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JEAN-BAPTISTE VAN MONS

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ABSTRACT

Jean Baptiste van Mons (1765-1842), a Belgian horticulturist, physician, and pharmacist, probably the most famous pomologist of his time, studied the active principle of many plants, particularly Rhus radicans (poison ivy). He gave a detailed description of the plant, of the poison it contained and its effects on the human body, and the chemical analysis and properties of its active principle. Van Mons is particularly known for the extensive research he carried on the development of new varieties of fruit trees, and the theory that rules this process. He run a large tree nursery and developed some basic principles on the proper way to develop a commercial variety of a tree. The fundamental one was that a natural (wild) species of a tree did not vary through its seedlings in the environment where it originated; as long as it remained there it could only reproduce itself or as a sub-species; its purpose was *not* to produce better fruit but to assure the maintenance of the species; this it achieved by remaining in a state of dynamic equilibrium with its environment. Van Mons carried on the synthesis of a variety of organic and inorganic compounds, among them the fulminates and was one the first scientists supporting the new chemistry of Lavoisier and Franklin's electrical theory, carrying on a large number of experiments to prove their validity.

Keywords: chlorine; fruit trees; galvanism; mercuric oxide; phlogiston; pomology; Rhus radicans

RESUMEN

Jean Baptiste van Mons (1765-1842), fue un horticultor, médico, y farmacéutico belga, probablemente el más famoso pomólogo de su tiempo, que estudió los principios activos de muchas plantas, en particular, la hiedra venenosa (Rhus radicans). Proporcionó una descripción detallada de la planta, del veneno que contenía, sus efectos sobre el cuerpo humano, su análisis químico y propiedades Van Mons es conocido particularmente por la extensa investigación que ejecutó sobre el desarrollo de nuevas especies de árboles frutales y la teoría que rige el proceso. Administró un vivero enorme y desarrolló algunos principios básicos acerca de la manera correcta de desarrollar una variedad comercial de un árbol. El principio fundamental era que una especie natural (salvaje) de un árbol no cambiaba a través de sus descendientes en el entorno donde se había originado; mientras seguía en él solo podía auto reproducirse como tal o como una sub-especie. Su propósito *no* era producir una mejor fruta sino asegurar la supervivencia de la especie. Esto lo conseguía permaneciendo en un estado de equilibrio dinámico con su entorno. Van Mons realizó la síntesis de una variedad de compuestos orgánicos e inorgánicos, entre ellos, los fulminantes, y fue uno de los primeros científicos que apoyaron la nueva química de Lavoisier y la teoría eléctrica de Franklin, realizando un gran número de experimentos para demostrar su validez.

Palabras claves: árboles frutales; cloro; flogisto; galvanismo; óxido mercúrico; pomología; Rhus radicans.

INTRODUCCION

Life and career (Quetelet, 1841; Cap, 1843; Stas, 1846; Bivort, 1855; Pynaert, 1871; Guislain, 1959)

Jean Baptiste van Mons (Figure 1) was born in Brussels, on November 11, 1765, the son of Ferdinand P. van Mons, legal administrator of the Grand Béguinage (autonomous community of nuns) of the city. He took his basis studies at the collège de Moll in Campine, where he received an education based on the humanities and totally unrelated to the future career he would follow (Cap, 1843). After graduation he began to study pharmacy and two year later he was awarded his degree of pharmacist (1787). In his youth, van Mons participated actively in the political turmoil that affected Belgium and Europe at the end of the 18th century. He took a vigorous part in the organization of a secret and revolutionary society known by the name *Pro Aris et Focis*, which propagated the ideas of the Wonkiste party that advocated substantial social and economic reforms. As a result of these activities he was incarcerated for three months, accused of being member of a secret society and crimes of harmful intentions to the nation. When Napoleon came to power, Belgium was united with France, and Claude Roberjot (1752-1799), the French representative, asked van Mons to carry on a review of Belgian mines, and afterwards, to prepare the reorganization of the teaching in the reunited departments. The successful implementation of these assignments catapulted van Mons scientific career and led to the strengthening of his relations with the most important French scientists. As a result, in 1796 van Mons was elected associate member of the French Institute (the temporary replacement of the Académie des Sciences) and afterwards, asked by Antoine-François Fourcroy (1750-1809), Pierre-Joseph Pelletier (1788-1842), Louis-Bernard Guyton de Morveau (1737-1816), Louis Nicolas Vauquelin (1763-1829), and others, to become a member of the editorial board of the *Annales de Chimie*. Van Mons knowledge of several foreign languages led him to become an intermediary with English, Germany, Dutch, and Italian scientists and report their scientific results in the Annales. The large amount of information coming from these countries led van Mons to publish his own journal, *Journal de Chimie et de Physique*, which, for economic reasons, survived only a few years. As mentioned by Cap (Cap, 1843) one of the issues of this journal carried a letter of Louis Valentino Brugnatelli (1761-1818) to van Mons announcing his discovery of a wet (electrochemical) procedure for gilding large silver coins. In 1797 he was appointed professor of chemistry and experimental physics of the École Centrale of the Department of Dyle. In 1807 he graduated as doctor of medicine from the Faculté de Médicine de Paris, after successfully defending a thesis about the origin and distribution of animal heat (van Mons, 1809c). Almost simultaneously, the University of Helmstadt offered him spontaneously the same degree, after presenting a thesis about contagious diseases. Van Mons's multiple activities led him to abandon the practice of pharmacy (Quetelet, 1841; Cap, 1843; Stas, 1846; Bivort, 1855; Pynaert, 1871; Guislain, 1959).

