



Chemophobia versus the identity of chemists: heroes of chemistry as an effective communication strategy

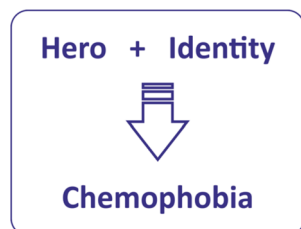
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Abstract

Abstract Decades of chemophobia are taking a high toll on chemistry. As current surveys suggest, people are displaying an irrational desire to live in a world without chemistry, but at the same time are unable to answer trivial chemistry questions. Constant questioning of the importance of chemistry induced by chemophobia leads to a weakening of the identity of chemists and can have negative consequences on the reproduction of chemistry. The need for the support of a positive perception of the chemical profession and an offer of positive examples for self-identification is the result. Everyday communication thus becomes the background on which the determination of the identity of the chemist takes place. The new communication strategy, which we call “heroes of chemistry”, aims not only to add a much-needed human touch to chemistry communications, but also to create the conditions for strengthening the identity of the chemist.

Graphic abstract



Keywords Ban of chemistry · Communication strategy · Didactics of chemistry · Fears of chemistry · Identity of chemist · Public image of chemistry

Introduction

Chemophobia continues to surprise us with the irrationality of its manifestations. At the same time, a recent survey [1] shows that the ability of chemophobia to influence the way the public perceives chemistry is not declining, but remains stable at a high level. This development takes place

against the background of the trivialization of public discourse, which goes hand in hand with the proliferation of false prophets. Traditional media continues to recede into the background as digital media supplies grow. However, the growth in supply is far from copying the growth in quality, and this creates further challenges for chemistry communications. One prerequisite for dialogue with the public and its chemical education, which is necessary for the public to be able to responsibly play the role of a democratic sovereign, is to gain its attention. The key to the public's attention is the ability to capture its imagination. As a possible solution, we propose the idea of “heroes of chemistry.” By focusing on the human side of chemistry and adding a human face to our science, we will not only address chemistry's inadequate perception as an overly abstract science, but also create the

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conditions to communicate its rigorous message through personal and professional stories of individual chemists. We recommend keeping this idea universal to emphasize the democratic nature of chemistry and to select suitable heroes of chemistry to make it easier for the public to identify with them and their stories.

Situation analysis

Consumers from eight European countries desire to live in a world where chemical substances do not exist. They do everything they can to avoid contact with “chemical substances” in their daily life and chemical substances scare them. Findings of a recently published survey [1] confirm a known state of affairs such as chemophobia continues to thrive and inspires prejudice in the society. As echoed by the chemical community, the lesson given could be dryly summarized as follows—the fact that everyone and everything is comprised of chemicals has passed most of society by [2]. Does the existence of large knowledge gaps and misconceptions by laypeople [3] mean that chemistry is doomed to remain fascinating science [4] for few but forgotten science [5] by many? And will chemistry continue to be perceived—unfairly—more as a curse than a blessing for humanity [6]? The fate of chemistry is entirely in the hands of chemists. It depends only on their communication skills, their ability to look for non-traditional forms of addressing the public, and forging alliances with those who really care about the welfare of humanity.

There was a time when chemistry inspired confidence. People appreciated it and put hope in it. In his novel *Fécondité* (1899; Fruitfulness), the renowned French writer Émile Zola (1840–1902) let his hero Mathieu Froment—a poor but hardworking proud father of twelve children—express a remarkable conviction in the ability of chemistry to help the mankind: “Even if the world should become densely populated, even if food supplies, such as we know them, should fall short, chemistry would extract other means of subsistence from inorganic matter” (Fig. 1). *Fécondité*, which is characterized by strong didactic motives and admiration for scientific progress, was considered by Sigmund Freud to be one of the ten most interesting books he had read [7].

Although unprecedented from today’s perspective, Mathieu Froment’s conviction was then not surprising at

all. The ground for the views of Zola’s hero was prepared by an agile group of science popularizers throughout the nineteenth century. During that time, the latest scientific knowledge adapted to the needs of individual professional and social groups was diffused in France [8]. Similar enthusiasm for science seemed also more than natural in the country where the idea of establishing the Universal Republic of Sciences originated [9]. Based on the idea of a society of men exclusively devoted to the quest for truth, the concept of Enlightenment thinker Marquis de Condorcet reflected his confidence in the benefits to be gained from an alliance between government and science in which the free pursuit of knowledge and the free pursuit of public happiness were envisaged as an integrated enterprise.

