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Mini Review

Chemistry, Dual Use and Ethics

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Abstract

When working in the area of chemistry, it is essential to have a high sense of ethics, personal and professional. In this work talk about the meaning of the term dual use, the consequences of a misinterpretation or ignorance of this concept, in the fields of drugs and chemical weapons, misuse and abuse of chemical knowledge and potential legal consequences faced when going from good to bad.

Keywords: Dual use; ethics; drugs; chemical weapons; chemical professions.

Introduction

In the practice of chemistry, an essential ethical principle must always prevail chemistry must serve to achieve the well-being of humanity, with absolute respect for the environment. It should never, never be used against either one or the other. The exercise of chemistry inevitably involves the transformation of matter, starting from one substance and arriving at another, sometimes very easily, sometimes overcoming enormous difficulties. However, the possibility that these transformations of matter result in something unwanted, or something desired but that can be used for purposes contrary to the ideal, is great, sometimes too big [1-4] .

Duality

We might think that almost all technology can have dual uses. When the primitive human discovered that he could make fire and control it, he used it to illuminate his nights and the interior of the caves, to drive away beasts and intruders, but he also learned that he could apply it to set fire to the possessions of his enemies and thus be able to subdue them [5]. And from then to today, when our civilization use fire to cook delicacies and burn villages with napalm, has the situation changed?

Louis Fieser

Using fire. During World War II, incendiary bombs were loaded with a gel formed from crude rubber. The attack on Pearl Harbor gave the Japanese control of the most important sources of natural rubber for the manufacture of bombs. Then Colonel ME Barker, from the US Army Chemical Weapons Service, met with Dr. Louis Fieser, asking him to find a substitute for natural rubber. The requirements were various: the gel should be stable between 50ºF, for operations in tropical areas and -40ºF, for operations in cold locations; withstand storage conditions and be safe in its handling to be able to adequately fill the bombs. Fieser and his team developed a gel with excellent properties, complying with what was requested by Colonel Baker and with temperature properties and destruction capacity superior to rubber gels [6]. With military optics, a great success.

Fieser was criticized for using science for destructive purposes, against humanity. Their varied answers are synthesized in a single one, supposedly published in the first issue of Time magazine of 1968, of January 5 (Science History Institute), which says: "I have no right to judge the morality of napalm, just because I invented it". Because he never participated in attacks using napalm, nor did he order them, he considered that his only responsibility was to have invented it [7-9]. This position of Fieser contrasts with the need for scientists, particularly chemists, to carry out our activities contemplating the possible consequences of what we produce, whether they are good or not so good. And that should also apply to the corporations and companies in charge of the mass production and distribution of these products developed by chemists. The Dow Chemical company was in charge of the manufacture of the napalm used in Vietnam (and also part of the herbicides used in that war, such as the well-known Agent Orange) and this corporation could not declare itself ignorant of the use that would be given to its product; far from it, they claimed that their product brought benefits for the acts of war that were carried out, they spoke of the merits of the war and questioned whether it was really used indiscriminately against the civilian population (Contakes, op. cit.). What a stupid way of defending themselves!

