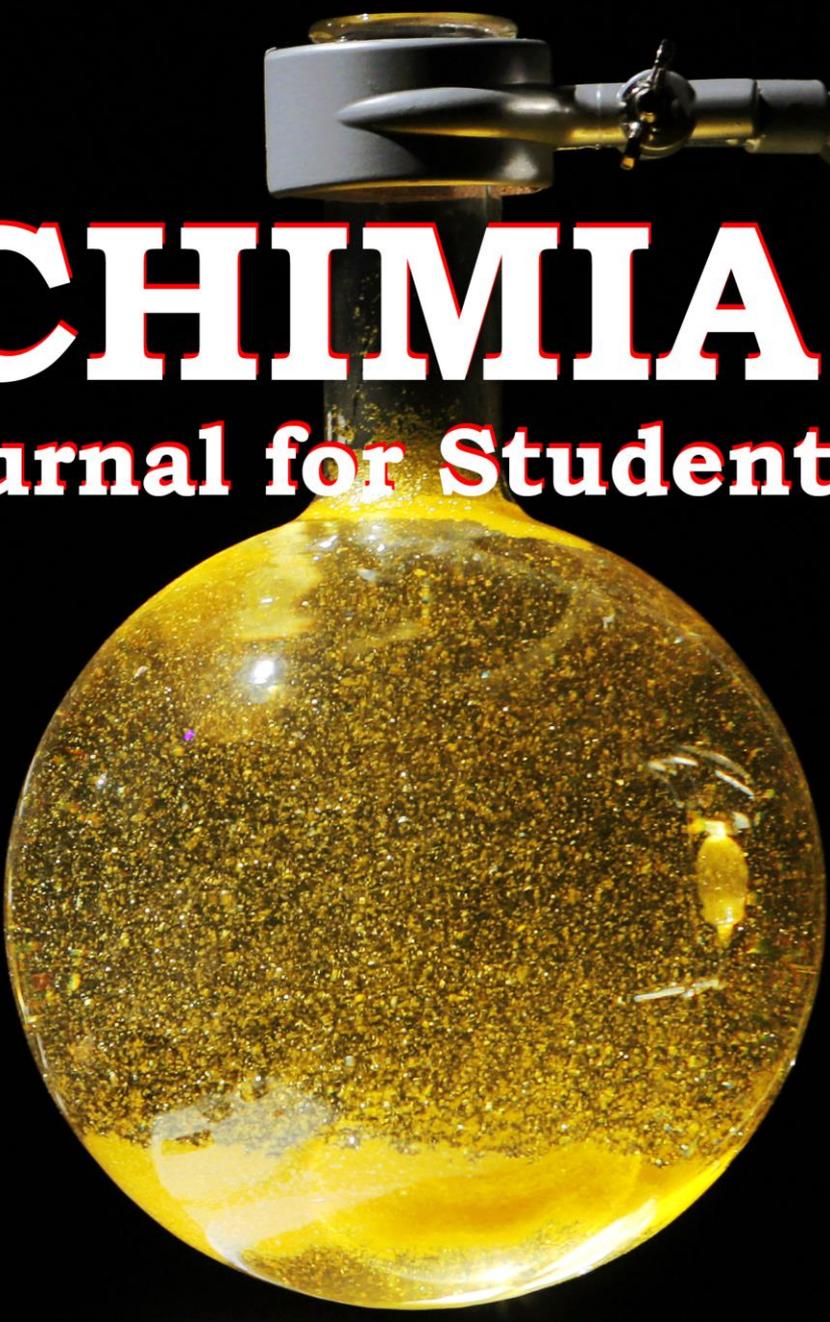




Romanian Chemical Society



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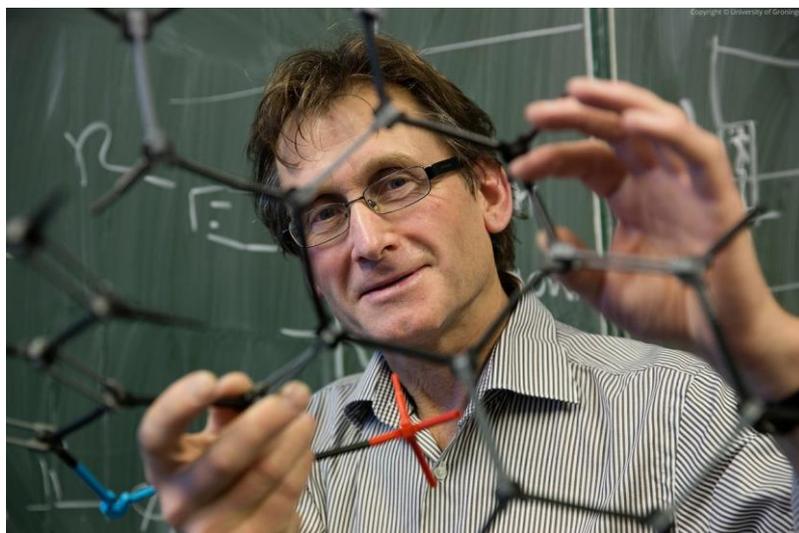
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"When I draw a molecule in China or in Argentina, it is the same molecule. People understand immediately without knowing Spanish or Chinese. That is beautiful. Our common goal is not about power or borders of the country, it is about bringing forward human knowledge."