Today, after more than 200 years, Condorcet’s idea has become a reality. The chemists have brought happiness to people. But do people know that? Do they realize that? Far from it—in reality the widespread aversion to chemistry, this “modern Inquisition” [10] prevails. Chemophobia—which we [11–13] define as a long-lasting and persistent irrational fear of chemistry and chemical substances and a strenuous effort to avoid them, causing people to become hypersensitive or even intolerant in this respect—takes its toll:

- Parents in Berlin demanded the immediate dismissal of a chemistry teacher because he had demonstrated his students the pungent smell of formaldehyde [14].
- Only a minority of Europeans are able to correctly answer simple chemistry-related questions, as just 18% of respondents answered the question “if the chemical structure of the synthetically produced salt (NaCl) is exactly the same as that of salt found naturally in the sea?” correctly [1].
- The German city of Baden-Baden, world famous for its hot springs, has decommissioned the majority of its thousands-of-years proven “Kurbrunnen” because nature (!) does not comply with the arsenic content prescribed for drinking water in Germany, but exceeds it many times over [14].
- Chemistry teaching has begun to be considered “money down the drain” and “chemistry fell under the knife” in Stary Oskol in Russia. The reason was the unwillingness of children in local schools to pass Unified State Exam in chemistry. Stary Oskol, an important center of iron ore mining, was thus left completely without

Si le monde se peuplait entièrement, et si même les
substances venaient à manquer, la chimie serait là pour
tirer des aliments de toute la matière inorganique.

Fig. 1 Extract with Mathieu Froment’s praise on the importance of chemistry from the first edition of Zola’s novel *Fécondité* (Paris, 1899). For English translation, see the text

chemistry education. Subsequently, those children who wanted to study at local university and enter the profession of metallurgy, traditional and in demand in the region, come to the university with zero chemistry knowledge [15].

- Historian of chemistry, William B. Jensen, recalls in his memoirs [16] how in the 1960s—as a teenager interested in chemistry—carelessly transported donated chemicals and laboratory glassware by public transportation in the small American town of Wausau, Wisconsin: “I cannot even imagine what would happen today if someone tried to enter a city bus with an armful of chemicals and chemical apparatus, but ... like most of the adults I encountered, the bus drivers were more than happy to encourage my passion for science.” And about his laboratory with hundreds of chemicals, which he set up as a teenager in the basement, he mentions: “Today, should the police discover such a laboratory in someone’s basement, that person would almost certainly end up in prison, since the assumption would automatically be that they were engaged in either illegally making drugs or bombs. This irrational fear of chemicals, which now permeates every aspect of our society, is glaring testimony to the utter and total failure of the last 50 years of chemical education at both the high-school and college level.” Finally, as an eloquent example of a restrictive policy towards chemistry, he cites the requirement for strict registration of nitrates in universities: “because they can become a means of producing explosives We monitor the location and quantity of every bottle of nitrate salts in our many laboratories. Many of these correspond to ridiculously small quantities of rare and very expensive compounds that no bomb maker in his right mind would ever use to make explosives. Thus, for example, a mere 10 grams of rubidium nitrate costs nearly \$200 ... no terrorist is going to break into a university to steal trivial amounts of rare chemicals when they can go to any gun or fireworks store and legally purchase all the ready-made explosives they may need.”
- Famous Carl Djerassi [17] recalled: “Biochemist Bruce Ames, once darling of all ‘organic’ chemophobes because of his development of the simple ‘Ames Test’ for detecting presumed carcinogenicity, has now become *bête noire*, owing to his subsequent recognition that the danger of cancer associated with ‘natural’ foods may be much higher than any risk posed by pesticides synthesized by organic chemist.”
- The majority of European consumers is insecure regarding the dose-response relationship [3] and believes that being exposed to a toxic chemical substance is always dangerous, no matter what the level of exposure is [1].
- The students tend to come to chemistry class holding existing ideas about the topic to be studied not consistent

with what is being taught, for example they commonly believe that all acids are inherently dangerous [18].

