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The relationship between chemistry and society according to Pablo Espinet, Professor of Inorganic Chemistry

"Chemistry is essential to our lives, but people need to be aware of that"

Pablo Espinet is professor of Inorganic Chemistry at University of Valladolid. His line of research is closely related to the Nobel Prize in Chemistry 2010, in using metal catalyses in organic synthesis reactions. In this interview, Pablo Espinet reflects upon the future of his research and other branches of chemistry. He also analyses the relationship between chemistry and society, something necessary when considering the industry and economy, but not always easy to combine from social perspectives.

Pablo Espinet is Professor of Inorganic Chemistry at the University of Valladolid. Director of the Innovation Centre for Inorganic Chemistry of the University of Valladolid, Professor Espinet has spent more than twenty years studying the mechanisms of the reactions described in the Nobel-Prize winning work, making his research team as one of the current leaders in the field. He regularly works with the Area of Physical Chemistry in the Chemistry Department of the UAB, developing theoretical calculations for the synthesis reactions carried out in Valladolid.

-The topic for your lecture coincides with that of the Nobel Prize in Chemistry. Coincidence?

-Yes, complete coincidence, because I prepared this lecture before the announcement of the Nobel Prize this year. It is one of my group's areas of research. We also work on some types of molecular material but in terms of hard chemistry, this has been our working topic for the last 20 years, and that means we made a good choice, because we didn't know then that the Nobel Prize would be awarded for that type of reaction. However, even then you could see the importance it could have. Heck's reaction was the object of our study when we decided to investigate the mechanisms of these reactions. After 8 or 10 years, we left Heck and went on to Stille and Negishi, and we were therefore able to work with the UAB with Gregori Ujaque and the rest of the group. We carry out an awful lot of experimentation, identification of intermediates, and it is all based on theoretical calculations, which is what they do here.

-What are these reactions of homogeneous catalysis with metals?

- The Heck reaction begins when palladium is dropped into an organic chain by addition to a double bond and then the palladium moves along the chain; we study what happens after the first stage of the Heck reaction. This was enough for two entire theses, meaning at least eight years of research. We then went on to the Stille reaction (who is not on the list of prize-winners because he died in 1989). This was the first reaction to be used on a large scale, so if he is not included it is because the Nobel Prize is not awarded posthumously. All of them are C-C bond formation reactions with palladium as a homogeneous catalyst. This sparks a series of events in the coordination sphere of the metal, so that a C-C bond is formed between two reagents, one of which could be an alkyl halide and the other an organometallic compound.

-Are we looking at a promising branch of chemistry?

-It might seems that nothing new has happened in chemistry lately, but that is not the case. The phenomenon of carbon polarity inversion was the first revolution in organic chemistry at the end of the 19th century, since it meant that C-C bonds could be formed, since one of the carbons adopts negative polarity on union with the metal. But the next revolution, which enabled the delicate manipulation of molecules with the introduction of enantioselectivity in reactions, is what began to develop from a synthetic point of view practically since the 1970s. And that is where recognition for the Nobel Prize lies, because it enabled enantioselective control using palladium-catalysts such that we can induce the reaction to take place wherever we want, and it is therefore cleaner, produces less residue and consumes less energy. Also, the work of our group adds an understanding of the reactions. Understanding the sequence of stages and how to control each stage is of vital importance in the development of specific molecules such as medicines, for example.

-Is nanotechnology winning over other disciplines?

-Nanotechnology is in vogue, and that has a lot to do with the fact that it is optically presentable, it can be shown in images, and that is fundamental for connecting with the average citizen, because I cannot explain in images how a reaction mechanism takes place (it is a highly technical question) but I can explain something about nanotechnology with nice pictures of a liquid crystal. There are things that can be said for and against nanotechnology. On the negative side, you could say that while nanotechnology makes molecules one by one, we make millions at a time in a typical organic synthetic reaction. On the plus side, it is clear that nanotechnology has applications right now, that cannot be denied, and it will have more in the future.

In any case, the present results of nanotechnology in relation to the time spent on communicating them are arguable. Nanotechnology enjoys the privilege of being transmissible, of looking good –good perfume is sold in small bottles. There are also unquestionable applications in the field of electronics. What point will its applications reach in medicine? Well, the window needs to be kept open. It is fortunate enough to be an area of research, a passionate one like so many others, which can be sold to the public with things that work.

-Do events such as today's serve as an impulse for the area you are researching?

-The possibility of speaking in public depends on something that we scientists do not usually have –and that is being able to adapt our discourse. When we are communicating we cannot be as strict as we tend to be in science. Fields such as medicine and biology are open to more graphic explanations and can therefore reach their public, but the fields of harder science seem to want to be very rigorous. That is why I am focussing my presentation on the seeing catalysts as "tools" that can be used to make molecules, because the "tool" concept is more easily understood. This type of simplification generates a lack of rigour but does not lack truth.

-They say that in science there is a difference between the expert and the lay person, which is widened by the deliberate use of technical terms.

-Yes, this has happened a lot, traditionally in medicine. The language of medicine is incomprehensible to the public, precisely to maintain its superior status. But this is a mistake. When this happens it tends to be because the so-called expert is defensive (although "expert" is too high a term for humans to cover). We should be suspicious when an expert is not capable of finding the words to communicate a concept to a person of average level of education. They will not be able to transmit the details, but they can still communicate the whys and wherefores of things.

-But that is why a good level of schooling is important.

-I have always been critical on this point. Of course, there is a small percentage of vocational university students, who make teaching worthwhile for us lecturers and take the lead. But there is also a great lack of overall education. Once a student came to me to review an exam mark, and on seeing that the whole exam was marked in red because of spelling mistakes, he defiantly said "I am a person of science". This is the same argument that the arts students use in reverse, and it is a problem, given that we have university students with serious shortfalls in the other half of their education.

-Do celebrations such as the Year of Chemistry make any sense?

-Of course, but because of them we the scientists need to be better versed in communication. A lot of effort has been put into giving talks in colleges to capture student interest and they end up seeing that chemistry is beautiful. People have no idea that they cannot live without chemistry. For example, as Pasteur said, we would start to "drink ailments" from the same tap, given that the water we consume is chlorinated o treated with ozone to eliminate microorganisms. The controversial insecticide DDT is the chemical product that has saved most lives by putting an end to plagues of mosquitoes and other insects, and therefore avoiding contagion and illness. When you see your doctor you think that they are prescribing a "medicine", but it isn't like that; they are prescribing a chemical product that has a positive reaction on the human body. However, the image that people tend to have of chemicals is that they create dirt and pollution. If this is true it is because they are used wrongly and because for industry it is cheaper to pay the fines than deal with the ecological problems.

-So it is a case of improving the image of chemistry.

-Chemistry has a bad image. When we talk about "chemical products" we tend to think of something contaminating or poisonous, or if we say "chemical therapy" this is linked with the treatment of cancer but not with taking an aspirin. For that reason the Year of Chemistry is important to offer a positive image of this science that is so necessary for our lives. As I always say: in life things are either spiritual (if they exist) or material and they are made of molecules and atoms, and that is chemistry.

Entrevista: Jordi Mora Casanova
Fotografia: Jordi Pareto
Área de Comunicació i de Promoció
premsa.ciencia@uab.cat