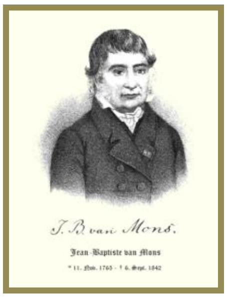

Fig. 1. *Jean-Baptiste van Mons (176-1842).*

After the fall of Napoleon in 1815, the king Guillaume re-established the Académie des Sciences et Belles-lettres of Brussels and appointed van Mons as one of its first members and afterwards, to the chair of chemistry and agronomy at the university of Louvain. After the University of Louvain was suppressed in 1830, van Mons was appointed professor at Ghent, but his advanced age and the unfeasibility of repositioning again his tree nursery compelled him to refuse this nomination. King Leopold, in gratefulness of all his scientific achievements appointed him professor emeritus, allotted him the maximum annuity, and appointed him chevalier de l'Ordre de Leopold (Cap, 1843; Stas, 1847).

Van Mons was married twice. His first wife, M^{lle} Diellen, died shortly after giving birth to a son; this son died sometime afterward. In 1794 van Mons married M^{lle} Diellen, the daughter of a physician; four children were born of this union: Louis, Ferdinand, Charles, Théodore, and August (who died at the age of three during the 1837 epidemics of typhus). His youngest son passed away in 1825 and shortly thereafter, van Mons' second wife died as a result of an unfortunate accident.

Van Mons passed away in Louvain, on September 6, 1842, and was buried in the cemetery of Molenbeek-Saint-Jean, next to the tomb of his second son.

Van Mons was particularly famous for his agronomical studies and the development of fruit trees varieties producing high quality fruits. In his youth he had already shown deep interest in the subject. Later on he planted with his own hands a vast tree nursery (named *Pépinière de la Fidélité*) in Brussels, which at the peak of activity had more than 80,000 trees. This nursery gave him much satisfaction and also bitterness. In 1819 the local council, without any consideration to the importance of the nursery, decided to expropriate the terrain for building and recreation purposes and summoned van Mons to vacate it in the short space of two months, during which he succeeded in rescuing only 20% of the trees. Misfortune followed misfortune; in 1831, during the French Army preparations of the siege of Antwerp, the military authorities decided that the site of the new nursery in Louvain was the best place for placing its bread ovens and the quartermaster's stores. This decision led to the destruction of the trees and plunder of the fruits. Once again van Mons was compelled to start from scratch, unfortunately the next nursery survived very little: The local authorities forced him out in order to build a plant for producing illuminating gas (Quetelet, 1841; Cap, 1843; Stas, 1846; Bivort, 1855; Pynaert, 1871; Guislain, 1959).