Ben Feringa, awarded the 2016 Nobel Prize in Chemistry.



<https://twitter.com/nobelprize/status/957982675675025408>

*Romanian chemists congratulate
Professor Jean-Marie LEHN (Nobel Prize in chemistry, 1987)
and
Academician Marius ANDRUȘ (Professor at the University of
Bucharest)
on their anniversaries*

PROFESSOR JEAN-MARIE LEHN – A LIFE FOR CHEMISTRY



Professor Jean-Marie Lehn is a French chemist who received, in 1987, the Nobel Prize in chemistry, together with the Americans Donald J. Cram and Charles J. Pedersen, rewarding their work on the development and use of host molecules that can selectively recognize guest molecules based on specific non-covalent interactions.

Professor Jean-Marie Lehn was born on September 30, 1939 and grew up in Rosheim, a small medieval city of Alsace, nearby Strasbourg in France. He went to the high school at the Collège Freppel in Obernai, a small city nearby Rosheim. During these years he began to play the piano and the organ. He became interested in French literature and philosophy, but also in sciences, so that he obtained the baccalaureates in both Philosophy and Experimental Sciences in 1957. He began carrying out laboratory practice experiments at his parents' home and it became more and more clear that he will follow to do research in organic chemistry.

He obtained the License of Physical Sciences in 1960 and immediately joined the team of Guy Ourisson, at this time a young professor of Chemistry in Strasbourg at that time, particularly impressed as he was by the experimental power of organic chemistry as a science of controlled transformations of the matter. He entered Ourisson's laboratory in October of 1960, as a junior member of the Centre National de la Recherche Scientifique and defended his Ph.D. degree in June of 1963 on Nuclear Magnetic Resonance – NMR studies of triterpenes. Then, he spent a year in the laboratory of Robert Burns Woodward at Harvard University, where he took part in the immense enterprise of the total synthesis of Vitamin B₁₂. He also performed his first computations with Roald Hoffmann and had the chance to assist to the initial stages of what were to become the famous Woodward-Hoffmann rules.

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After this period Jean-Marie Lehn returned to Strasbourg, where he began to work in the area of physical organic chemistry as an Assistant Professor (1960) and then Full professor (1970) at University Louis Pasteur of Strasbourg. Later, in 1979, he was elected Professor at the chair of “Chimie des Interactions Moléculaires”, at the Collège de France in Paris, the highest academic institution in France. His first scientific paper in 1961 reported an additivity rule for substituent induced shifts of proton NMR signals in steroid derivatives. Immediately, Prof. Lehn became famous for his work in physical chemistry (nitrogen inversion barriers, molecular dynamics), after an incisive detour in the field of theoretical organic chemistry.

In the late 1960s the young French chemist Jean-Marie Lehn visited for the first time Romania. He had been invited by *Varian Associates* (Palo Alto, California) to give lectures at the first Nuclear Magnetic Resonance Romanian Workshop organized in Bucharest together with Professor Gheorghe D. Mateescu (now Emeritus Professor at Case Western Reserve University in Cleveland, USA), at the time, Research Associate at the Romanian Academy's Center for Organic Chemistry. The Center, led by Professor Costin D. Nenitzescu, had just purchased from Varian the first NMR spectrometer in Romania. Together with Dr. James Feeney, England, and Professor Didier Gagnaire, France, Lehn introduced the Romanian scientists to the principles and applications of NMR in Chemistry. The expertise and clarity of the speakers ensured the success of the workshop. The event had been planned during preliminary visits to Bucharest of Dr. Rogers, Vice-president of Varian, and Dr. Warren Proctor (also of Varian), the discoverer of the NMR Chemical Shift. As Professor Mateescu put it, the visitors also had the opportunity to do some *touristic chemistry*, visting a few of the natural and man-made beauties in Romania, particularly the *Danube* and the (very old) *Painted Monasteries*.

In the same period, Prof. Jean-Marie Lehn began his seminal research in a new field “Supramolecular Chemistry”, in which “molecular recognition” and “self-assembly” are the leading concepts. This is about the way in which molecules were able to recognize and interact selectively with one another, to give a ‘supermolecule’ including both partners connected by non-covalent interactions. More important, the interactions between molecular partners are related to a specific complementarity based on interactional codes between components; it is a kind of complementarity “Key and Lock” complementarity concept, as proposed for enzymatic processes by Professor Emil Fischer. For this work, Jean-Marie Lehn received the Nobel Prize in Chemistry in 1987 with Donald J. Cram and Charles J. Pedersen.