This year, however, brought an important change, with many unlikely to realize it unless we tell them. Bearing in mind the countless victims of COVID-19, sorrows of their relatives, as well as the forcibly empty streets of the capitals of the world, we are beginning to get a better grasp on the importance of using DDT in Naples in 1943–1944. Then, as Kovács et al. [19] recalls: “in October 1943, the German occupying army left Naples in ruins: the water and sewage system was blown up. Washing became a problematic task in the cold winter weather: poor hygiene made the environment inviting to body lice, especially on people living in caves, and an epidemic of louse-born typhus followed. By January 1944, the number of infections rose to 700. Allied forces had to act fast and their coordinated efforts were successful ... [as] 1.3 million people were treated against body lice with 3.2 million doses of newly discovered DDT, and local people were vaccinated with an extract of chicken embryos. The typhus epidemic was stopped, an achievement never seen before in history”.

The right decisions are usually supported by the collective memory. Unsurprisingly, chemistry is again becoming a beacon of hope as it has many times in the history, and proves to be a good companion in bad times. The people concerned about the COVID-19 pandemic instinctively turned to the results of the work of chemists: they started to hoard disinfectants at home, procured protective equipment, and accumulated long-lasting foods. Simultaneously, they hold out hope for the development of effective drugs and vaccines. And although this might be an unexpected finding after decades of chemophobia, we chemists have actually—at least for the moment—become socially relevant. Nevertheless, the damage caused by chemophobia to chemistry and chemists over several decades has been considerable.

Chemophobia thus affects, among others, the reproducibility of chemistry as it has metamorphosed into the shape of the existential question [20]: “There seem to be fewer chemists that identify them as such. What does it mean to be a chemist?”.

Identity at risk

It seems that one of the first emotions new chemistry talents experience is frustration [21]. The manifestation of this feeling follows the realization that being a chemist makes them “different”. In the words of one of the students: “I always get that ‘ooh!’. Some type of sigh or weird noise that people make whenever I say I’m chemistry major.”

The limited willingness of chemists to openly admit that they practice their profession or study their science is one of

many expressions of chemophobia, and could be understood as an expression of the crisis of the identity of chemists. We understand identity as a form of social representation that mediates the relationship between the individual and the social world [22]. Its functions are to inscribe the person in the social environment, to communicate peoples' positions and to establish relationships with others; in other words: social recognition.

There is a little doubt that there are sharp divisions between the expectations of young, aspiring chemists and chemophobia-influenced reality. The particular narrative, as mentioned by Li and Loverude [21], however, suggests us how strongly the identity of chemists might be influenced by the outer, non-chemist world. In a time of professional formation feeling that they are not fully accepted as chemists may develop a weaker relation to chemistry, and their identity of chemists might suffer. Even if young chemists tend to wear the difference with acceptance and pride, they are conscious of the fact though, that under certain circumstances, fully expressing their identity of chemists would alienate the communities they interact with or belong to, e.g., family, friends, and casual acquaintances.

However, the openly lived identity of chemists, their articulated presence in public spaces, have a fundamental impact on the image of chemistry and its future as the reproduction of chemistry takes two forms: (i) the expanding of quantity of knowledge, and (ii) the education and training of the new chemists [12]. The successful accomplishment of the educative mission is conditioned by the ability to pass on the chemical tradition in the form of shared identity. So, for example, many pupils unsurprisingly opt for a field other than chemistry as the wide range of applications of chemistry remains a secret for them (e.g., in the field of environmental protection or in the development of new drugs) and they have never met a living practicing chemist [23].

It was said that widespread chemophobia may result in non-optimal policy decisions and stifle innovation [1]. The no-less-negative impact on chemists, on their psychological well-being (more on this in one of our previous articles [12]), however, is ignored. The identity of people is affected by discourses though, as they set the scene for the ways an individual acts and thinks and has a need to define himself [24, 25]. Discourses refer to what is currently considered praiseworthy, acceptable and worth following. If the public discourse is distorted, as it has for decades been the case with the chemistry, some chemists then easily fall victim to it and cease to struggle. They might feel that the complaint made years ago remains still valid, namely that [26]: “in the minds of the general public, the chemist does not merit the importance and the status of the physician, the lawyer, the dentist, simply because the general public has no way of knowing that the chemist merits them.” They try then to escape in hope that new fields of science with fancy new

names (but chemical content) will provide them a secure and venerated haven for their research (for more about the “label fraud” phenomenon see [12, 27]). Consequently the cutting edge made by them is lost for the chemistry. Those who hold back their real identity usually soon realize their mistake.