Van Mons received many honors and awards for his social, professional, and scientific activities. In 1789 he was elected permanent secretary of the Society of Experimental Physics of Brussels and in the same period he was nominated member of the Society of Natural Sciences of Akmaar. In 1795, he took active part in the foundation of the short-lived Brussels Society of Medicine, Surgery, and Medicine (*Ægrotantibus*), which in 1804 reappeared as the Society of Medicine of Brussels. He was also member of the Bataafsch Genootschap der Proefondervindelijke Wijsbegeerte of Rotterdam; the Imperial Academy of Sciences, Letters, and Arts of Turin; the Medical Societies of Lyon, Bordeaux, Carpentras, and Antwerp; and many other foreign scientific societies. He was also corresponding member of the Horticulture Societies of Boston, New York, and Massachusetts. The Société Royale et Centrale d'Agriculture de la Seine awarded him several gold medals "in recognition for the zeal and success in multiplying the varieties of fruit trees". Van Mons was a member of the committee appointed by the government of Pays-Bas to write the second edition of the Belgian Pharmacopeia (1827).

Scientific contribution

Van Mons wrote more than 90 papers, booklets, and books (van Mons, 1793b, 1800c, 1818, 1822, 1827b, 1829 1835-1836) about his research activities in the areas of botany, animal physiology, pomology, agriculture, inorganic and organic chemistry, physics of the atmosphere, electrochemistry, etc. He was an active defender of the anti phlogiston theory and the new chemistry of Antoine-Laurent Lavoisier (1743-1794) and carried on many experiments to prove it. An interesting fact is that most of van Mons' biographers mention the fact that "at the age of 20 he had already published a booklet under the title *Essai sur les principes de la chimie antiphlogistique*", supporting Lavoisier's new chemistry and his opposition to the phlogiston theory. Carlton E. Perrin has shown that van Mons was only intent in writing a paper backing Lavoisier's ideas and that he never put in practice (Perrin, 1984).

In addition to the subjects described below. Van Mons also studied the decomposition of mercury(II) chloride (van Mons, 1792); artificial cooling (van Mons, 1798, 1814, 1820b); the synthesis of ethyl nitrate (van Mons, 1800b); meteorological phenomena (van Mons, 1809, 1810, 1827a); the nature of sulfuric acid (van Mons, 1813); metal fulminants (van Mons, 1816, 1837); extraction of iodine from algae (van Mons, 1819b); cebadilla (van Mons, 1820a); reduction of alkalis to metal (van Mons, 1826a); the phenomenon of putrefaction (van Mons, 1835a); preparation of potassium chlorate (van Mons, 1835b); etc.

The fight against the phlogiston theory

As mentioned above, van Mons was a strong supporter of the combustion theory of Lavoisier and the anti-phlogiston camp. This brought him in direct confrontation with several important German chemists, which believed Lavoisier was mistaken. Here we illustrate some of the papers he wrote to support his position and prove that Lavoisier results were correct.

Mercury red oxide

In 1791 Claude Louis Berthollet published a paper discussing the arguments presented by different scientists against the anti-phlogiston theory (Berthollet, 1791). Among them, he mentioned that Friedrich Albrecht Carl Gren (1760-1796) had written that the results of experiments pointing to the reduction of the oxides of mercury without a carbonaceous material and accompanied by the release of vital air (oxygen) were unreliable when they were done with oxide freshly prepared, or with oxide that had been exposed to the action of heat in an open vessel. Gren claimed that this reduction took place only when the oxide had absorbed the humidity of air. According to Berthollet, the reduction of mercury oxide was easily demonstrated by putting in a heat-resistant retort a mixture of pure nitric acid and mercury, and heating and distilling it under vacuum. The first material to pass was nitrous oxide and thereafter the collar of the retort would become full with the red vapors produced by the mixture of nitrous acid and vital air (oxygen) containing a very small amount of nitrogen, Eventually the color disappeared and the mercury was seen to be reduced moderately. Here the oxide had formed shortly before being reduced. These changes had taken place in the absence of air and its humidity, and under all the heat the retort could support (Berthollet, 1791).

