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Professor Jean-Marie Lehn: Supramolecular chemistry in the very essence of life

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Professor Jean-Marie Lehn, laureate of the Nobel Prize for Chemistry in 1987, has been returning to Prague regularly every June for three decades to present the prizes to the winners of the competition for the best dissertation in chemistry at the French Embassy together with his Excellency the Ambassador of France other fields. Regular returns are an opportunity for him to meet friends, colleagues and students from universities and research institutes of the Academy of Sciences not only in Prague. Last year he visited Brno, České Budějovice, from there also Linz in Austria, and this year visited University of Pardubice, everywhere his performances for professionals and the wider public attract the attention of full auditoriums and practically always result in a long discussion on, among other things, questions of the functional arrangement of matter in living systems/organisms. Professor Lehn is a great lover of music, so some time ago he decided to expand the program of his regular visits in June with the unique music festival "Sounds of Science" in the National House in Vinohrady with the participation of other fellow Nobel laureates. Participating in the second year of "Sounds of Science" in June 2023 has been promised, among others, by Jules A. Hoffmann, who received the Nobel Prize in 2011 for his pioneering work on natural immunity in the Drosophila model.

Professor Jean-Marie Lehn is a foreign fellow of the Learned Society of the Czech Republic and this year he was so kind as to deliver a lecture for the general public entitled *Steps Towards Life: Chemistry!* (<https://www.youtube.com/live/YxBjOOx-ZT8?feature=share>). It was also a good opportunity to ask the professor for a short interview for ŽIVA magazine, here are his answers to a few questions.

Professor Lehn, Jean-Marie, next year it will be exactly 30 years since you regularly return to Prague to present prizes to the best diploma theses of students of chemistry, pharmacy, nuclear and information technologies, as well as humanities and social sciences, in cooperation with the French Embassy in Prague sciences. Where did your fondness for Prague and other places in the Czech Republic come from? Is it somehow related to your cooperation with local scientists or with family ancestors? And what role does your well-known love of music play in this?

Prague is simply a unique city, one of the most beautiful and attractive cities in the world, combining architecture, music, art and science.

Where did your love for chemistry and science come from? Did it begin with a boyish interest in chemical experiments or rather with a student interest in natural sciences and mathematics and a determination to uncover the secrets of nature?

I was attracted to chemistry when I realized at the end of high school and beginning of university studies that it gave the power to transform matter by chemical reactions and to create novel expressions of matter, novel molecules, novel materials. It gives a sort of Promethean feeling!

Jean-Marie, with your discoveries you laid the foundation of supramolecular chemistry. Does this new direction of polymer chemistry hold any hope for an ecological solution to the technological problems that humanity faces in connection with traditional polymers and modern nanomaterials?

Supramolecular chemistry is the chemistry of molecular assemblies, populations of molecules interacting with one another. It extends in all directions of chemistry, including biological chemistry, drug discovery and polymer chemistry. In particular, supramolecular polymers offer novel properties such as degradation in the environment and self-reparation.

The common denominator of supramolecular chemistry and the chemistry of life (organisms as living systems) is weak non-covalent bonds (interactions). Jean-Marie, what then is the added value of those molecular bases of life over the mere supramolecular chemistry of life? Where does the ability to self-organize living matter, recognize self and non-self, and “self-awareness” come from?

Life is a chemical process involving both the molecular and supramolecular levels. In addition of being the science of structure and transformation of matter, chemistry is also an information science, the science of informed matter, involving the storage of information at the molecular level and its processing through molecular interactions. An emblematic case is that of the genome of living organisms where the genomic information is stored in the form of a specific sequence of four chemical letters in the molecular strands of the DNA double helix and is processed by pairing of these four letters. Storage and processing of chemical information is also at the heart of the ability of molecular matter to undergo self-organization.

French microbiologist André Lwoff, Nobel Prize winner for lysogeny in the infectious cycle of bacterial viruses, defined the virus in a unique way: A virus is a virus is a virus is a virus! He certainly wanted to emphasize the uniqueness of viruses from the point of view of the definition of life. Jean Marie, how do you view viruses? Can viruses be considered just such supramolecular complexes of nucleic acids and proteins?

Indeed, viruses are not living, they are supramolecular architectures built on protein (the bricks) and nucleic acid (the genomic information) molecules. They invade cells and use their machinery to reproduce and generate new virus particles. They are so to say located at the brink of life.

Jean-Marie, your two statements as follow are well known: "*Chemistry is the art of the matter*" or "*The essence of Chemistry is not to discover but to create*". Do you believe that supramolecular chemistry can be the key to the synthesis of artificial enzymes as ecological catalysts for the chemical technologies of the future, or to the synthesis of chemical robots.

Chemistry is first of all a science (see above), not just a useful tool! So, let's leave ecological considerations aside ! They rest on applications of chemistry.

Jean-Marie, thank you for your kind willingness to provide the interview.

With pleasure and cordial regards to the Živa magazine readers.