The situation of nanotechnology—or more true to the essence, nanochemistry [28–30]—shows this. Although this field denies its chemical nature for fear of being associated with the reputation problems of chemistry, it cannot avoid the similar problems with the concerned public, for example:

- Citizen juries, discussion forums, or citizen conferences have been organized to assess the emergence of technological innovations in this field, to debate their potential risks and evaluate regulatory measures [31].
- “Opening Pandora’s box”, “Messing with nature”, “Kept in the dark”, “The rich get richer and the poor get poorer”, and “Be careful what you wish for” are five archetypal narratives summing the content of lay ethical concerns [32].
- The fear of a public backlash is withholding efforts at commercialization of numerous developed food and agriculture applications [33].

Despite all the difficult consequences, this development helps us to formulate an answer to the question about the essence of being a chemist and thus realize the importance of our identity. What does it mean to be a chemist, then? As put aptly by Campos [20] the “chemist” is both an identity (first) and (then) a profession. Being a chemist has to do with the acquisition of a level of knowledge, expertise, and skills that stay with us forever. Once you are trained as a chemist, you stay always a chemist.

However, given the variability of discourse, its temporal conditionality, and the constant questioning of chemistry, it is important to work with our identity as a process rather than a permanent state. Therefore, the management of the acquired identity seems to be important. The constant support of a positive perception of our profession is necessary (e.g., by emphasizing the fundamental contribution of chemistry to humanity) and the offer of positive examples for self-identification—from the present and from the past of chemistry. Everyday communication thus becomes the background on which determination of the identity of chemist takes place.

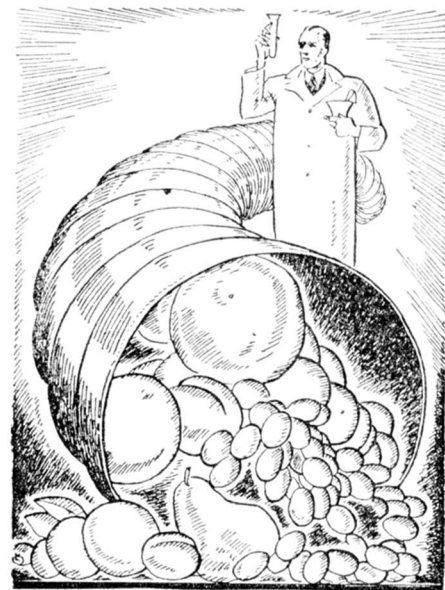
We need to translate the message of chemistry in an understandable way that is accessible to all potentially willing participants in the discussion about chemistry’s place in current society. The language of our narrative should become not just simple and clear, but first of all illustrative and emotional [12]. At the same time, it is important to make up for a lack of those who can tell the story of chemistry by telling it as the sum of the stories of individual

chemists [5]. Every chemist thus has the potential to become a hero in the story of chemistry. The contribution of each of them counts, for example: (i) a Berlin teacher bullied by uneducated parents [14]; (ii) the late Czech chemist Antonín Holý, “a very quiet person”, though “very tenacious”, who developed antiviral drugs for HIV and hepatitis B [34]; (iii) a historian of science Lawrence M. Principe, who restored alchemy to its important place in human history and culture, and as a trained chemist one of the few people who can approach alchemical texts from the perspective of contemporary chemistry [35].

Heroes of chemistry

Over the last 200 years, chemistry, more positively than any other science, has changed the way we live (Fig. 2). Chemistry has done this by making available to a wider range of people the necessities and comforts that in a previous age were reserved for privileged elite [36]. Yet, most people are unaware of it. They do not realize that chemistry is responsible for doubling of our average life expectancy from 47 years to over 85 in merely last 100 years [37]. As the Nobelist Hoffmann points out [36]: “one only has to look at

Fig. 2 Examples of illustrations on benefits of chemistry from the book *Man in a Chemical World* (1937) by American chemist Abraham Cressy Morrison. Clockwise from top left: chemist as a protector, chemist as a farmer, chemist as a breadwinner, chemist as a builder



the cemeteries of the last century to see the tragedy of seven children out of eleven dead before puberty, or of childbirth as a killing prospect.” Most people also take it for granted that in our times, most wounded soldiers do not die, whereas the huge military graveyards of World War I show that only 5% died directly in combat, while the increasing 95% died as a result of injuries, especially infections [37]. We need to get this message to people.