Van Mons also came out against Gren's claim quoting the results of two experiences he had conducted to prove that mercury could be oxidized in contact with dry air and in the absence of water (Van Mons, 1793a). In the first experience he put the mercury in an open bottle of his own design that assured the spontaneous oxidation (but not the volatilization) of the metal when heated properly, and in contact with air circulating freely. The heating was carried in a furnace heated to a temperature near the boiling point of mercury. Under these conditions it took about three months for the mercury to oxidize completely. The oxide was then put in a small glass longneck retort, previously heated for one hour to assure it was completely dry. The retort was then heated on top of burning coal while its neck was introduced inside a bell sealed with mercury. Van Mons applied vacuum to eliminate as much as possible of the air present in the bell and then increased the heating. The first fraction to pass was residual water, which condensed in the bell; this fraction was followed by a large amount of gas while the mercury became reduced. Repeated analysis of the gas showed it was almost pure oxygen. In the second experience mercury, purified by distillation, was placed in a glass retort having his neck pointing up, so that any vaporized mercury would condense and return to the main body of the retort. After the apparatus was evacuated with a vacuum pump, it was filled again with oxygen containing about 10% nitrogen, and then put in a furnace where it was heated enough to boil the mercury. The oxidation of the mercury was very rapid and eventually turned the metal into a red crystalline mass. Van Mons evacuated the retort, sealed it, and heated the contents to incandescence. Under these conditions, the mercury reappeared while releasing a large amount of gas, which was found to very pure oxygen (Van Mons, 1793a).

Van Mons wrote that he taken extreme care and precautions in his experiments to assure that they were conducted in the absence of water, his results proved that it was possible to oxidize the mercury in the presence of oxygen, and then recover separately the metal and the accompanying oxygen (Van Mons, 1793a).

Nitrogen

By the end of the eighteenth century several famous German scientists, such as Gren (1760-1796), Johann Friedrich Westrumb (1751-1819), and Johann Friedrich August Götlling (1755-1809), were still publishing experimental results supporting the phlogiston theory and attacking Lavoisier's claims that combustion required oxygen. In particular, Götlling published two papers about the combustion of phosphorus in nitrogen, which allegedly proved that oxygen formed the base of nitrogen and that this base had the force of burning and oxygenating phosphorus and converting it into phosphoric acid (phosphorus pentoxide). In his first paper Götlling assumed that oxygen and nitrogen were combined with caloric and in the second that they were actually combined with light. In Götlling's words (as quoted by Van Mons) "this acid is not completely oxygenated (oxidized); it remains mixed in the gas and opposes further combustion. Adding a little of oxygen gas, the oxygenation of phosphorus is completed and the combustion in nitrogen gas continued...The presence of a certain amount of hydrogen phosphurate (phosphine), or ammonia gas also hinders the combustion of phosphorus in nitrogen gas. Washing the gas mixture with nitrous oxide or water, respectively, renews the combustion...The combustion is also prevented in atmospheric acid containing ammonia gas." (Van Mons, 1796).

Van Mons believed that Gotlling's erroneous conclusion was due to experimental errors or to a false interpretation of his results. He mentioned that Götlling had failed to consider the following facts: (a) phosphine was able absorb oxygen vey rapidly, generating water and phosphorus pentoxide and completely eliminating the oxygen present and thus, stopping the combustion of the phosphorus in nitrogen; (b) nitrous oxide was able of decomposing, generating a small amount of oxygen, and thus restart the combustion; (c) ammonia was decomposed by the combined action of oxygen and phosphorus, the hydrogen formed burned forming water and the freed nitrogen mixed with the nitrogen atmosphere. The addition of a new portion of nitrogen explained the volume contraction observed during the experience; and (d) all the above substances were known to have a strong tendency of combining with oxygen to generate a compound able to block the combustion; the latter did not take place in the absence of oxygen. Van Mons added that his experiments failed to prove that washing the ammonia away with water rendered it capable of burning phosphorus. They also seemed to prove that phosphorus was soluble in nitrogen and hydrogen, even at room temperature; it dissolved in oxygen at high temperatures and then was able to burn (Van Mons, 1795, 1796, 1797).

Götlling also claimed that passing water vapors through an ignited tube changed them into nitrogen and this change was due to a combination of the vapors with caloric. This result proved that water was the ponderable basis of nitrogen gas and every other gas and that Lavoisier's theory was false. According to Van Mons (and other Dutch chemists) the nitrogen observed was not a product of water but part of the atmospheric air, which passed through the tube and Lavoisier's hypothesis continued to be true. In 1801 Christopher Girtanner (1760-1800) repeated the experiment and claimed that the nitrogen found did not originate from air passing through the tube but was due to the fact of its being a compound body formed by a combination of hydrogen and oxygen (containing, by weight, 93% of hydrogen and 7% of oxygen), or water deprived of part of its oxygen. Not only that, ammonia, water, and atmospheric air were also a combination of the same elements, in a different proportion (Girtanner, 1800). These conclusions were strongly contested by Van Mons quoting phenomena taking place in nature and the fact that he had repeatedly passed through a hot tube a gas mixture composed of 97% hydrogen and 7% oxygen, without ever obtaining nitrogen (Van Mons, 1800a).

