneering research on the magnetic field around a conductor carrying a direct current helped Faraday established the basis for the concept of the electromagnetic field in physics. Faraday also established that magnetism could affect rays of light and that there was an underlying relationship between the two phenomena.

Faraday's discoveries as a chemist included benzene, examining the clathrate hydrate of chlorine, inventing an early prototype of the Bunsen burner and the system of oxidation numbers. Albert Einstein was so inspired by the genius of Faraday that he had a picture of him on his study wall, together with pictures of Isaac Newton and James Clerk Maxwell. Physicist Ernest Rutherford stated; "When we consider the magnitude and extent of his discoveries and their influence on the progress of science and of industry, there is no honor too great to pay to the memory of Faraday, one of the greatest scientific discoverers of all time." One of my favorite quotes by Faraday I try to use to conduct my life is this one, "The five essential entrepreneurial skills for success are concentration, discrimination, organization, innovation and communication."

On Scientific Element

"It will no doubt be a matter of surprise," Lavoisier writes in the Preface to *his Elements of Chemistry*, "that in a treatise upon the elements of chemistry, there should be no chapter on the constituent and elementary parts of matter; but I shall take occasion, in this place, to remark that the fondness for reducing all the bodies in nature to three or four elements, proceeds from a prejudice which has descended to us from the Greek philosophers. The notion of four elements, which, by the variety of their proportions, compose all the known substances in nature, is a mere hypothesis, assumed long before the first principles of experimental philosophy or of chemistry had any existence."

However, Lavoisier does not completely rejects the idea of elements in chemical analysis. Quite the opposite, he says that "we must admit, as elements, all the substances into which we are capable, by any means, to reduce bodies by decomposition." We are not allowed "to affirm that these substances we consider as simple may not be compounded of two or even of a greater number of principles" simply because we have not nonetheless discovered "the means of separating them."

The most fundamental change in theory is not this nevertheless; neither is it the increase in the number of the elements from four to more than ninety-four; nor the collection of the elements by identity of their atomic weights instead of by the comparison of their qualities. The consequences from the experiment that an atom is not the smallest element and that additional elements can be formed by atomic fission. Faraday's experiments in ionization and in electro-chemical decomposition is derivative of the material researches which have breached the internal structure of the atom and separated smaller elements of matter. Before the advent of atomic fission where atoms were experimentally exploded, analysis had imagined them as established by positive and negative charges.

By means of the effect of his experimentation, Faraday, for instance, imagines of atoms as "mere centres of forces or powers, not particles of matter, in which the powers themselves reside." The atom therefore stops being "a little unchangeable, impenetrable piece of matter," and "consistes of the powers" it exercises. What was normally referred to "under the term *shape"* turn out to be the "disposition and relative intensity of the forces" that are revealed through experimentation.

Science and Experimentation

Scientific experimentation appears to be the distinctive devise of science allied with the scientific method; and, furthermore, even in those academic areas where experiments in a specific sense – in laboratories, with mechanisms, under controlled conditions – are difficult, the scientist changes from the philosopher in a comparable demonstration of the scientific method. The scientist investigates, does research, makes observations which advance past the empirical senses or move beyond the experiences which average men encounter in the course of life.

This zeitgeist seems to be evident when Sir Isaac Newton opens his book *Optics* with the statement that "my design in this book is not to explain the properties of light by hypotheses, but

to propose and prove them by reason and experiments." This same zeitgeist Faraday says of himself: "As an experimentalist, I feel bound to let experiment guide me into any train of thought which it may justify; being satisfied that experiment, like analysis, must lead to strict truth if rightly interpreted; and believing also that it is in its nature far more suggestive of new trains of thought and new conditions of natural power."

Lavoisier enforces upon himself the rule "never to form any conclusion which is not immediate consequence necessarily following from observation and experiment." Also Fourier, who considers physical theory as a form of applied mathematics, says that "no considerable progress can hereafter be made which is not founded on experiments ... for mathematical analysis can deduce from general and simple phenomena the expression of the laws of nature; but the special application of these laws to very complex effects demands a long series of exact observations." Like Fourier, Galileo also combines mathematics and experiment in the study of nature. However all the same he is disposed to present experiments where they are required in order to test competing hypotheses or alternative mathematical formulations of the laws of motion, he seems to favor a preference for the exactitude of purely mathematical physics.

Epilogue to a poison pen

In conclusion, this very brief synopsis of three geniuses of science from the Age of Enlightenment should give one pause – that the purity of their innovations were not tainted by the collusion with government bribery as many scientists do today, particularly by raising anthropogenic (man-caused) climate change to be in essence a pseudo-scientific wish list for government grants and graft. If Joseph Fourier is the great scientist that discovered the greenhouse effect, now global warming, now climate change, let us not allow these pseudo-scientists of today who shameless collude with government apparatchiks in America or with the United Nations, to pervert Fourier's scientific discoveries for their own ill-gotten gain.

To continue to allow the unholy collusion of science and government is to suffer the same fate of Lavoisier who at the word of one petulant, pathetic little newspaper writer (Jean-Paul Marat), used his poison pen to convince the murderous Jacobins and Robespierre of the French Revolution to march Lavoisier – one of France's greatest scientists – to the guillotine. Remember Classical Liberalism was born in the blood Christian martyrs and upon the ashes of destroyed churches and cathedrals converted into pagan shrines by secular humanists rampaging during the French Revolution (1789-99). Today we call the ideological children of the French Revolution, Progressives.

*N.B.: This essay is based in part on ideas from *Encyclopedia Britannica Great Books of the Western World,* Robert Maynard Hutchins, Editor-in-Chief (University of Chicago, 1952), Vol. 2, Chap. 21 – Element; Vol. 3, Chap. 83 – Science; Vol. 45 – Lavoisier, Fourier, Faraday.

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