Although we chemists have made the world a better place to live, the imaginary picture that society holds of chemistry and chemists differs from the real one. Without a fundamental change, a negative perception of chemistry will continue to mean not only less social acceptance of chemistry, but also less funding for new research, further narrowing of space for what is allowed in chemistry, and also fewer new chemical talents [12, 13]. This can prevent the molecules containing solutions to the problems of humanity from being synthesized and made available to people and thus will further limit us in our work for the benefit of humankind [38].

While we so far have focused on the most sensitive part of chemistry communication, i.e., the fight against chemophobia [12, 13], we are convinced that the time has come for an overall change in chemistry communication. The current, predominant way for chemists to interact with the non-chemical world might be education, though its possibilities have been largely exhausted [39, 40]. In today’s information-overloaded and fragmented world, we need to look also for other ways to address the public and search for the new opportunities to reverse the loss of sovereignty of interpretation.

Although heroes are a universal part of human history and, as a general phenomenon, form much of our idea of the present, we practically do not encounter them nowadays in the communication of modern chemistry. This absence seems to echo the words of the French chemist Gaston Tissandier, who in his book *The Martyrs of Science* (Fig. 3), drew attention to the existing paradox: in our collective mind, we give far more space to conquerors to whom the nations owe the scourges of war, than scientists who ensure the well-being of societies [41].

The newly developed communication strategy—which we call “heroes of chemistry”—should therefore reflect the need described and fill the existing void. In chemistry communication, we usually focus on spreading a rigorous message. Now, as a part of the new strategy, we recommend partially changing the focal point on the person of the chemist. While changing the focal point of the communication, we aim to communicate rigorous messages through the lens of chemist’s unique professional experience while simultaneously adding a human touch. The heroes of chemistry thus become the embodiment of the message of chemistry. This on-going communication strategy will help us to create a more suitable communication space to deliver the

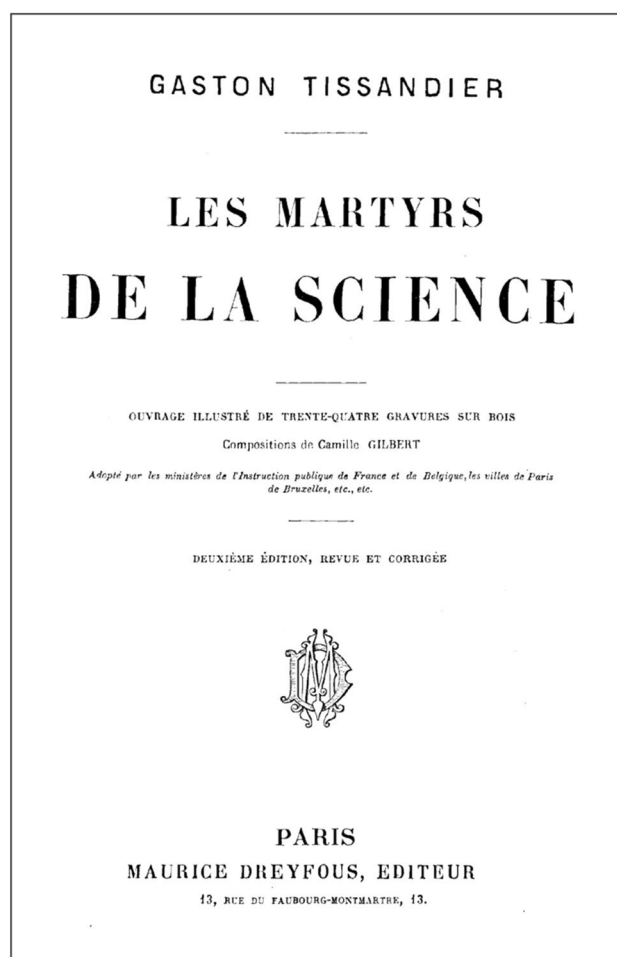


Fig. 3 Title page of the book *Les Martyrs de la science* (1879) by French Chemist Gaston Tissandier

message of chemistry over time. In using this strategy, the message retains its rigorous essence, but loses its perceived abstractness.