Rhus radicans

In his memoir on the subject (van Mons, 1800d), Mons mentioned that Louis Agustin Bosc d'Antic (1759-1828), the President of the Society of Natural History of Paris, had established the identity of the two climbing bushes, *Rhus radicans* and the *Rhus toxicodendron,* during his stay in the US as French ambassador, and provided its botanical description. This shrub, called *small-leaved poison oak* by the local inhabitants, was known to be very poisonous; the deleterious property was assumed to reside in the resinous gum exuded by its young shoots, petioles, ribs, and the trunk sapwood. The juice was particularly abundant during the flowering period and then diminished gradually until the maturity of the fruits. According to van Mons this fact indicated that for medical uses the juice should be collected during the flowering period.

Van Mons' memoir consisted of five sections: (1) a detailed botanical description of *Rhus radicans*; (2) on the poison of *Rhus radicans,* its effects on the human body and the means of preventing them; (3) on the nature of the deleterious exhalations of *Rhus radicans*; (4) chemical analysis of the plant and the existence, properties, and nature of the immediate active principle; and (5) on the effects of *Rhus radicans* as a remedy, its specific virtues in palsies and herpetic diseases (van Mons, 1800d).

Van Mons wrote that although common belief assigned the poisonous effects to the exuded juice, it was easy to observe that the atmosphere surrounding the plant exerted the same effects, which were even stronger than those produced by touching; the dried and even the withered leaves never caused any inconvenience. The sufferings experienced by those who broke the stem, or warmed themselves at a fire of this poison oak, originated from the same emanation, or from the gaseous base condensed, the rupture of the cells that contained it or its gasification by heat, freed the poison. The poisonous effects on the human body varied according to the difference in the physical constitution of those that were exposed to them, and the circumstances under which they operated upon it. According to Bosc, the inhabitants of those countries where the plant was indigenous were not liable to suffer by it. The emanation was harmless when the plant was exposed directly to the sunlight but was particularly injurious when the plant was in the shade, during a cloudy day, and at night. This observation suggested to van Mons that in the presence of sunlight the pernicious gas was retained and transformed by the plant during the photosynthesis process. Van Mons collected the gas released and found that its composition was completely different according to the conditions: it was pure oxygen when collected under direct sunlight and a gas composed of hydrogen and carbon, when collected at night or from a shaded plant. The emanation was more poisonous when collected after a rain, or at a slow than rapid growth. Bosc wrote to van Mons that a drop of the juice of this plant applied to the bare skin caused an itching, followed by a rising of the epidermis that was often converted into a dangerous swelling of the part. Van Mons added that the effects in Europe appeared in different forms. The persons most susceptible, on being exposed in the shade to the emanation for a few minutes, experimented an itching at the forearm and at the neck, which disappeared after about two hours. The same persons, on plucking the leaves, or only shaking them from off the trees, got pustules, not unlike scabies, first on the hands, and afterwards on the arms. When the eruption left these parts, it re-appeared at the legs, the chest, and sometimes in the face. Its duration was generally from 30 to 40 days, and often it did not make its appearance before the eighth or tenth day after the infection. Sometimes the effects of the poison were confined to the head, which swelled to almost double its size. Van Mons described some of the treatments employed to prevent or mitigate the effects of the poison. For example, he mentioned that Bosc recommended simple washes with fresh water, while Dudley suggested besmearing the body with any fat substance, or only to approach the tree while the sun shines. Interesting enough, animals like horses were not affected by the poison, but died very rapidly (van Mons, 1800d).

Van Mons collected a large volume or the poisonous gas and subjected portions of it to a series of chemical reactions with the purpose of identifying its nature, for example, bubbling through a solution of KOH, mixing with oxygen and firing the mixture with a spark, and bubbling through a solution or calcium hydroxide. The result of these and other reactions proved that the gas was essentially a hydrocarbon, extremely combustible and forming a black substance in contact with oxygen. This gas was found to be present in the stalk as well as in the leaves. Additional experiments proved that the liquid poison contained a large amount or tannin, gallic acid, a green starchy material, and very little resin and gum (van Mons, 1800d).