Fritz Haber

Let's talk about Fritz Haber, German chemist who won the Nobel Prize in Chemistry in 1918 , although it was awarded to him in 1919. The committee in charge of the selection of candidates agreed to recognize him "for the synthesis of ammonia from its elements " [10]. The discovery by Haber allowed to use the most abundant gas in the planet's atmosphere to produce in a fairly simple and economical way a compound that is of high social importance; since it allows, among other things, the synthesis of synthetic fertilizers with a high nitrogen content. Plants cannot use atmospheric nitrogen in their vital processes, but ammonia nitrogen is very easy to assimilate [11-13]. In this way, dependence on natural fertilizers (guano, manure, animal and human feces) is reduced and crops with much higher yields can be achieved. This discovery helped the world combat the specter of famine and Haber's name was then linked to the concept of "bread from air" [6]. The curious thing about the matter is that Haber did not seek a welfare for humanity but the progress of his homeland. Before ammonia, most of the fertilizers used in Germany consisted of guano, which was imported from the distant lands of Chile. In this way, what drove Haber was a fervent nationalism; claimed that the meaning of Germanhood, (used by Haber) was something that would have to be adjusted "like everything great and eternal" [4,7]. The impetus for his development of the work on ammonia was based on the fact that in a state of belligerence although not of war per se (which would soon be declared politically), British ships blocked the importation of South American guano, affecting not only agriculture but also to the production of ammunition, which required large amounts of nitrates, available in guano. In September 1914, a group of experts, including Haber, undertook the task of solving this problem and first devoted themselves to the question of ammunition, which apparently was their primary motivation (Spleen CE,). At the outbreak of the Great War, Germany was prepared, in part thanks to Haber's work, which had not been completed. He then began to think of a technology of war that would allow Germany to quickly rise to victory and decided to dedicate efforts in this direction. He focused on what he knew well, chemistry, developing the first chemical weapons. In April 1915, he himself appeared in the vicinity of Ypres to monitor the weather conditions, he spent several days until he considered that everything was in favor of the German army, and on the 22nd of that same month, he ordered an attack against the allied forces barricaded there. With the wind in his favor, blowing towards the enemy trenches, Haber ordered the release of about 150 tons of gaseous chlorine that was transported in 6,000 cylinders and that were opened almost simultaneously; the cylinders were placed along more than six kilometers of the German trench and a huge and dense cloud of greenish gas drifted towards the Allied lines [8]. Different authors mention different numbers of casualties due to this attack. For example, Harris and Paxman report 5,000 dead and 10,000 injured [11], while Spiers reports around 7,000 injured and 350 dead [2]. Haber bragged about the success of his strategy, adding that it caused a truly agonizing death [5]. And yet, he said that "all modern weapons ... owe their success to the vigor with which they temporarily weaken the psychological strength of the adversary" [4,10]. The point is, Haber was proud of the success of his attack, not caring that the Hague accords of 1899 had been violated. After the attack on Ypres, Haber was appointed captain of the German army. For him, humanity was not as important as the homeland, his homeland. To celebrate his appointment as captain, he held a great party at his home on May 1st, 1915 [3]. There something unexpected happened, closely related to Haber's ethics.

Clara Immerwhar

Clara Immerwahr was an excellent chemist, in her own right. It is said that she was probably the first woman to obtain a doctorate in chemistry in Germany (Essex and Howes, op. Cit), but it was not easy at all. Her stay at the university was as observer, that is, she had to obtain authorization from all teachers to attend any of the classes, among many other obstacles. She finally obtained a doctorate degree in 1900. One of her teachers had been Fritz Haber but contact between them during Clara's student days was short. His biggest approach was in a dance class. The couple met again after Clara's graduation and married in 1901. Initially Clara participated in Haber's projects, but little by little she was relegated to the role of wife and mother. To keep up to date, she translated articles from English into German for her husband to use and was responsible for the English edition of Fritz's book, Thermodynamics of Technical Gas-Reactions. Clara never stopped thinking about going back to a laboratory, but when her son Hermann was born, she realized that this would be almost impossible, due to the delicate state of her son's health. However, the differences between Haber and Clara grew deeper every day. The differences were clearly reflected in two statements that show two lines of thought, two views of scientific ethics; Clara thought that "scientific study was obliged to respect life", while Haber argued that "In times of peace a scientist belongs to the world, but in times of war, he belongs to his country" [8]. In fact, it is mentioned that when the use of toxic substances as a method of warfare began, Clara publicly denounced that this "constituted a perversion of the ideals of science", to which Haber responded by denouncing her as a traitor (Essex and Howes, op. cit.). So, disturbing the Haber's reaction against his own wife, the mother of his child! Let's go back to the big party on May 1st . Clara waited for the guests to leave, then took Haber's service weapon, headed out into the garden, and shot herself in the chest. The one who heard the shot was her son Hermann, who found her still alive, but she died in a few moments. And to emphasize the tragedy, it seems that Haber's orders were to go to the front immediately, so that his wife's funeral was left to his son, who was then only thirteen years old (Vazquez, op. Cit.). This family conflict reflects two different visions of professional ethics: one decidedly nationalist, regardless of the consequences for humanity, and the other deeply human, always looking out for the well-being of all, regardless of borders and other differences. And paradoxically, this vision of ethics in favor of humanity, ended one life and deeply hurt another.