The idea of involving heroes in the communication of chemistry reflects the fact that people make sense of the world through shared experiences, language, and symbolic action [42]. The heroes are an essential part of this pursuit. People commonly use the term “hero”, can easily name several heroes (real-world figures or fictional characters), and attribute high levels of competence and morality to them [43]. It is important to our cause that they especially admire heroes who struggle, achieve, and do the right thing—even when doing so is very difficult, and even when it might cost them their lives. That is also why heroism is frequently viewed as an apex of human behavior [44]. People often feel that while they, as individuals, would like to achieve heroic status, this goal must be a remote possibility reserved for an elect few with special skills or luck. According to Messick [45] heroes, like good leaders, give their followers a sense of security, vision, inclusion, and pride that is the qualities

that chemists also offer, as it turned out again during the COVID-19 pandemic.

So who are the heroes of chemistry? In a broader sense, the heroes of chemistry are de facto all chemists who remained loyal to chemistry in the time of chemophobia. In a narrower sense, they are all chemists who can bring chemistry to a qualitatively higher level and thus further multiply the legacy of past generations of chemists; chemistry teachers who are on the front line and have not become embittered and are looking for new attractive ways to get a young generation for chemistry and to discover and promote new talents among them. The heroes of chemistry, however, can also be sought in the past of chemistry. An important feature of distinctive quality is their courage to go against the flow and their merits in chemistry.

When an organization wants its message to reach its audience, it usually decides for the communication via stories [42]. The same should go for chemistry as the public desires to hear the story created and presented by good storytellers [13, 46]. This desire is affected by the fact that people live life narratively, not just through plot-driven themes of love, hate, and work, but also through aspiration, coordination, process, and analysis. That is why, according to Fisher [47], *homo narrans* is one of the root metaphors which represent the essential nature of human beings. Identification is a fundamental technique in storytelling [42]. All stories that resonate with audiences draw upon heroes, places, ideas, and other concepts that an audience identifies with.

In this context, we want to encourage all chemists to use our strategy of “hero of chemistry” as an effective communication matrix. When considering the possibilities of communicating any message, we should find out whether it can evoke, for example, identification, empathy or memorable experience and thus be a suitable basis for a good story.

Illustrative case studies

Let us illustrate the developed communication strategy of “hero of chemistry” in the following case studies. We selected three chemists from different times as suitable representatives, as they perfectly embody willingness to go against the flow, a readiness to look for unusual solutions, and a possession of what we could call scientific or civic courage.

Case 1

Convinced at a very early age by her curiosity and creativity that she would be a scientist—one of our heroes of chemistry—American chemist Zafra M. Lerman later summed up her life tenet that equal access to Science Education is a human right [48]. At a time when chemistry teaching is

becoming an increasing problem, she understood the basic rules of a being a good chemistry teacher. She was able to show her students that chemistry was important to them [49]: “If you make chemistry relevant to the student’s life, experience, environment, and interests, you can teach them anything you want, even secondary isotope effects.” Naturally, success did not take long. Although she taught chemistry to students of music, dance, drama, and fine arts, two of them earned PhD degrees in the chemical field. After graduating, many others decided to pursue careers in chemistry or chemistry-related fields.

According to her, the arts can play a valuable role in reversing negative public perception of chemistry, and chemistry, in turn, can be a wonderful subject for the arts [50]. Shakespeare’s drama *Romeo and Juliet*, adapted into a love affair between Sodium and Chlorine, for example, has become for her students a clever tool for understanding the bonding relationship [49]. “For never was a story more dark and glum, than that of Chlorine and her Sodium”, is asserted in the play [50]. As Lerman points out [49]: “The drama students who write and act out the script remember the concept far longer than would be expected through more conventional teaching methods. The same is true for students who wrote and acted in ‘The Bondfather’, and for the students who danced ‘The Three States of Matter.’”

Her belief that chemists have a duty to make the Earth a better place for humanity has led Zafra M. Lerman to participate in a number of activities dedicated to the protection of human rights and scientific freedom [51].

Case 2

The importance that chemistry gained in medicine and as a forensic science during the eighteenth century culminated in another hero of chemistry, the Spanish chemist and the naturalized Frenchman Mathieu Joseph Bonaventure Orfila (1787–1853), the founder of modern toxicology. He taught at the Faculté de médecine de Paris, where in 1819 he became the first professor of forensic chemistry ever [52, 53].