The French botanist André-Ignace-Joseph Dufresnoy (1733-1801) was the first to report the use of Rhus toxicodendron use in the treatment of palsies and herpetic diseases (Dufresnoy, 1799). His observations were confirmed by numerous experiments made by practitioners of different countries. Van Mons believed that the best mode of administering *Rhus radicans* was as extract, which did not contain obnoxious substances, and he described the results of various successful experiences carried on with his potions (van Mons, 1800d).

The best mode of administering the *Rhus radicans* was undoubtedly in form of an extract, which, as may appear from the above statements, was entirely deprived of its noxious particles. Dufresnoy recommended that the extract be made of the fresh leaves, while van Mons preferred making it from dry leaves. Dufresnoy combined the internal use of the plant with the external application of the oil of this plant, with which the affected parts were to be rubbed three times a day (van Mons, 1800d).

Van Mons described in detail the preparation of the extract from the fresh leaves by expression, from the dry leaves, from the juice from the leaves, and from dry cold leaves. The medical oil of Dufresnoy was prepared by macerating in hot olive oil during 15 days, a mixture of stalks of *Rhus radicans* and *Hyosciamus niger* roots (in the ratio 1:3) (van Mons, 1800d).

In an appendix to his paper van Mons analyzed a pamphlet of the physician Francis Wurzer (1765-1844) describing the successful use of *Rhus radicans* to cure seventeen cases of palsies of the inferior extremities and hemiplegics, a case of a paralysis hepatitis, and another of a convulsive disorder (van Mons, 1800d).

Galvanism and electricity

In 1804 Giovanni Fabbroni (1752-1822) communicated to the Institut de France that Francesco Pacchiani (1722-1835), professor of physics at the University of Pisa, had discovered that muriatic acid was an oxide of hydrogen in a minimum state of oxidation, the same as water was an oxide of hydrogen in its maximum state of oxidation (Fabbroni, 1804). Pacchiani wrote that after learning that many scientists had tried unsuccessfully to determine the composition of muriatic, it occurred to him that perhaps the use of a voltaic cell would help in solving the problem (Pacchiani, 1805). Pacchiani's experimental apparatus and technic was very simple: A glass tube provided with two orifices, one small and without sharp edges; the other large enough to introduce distilled water without difficulty. Through the small orifice a gold (platinum or other metal) wire was introduced and the orifice sealed hermetically with wax; the tube was then filled with distilled degassed water, and finally, the large hole was sealed with two or three pieces of moist linen. The tube end having the large whole was then plunged into a vessel containing very pure water and the water connected with the negative pole of the pile by means of moistened slips of spongy paper. Finally, the gold wire was connected with the positive pole of the pile. As a result of the current of electrical fluid flowing through the water, hydrogen was seen to escape near the metallic pole while the water became highly oxygenated (Pacchiani, 1805).

Pacchiani reported the following results: (a) the water left in the vessel had an orange yellow color, more or less intense according on the remaining volume and the duration of the experiment, and resembling a true solution of gold; (b) near the large hole an odor was felt, very similar to that of oxygenated muriatic acid; (c) the appearance of the gold wire had changed from metallic luster to that of a metal attacked by a solvent; (d) a deep purple colored ring had formed around the edges of the vessel; a drop of this liquor tinged the skin of the hand rose after some hours; (e) the surface of the vessel contained a volatile acid, which formed white fumes in contact with ammonia. This acid had to be muriatic acid oxygenated because in contact with silver nitrate it generated a white curdy precipitate of silver nitrate. Pacchiani believed that all these phenomena were a clear demonstration that muriatic acid was a hydrogen oxide and that hydrogen exhibited several degrees of oxidation, one of them water, and another, oxygenated muriatic acid (Pacchiani, 1805).

Van Mons repeated Pacchiani's experiments about the alleged decomposition of water into oximuriatic acid and observed again that the galvanic current was also a heat conductor: He put between the plates pieces of carton moistened with substances such as oximuriatic acid and nitric acids, which were known to attack the poles releasing caloric (heat), and noted the fluid of the cell became considerably hot. Van Mons believed that the substances carried away by the action of the cell were partly decomposed into their ultimate elements and that "this decomposition did not seem to be a result of chemical affinity or an attraction of composition; it was a result of the different degree in which the elements were conductible by the galvanic current; the conductivity was measured by the rapidity of the transmission and the distance between the two poles". He was quite amazed by the facility by which the current was able to "vaporize", even partially, the most stable substances such as alkaline earths the fixed alkalis (sodium and potassium hydroxides), and metals (Van Mons, 1809a).