Clara and Fritz's son Hermann was a chemist, worked in the patent area and committed suicide in 1946, after the death of his wife, who died of cancer. He apparently never recovered from having been in charge of his mother's funeral and his father's second marriage.

Back to Duality

Dual use processes are those that can be used to obtain substances for peaceful or harmful purposes. Dual-use chemical substances can have a legal, legitimate use and other illegal or illegitimate use. We can also find equipment and instruments that can be used in a double way; a knife can be used to cut meat and eat, or to assault people in the street. Large ultra-pure aluminum tubes, which can be used in rockets to put satellites into orbit, also make long-range missiles transporting explosives or weapons of mass destructions in their heads or use them in centrifuges to enrich uranium. In turn, the centrifugation of uranium to enrich it can lead to its use in nuclear power generation plants, or for the manufacture of atomic bombs [1]. Here we have examples of dual-use processes (centrifugation), dual-use equipment (rockets and missiles) and dual-use substances (aluminum).

Dual Use Substances

One example of a dual-use substance is isopropanol or isopropyl alcohol. It is widely used as a wound disinfectant (like ethanol or ethyl alcohol) and is widely used as an industrial solvent for the extraction of natural plant products, in inks and varnishes, for cleaning electrical components, in the manufacture of topical medicines, in cosmetics and in a wide variety of other applications. But it is also one of the raw materials for the manufacture of chemical weapons, specifically the neurotoxic agent called sarin, which has not only been used in warfare but has also been used in terrorist acts. And the case of chlorine is even more dramatic. Chlorine is the most used chemical for the purification of water, that is, to provide water suitable for human consumption from a microbiological point of view. In addition to this tremendously important use on its own, it has multiple industrial uses in plastics and drugs, to name a couple of them. But, as we have seen before, it was the first toxic agent used in a massive way in a war, that is to say, it is an indisputable chemical weapon. Is chlorine good or bad? Neither one nor the other. Its application is what can be questioned from the point of view of ethics. And it will depend on the type of ethics that is used to judge it. So, a chemist can face the ethical dilemma, when working with isopropanol or chlorine: do I make drugs to help people, or do I make weapons that are going to leave me more money? But this is not the only ethical dilemma someone may face in relation to these two products. Should the chemistry teacher respect the right to information of his students? Should he indiscriminately inform them of the relationship between beneficial isopropanol and chlorine and the evil chemical weapons? If they have never heard of this, now they know it. It is not necessary for the teacher to tell them how to do evil products, there are many Internet pages that describe step by step the chemical transformation of good into evil. Shouldn't the teacher give that information to his students? What about their right to information? On the other hand, is it useful to inform young people and does it guarantee that chemistry misuse is avoided? Or is that achieved by hiding the information.

Uranium enrichment is the process by which the amount of fissile uranium (which decomposes by breaking its nucleus into smaller nuclei, emitting radioactive particles) is increased with respect to the amount of non-fissionable uranium found naturally in minerals. The fissile (U235) in nature is found in less than 1%, while the non-fissionable (U238) is found in more than 99%. If it is enriched to 10%, it is used for nuclear power plants; if it is enriched to 90% or more, it is used for armaments.

Conclusión

As we can see, the relationship of ethics and chemistry is a complicated matter. There are personal interpretations, nationalism, patriotism, particular interests and other ways to accommodate ourselves or accommodate the science to our particular interests. The author is left with the basic element mentioned by the OPCW: achievements in the field of chemistry must be used for the benefit of humanity and in defense of the environment.

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