Orfila was an expert witness in many popular poisoning trials of his time; including the famous Marie Lafarge affair, where she was the first person convicted largely on direct forensic toxicological evidence [54]. He became an outstanding figure in nineteenth century European medical and scientific circles, and his work had a profound impact in molding the public perception of toxicology and chemistry.

Orfila demonstrated effects of poisons on specific organs by analyzing autopsy materials for poisons and their associated tissue damage. He stated that toxicology should be a separate science and that chemical analysis must be part of its foundation. In 1814, he published the first edition of his fundamental textbook *Traité des Poisons Tirés des Regnes Minéral Végétal et Animal, ou Toxicologie Générale*

(Treatise on poisons found in the mineral, vegetable, and animal kingdoms, or general toxicology), which has been used as a basic text for decades. The book is a landmark in not only toxicology but in scientific history [55].

In 1818, Orfila published a book for the general public *Secours à donner aux personnes empoisonnées et asphyxiées* (A popular treatise on the remedies to be employed in cases of poisoning and apparent death), which became very popular and has been translated into a number of foreign languages [56]. In the book, Orfila criticized not only popular ideas and misconceptions on poisons and antidotes, but also the practices of quacks; very similar to today, when chemophobia is the result of ignorance in chemistry and the intervention of various activists.

Case 3

One of the heroes of chemistry in the Middle Ages was Johannes de Rupescissa, whose writings were extremely widely circulated and copied in his days, and thus had a significant impact [57]. He was born around 1310 in Auvergne, central France. In 1332, he joined the Franciscan order, some 5 years after he began his studies at the University of Toulouse. Rupescissa died between 1366 and 1370, probably at Avignon.

In his time, part of Christendom expected an impending apocalypse associated with hardship, disasters, and diseases (resembling today's COVID-19 situation). Rupescissa tried to find a solution to this situation by using (al-) chemical knowledge and methods. Basically, the same as we do today, when we use chemistry to ensure humanity's prosperity. Rupescissa, of course, wrote his works using the language and expressions of his time, but formulated his firm conviction that when facing disasters, chemistry is able to help humankind overcome them and has a central role in the wake of the world. In his *Liber Lucis* (Book of light) from 1350, he proposed the possibility of making artificial gold by transmutation. Although we know that chemical transmutation of base metals into gold is not possible, we can perceive this Rupescissa's effort as a metaphor for creating new materials that are indispensable to our modern technologies. In his later work, *De consideratione quintae essentiae omnium rerum* (On the consideration of the fifth essence of all things), he is one of the first to discuss the possibility of using chemistry in a new area—medicine [58, 59]. In this work, Rupescissa proposed a plan for humankind to escape disease, ageing, and even death through alchemy, i.e. chemistry. The task of chemistry is simply to prepare chemical medicines and medicaments that can restore lost health and improve human bodies to the point of near-immortality. Therefore, Rupescissa made chemical preparations a key part of medical practice; ever since his times, chemistry

would forever after be closely linked to medicine. Now, he is regarded as the founder of medicinal chemistry [58].

According to Rupescissa, the study of chemistry is legitimized by the fact that chemistry plays such a crucial role for humankind [57]. He was likely the first chemist to assert that by using chemistry, human beings could correct and transform the world, fight catastrophes, and enjoy an improved and high-quality society. He points to chemistry as a solution to all crises that seems to be apocalyptic. In short, chemists and chemistry can actively change the course of human history.

Conclusions

Willingness to go against the flow, a readiness to look for unusual solutions, and a possession of what we could call scientific or civic courage, these traits connect the heroes of chemistry Zafra M. Lerman, Mathieu Orfila, and Johannes de Rupescissa. And this is also one of the possible answers to the problem of chemophobia, as the findings of recent surveys confirm the rise of irrational desires and the existence of fundamental gaps in basic chemical knowledge. The need to gradually reverse the unfavorable development in the spread of chemophobia has led us to develop a communication strategy, which we called “heroes of chemistry”. The increased presence of chemists in public spaces and their active participation in chemistry communication will also have a positive effect on the identity of chemists. Chemists, together with the sum of chemical knowledge, are the biggest asset of chemistry. The advancing threat posed to the identity of chemists by chemophobia endangers chemists as much as their science of chemistry. However, society as a whole is exposed to a fundamental threat too, because chemistry and chemists are essential to its dignified life.

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