Van Mons was unable to understand why some scientists supported Pacchiani's claim that an electric cell was able to decompose water into muriatic acid. He believed that the acid originated from the chlorides present in the wet paper used as part of the circuit, because wetting it with water containing only borates or fluorides the acid released was hydrogen fluoride or boric acid, instead of hydrogen chloride. Van Mons added that the galvanic current was able to transfer substances combined with it at such a high rate that it could traverse bodies having a strong affinity for them, with reacting (Van Mons, 1809a).

Van Mons was also surprised that French scientists held the dualistic electric theory to be true. According to this theory, electricity was composed of two fluids, one called vitreous and the other resinous, which could flow through solid substances. Bodies charged with one type of electricity attracted bodies charged with the other fluid and repelled those charged with the same electricity. Van Mons could not accept the idea that two fluids of the same nature could repel each other; he believed that Benjamin Franklin's (1706-1790) one-fluid theory provided a better explanation of the observed phenomena. According to Franklin, all the electrical phenomena were due to a fluid, which he named *electrical fluid* (Franklin, 1741). This fluid was a simple body present in all natural bodies in an amount that depended on their attraction for the fluid and their capacity for storing it. Although this was their natural situation, they could acquire positive electricity by picking up an excess of electrical fluid, or negative electricity by losing part of their stock of the fluid. The particles of the electrical fluid repelled each to considerable distances and could be drawn in by other bodies. Glass had a peculiar behavior: it was impermeable to the electrical fluid and any increase in the electrical fluid present in one of its surfaces was accompanied by an equivalent decrease in another surface (polarization). An extended electrical atmosphere surrounded electrified bodies; consequently, two bodies charged positively repelled each other and two bodies having opposite electrical charges attracted each other. These phenomena explained why a needle turned always in the same sense, independently if it was located on a pivot charged with positive or negative electricity (Van Mons, 1793b, 1809a).

Van Mons adopted Franklin's theory and the hypothesis of only one electric fluid. On presenting Franklin's theory, van Mons added his own ideas. In his mind, the electric fluid was a particular modification of caloric, which he named *calorique-électrique*, or *calorique-électricité*. Its distinct character in this modification was of adopting a mechanical adhesion with the bodies, like the character of light of refusing such adherence, or being repulsed by the bodies, and that of heat, of being able to penetrate matter. The light modification had no affinity with bodies; the modification heat had an affinity for them of penetrating (mass effect). The electric modification had a surface affinity, or adherence. In the same manner that light turned into heat, when it was not repulsed by them, and heat transformed into light, when it was concentrated in a large amount in a body, electricity changed into light and into heat when it ceased of being adhered to the body. "Attraction and repulsions were effects of the same cause and the natural result of an elastic fluid; the opposite states of this fluid rushed from the place were it was positive to where it was negative carrying with it the excited substances. Hence, it was never repulsion, but always attraction that caused the motion of these substances" (Van Mons, 1793b, 1809a).

Chlorine and hydrogen chloride

In 1826 van Mons published a memoir about what he thought were common errors regarding the nature of chlorine and certain new properties of hydrogen chloride (van Mons, 1826b). This paper is interesting because it describes the state of knowledge at the time the first version of Lavoisier's new chemistry was still extant. Van Mons wrote that chlorine and iodine were assumed to be acid radicals super combined with oxygen with the help of the latter. Fire (heat) alone was unable to separate the oxygen from these combinations, but other substances were able to substitute it. Chemists defended these arguments by mentioning that the reaction between dry weak chlorides and incandescent carbon yielded muriatic acid

(HCl) accompanied by a proportional reduction of the metal. Van Mons based his experiments on the known fact that the synthesis of carbon disulfide by the reaction between sulfur and incandescent carbon was always accompanied by the presence of hydrogen sulfide. In order to try to separate the carbon from the hydrogen, a separation that the fire (heat) was obviously unable to do, he carried on this synthesis using carbon black prepared from essence of turpentine, previously washed with an aqueous solution of chlorine in water and then dried for one hour. During this time there was a continuous discharge of HCl proving that hydrogen had combined with chlorine and the pertinacity with which HCl remained attached to the carbon. In a following experiment he digested the carbon with a weak aqueous solution of ammonia and then washed with a solution of silver nitrate until no precipitate was formed. He then heated twice the carbon to red and passed over it calomel [mercury(I) chloride]. The resulting product was a mixture of mercury(II) chloride and live mercury, with practically no HCl. Van Mons believed that these results proved unequivocally that oxygen was not displaced by chlorine. Similar results were obtained with phosphorus pentoxide, the vapor of fuming sulfuric acid, and melting a mixture of sodium chloride with boron pentoxide (van Mons, 1826b).

If it was desired to prove that chlorine contains oxygen, an acid radical, or an oxidizer, it was enough to consider the red or black chlorides of mercury without oxygen, the metallic fluorides, or the action of a galvanic cell over hydrogen fluoride. In the latter case, the acid radical and the oxygen of water moved to the positive pole were it escaped, while the acid radical combined with the metal. It was also appropriate to track this oxygen in the carbo-chloride (phosgene) that chlorine formed with carbon monoxide, in the chloro-phosphorus (phosphorus trichloride) formed with phosphorus, or in the boro-fluoride (boron trifluoride) that the radical of hydrogen fluoride formed with boron trioxide. Van Mons also mentioned that some chemists considered that muriatic acid (HCl) was actually a combination of the acid with water and chlorine or a combination of the same acid with oxygen (van Mons, 1826b).

Van Mons wrote that chlorine, in the presence of water and sunlight, casted one half of its oxygen and became chloro-muriatic acid. Upon distillation, the heat of the process decomposed this acid into its constituents, chlorine and muriatic acid. Some believed that if the hydrogen of water was the factor which runs the sub-acidification of chlorine, then the effect would be complete; van Mons believed that the actual agent was chlorine, which by exchanging one-half of its oxygen, took water; the other half of oxygen did not contain the caloric needed for becoming a gas. In a similar manner, iodic acid (HI) in contact with air and water, supercharged with oxygen and became iodo-iodic acid and fuming brown muriatic acid, where the color was due to muriatic acid incompletely saturated with water, took the same oxygen from the air and became partly chloro-muriatic acid. Upon heating, the latter decomposed into chlorine and colorless muriatic acid (van Mons, 1826b).

All the information available pointed out that chlorine was not ordinary muriatic acid united with oxygen, and muriatic acid was not a combination of the same acid with water; both were indisputably an acid radical with oxygen or water (Van Mons, 1826b).

Pomology

In spite of all the unfortunate incidents experimented with the running of his tree nursery, Van Mons was able to accumulate a significant amount of practical experience in the growing of fruit trees and flowers and become the most famous pomologist of his time. Many present varieties of trees and plants grown today attest to his achievements. Van Mons summarized his knowledge in his famous book (Van Mons, 1835-1836; Poiteau, 1838) and several papers (e.g. Van Mons, 1819a).

Stas[3] (Stas, 1846) summarized Poiteau's paper saying the van Mons theory was based on the following five principles: (1) A natural (wild) species of a tree did not vary through its seedlings in the environment where it originated; as long as it remained there it could only reproduce itself or as a sub-species; its purpose was not to produce better fruit but to assure the maintenance of the species; this it achieved by remaining in a state of dynamic equilibrium with its environment; (2) in order for a natural species to change it was necessary to change its environment (soil, climate, or temperature); hence as soon as a young tree grown in his nursery produced fruit Van Mons sowed the seeds, selected the more promising plants, and repeated this process time after time. In each stage he noted that the new fruit was better than that of the previous generation; in due course he learned that three or four uninterrupted generations were enough to obtain excellent fruit from the stones of peaches, apricots, plums and cherries. From the observations of the shape, form, and look of the leaves and twigs, he was able to predict, more or less, if the next generation would yield a better or poorer fruit and if the fruit would appear early or later; (3) whenever a natural tree species produced one or more varieties, these would continue to vary always if multiplied by means their seeds, without being able to return to the original primitive form; (4) the source of all transmissible variation by sowings resided in the seeds; within this strategy Van Mons collected the fruit before the seeds had matured and left it to decay before removing the seeds or stones for planting; and (5) the older a variety of a fruit or other tree, the less variable were its seedlings, and the more they tended to return to the primitive species, without being ever to reach that state. The younger the variety, the larger was the variation of its seedlings.[3]

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