At the start of all this work it was the interest of Professor Lehn on how the nervous influx is transmitted *via* electrical phenomena in nerve cells, the action potential, which depends on sodium and potassium ion distribution across cell membrane regulated *via* transmembrane protein pathways. With these considerations in mind, a new area of reserach was started in October 1967, to create “cage” molecules, the cryptands, capable of recognizing

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host cations in their cavity. The resulting *cryptates* formed by association of the host cage molecules and fittest cations are representing early pioneering pillars of the supramolecular chemistry. Thereafter, supramolecular chemistry has been extended to other functions based on molecular recognition, like chemical transformation and catalysis, in the manner that natural enzymes operate in the biological world or highly selective transport phenomena through membranes, bio-mimicking the natural translocation processes of various metabolites. From these basic functions: molecular recognition, catalysis and transport, the work has led to the design and development of several photonic, electronic and ionic supramolecular devices that process the information from the molecular to the supramolecular level. Introduction of the concepts and results of supramolecular chemistry into materials science, led to the emergence and the development of *supramolecular polymer chemistry*, as a new area in polymer chemistry. The research of Jean Marie Lehn has been then oriented towards more and more complex systems and processes of organized matter, such as the phenomena of self-assembly and self-organization.

In 1993 Professor Lehn was elected Honorary Member of the Romanian Academy and one year later, in 1994 he became Doctor Honoris Causa of the University Politehnica of Bucharest. In 1994 he was invited by Professor Constantin Luca, at the time Professor of Analytical Chemistry and Instrumental Analysis at University Politehnica of Bucharest and one of the pioneers of Supramolecular Chemistry in Romania, to visit Romania again and to give a series of lectures at the Faculty of Industrial Chemistry. During a week, Professor Lehn presented fantastic lectures, showing the very interdisciplinary nature of supramolecular chemistry, that bridges the gap between biology and physics, while also moving a variety of products in industrial arena.

Starting with 1990, Professor Lehn's laboratory designed a variety of metallo-supramolecular architectures assembled respectively through non-covalent interactions and ligand-metal ion recognition processes: such as double, triple and circular helicates, cages, nanocylinders, "grid-type" architectures presenting a range of intriguing physico-chemical properties (selective recognition, multiple redox states, spin crossover magnetism, etc.). Professor Lehn realized that all these recognition processes implied information and their combination led to its processing at the supramolecular level through interactional algorithms. The work led to the definition of the concepts of molecular *programming-molecular "softwares"* and of *programmed chemical systems*, undergoing self-organization on the basis of the molecular storage and supramolecular processing of information. These investigations provide steps towards a progressive understanding of *multiple expression of molecular information* toward organized supramolecular matter.

It is interesting to note the strong contribution of several Romanian Chemists to these discoveries: Dr. Daniel Funeriu – the former Romanian Education Minister, PhD with Professor Lehn, contributed the field of programmed chemical systems. Prof. Silviu Teodor

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Balaban, at Nanotechnology Institute, Research Center of Karlsruhe, Germany and then at University of Marseille, France, Dr. Mihail Barboiu, Senior Research Scientist at Institute Europeen des Membranes, Montpellier, France and Prof. Augustin Madalan, Professor at the University of Bucharest, Romania, contributed extensively to the long range goal to design functional “metallo-supramolecular devices”. Then, the elaboration of new approaches towards the generation of dynamic architectures by using effector-modulated shape changes of polyheterocyclic strands like proteins operate in nature, have been developed by Dr. Mihail Barboiu and Dr. Adrian Mihail Stadler, Senior Research Scientist at the Institute de Science et d’Ingénierie Supramoléculaires in Strasbourg, France.



The former Romanian Chemists working with Professor Lehn in his laboratory. From left to right: Dr. Adrian-Mihail Stadler, Professor Jean-Marie Lehn, Dr. Mihail Barboiu, Dr. Daniel Funeriu, Prof. Teodor Silviu Balaban, Prof. Augustin Madalan.

Since the early 1990s, a novel field of chemistry was initiated by Professor Lehn, that of Constitutional Dynamic Chemistry (CDC). CDC provides an evolutionary approach to the generation of chemical diversity on both the molecular and supramolecular levels through the implementation of reversible covalent and non-covalent interactions respectively. It confers a fifth dimension to chemical systems, that of constitution, in addition to the 4D spatial/temporal chemical space. At the molecular level, CDC covers *dynamic combinatorial chemistry* (DCC), an approach that, in contrast to classical combinatorial chemistry based on collections of synthesized molecules, implements dynamic libraries of components undergoing continuous interconversion by recombination of their building blocks through reversible covalent bonds and reversible chemical reactions. The application of this methodology allows for the discovery of biologically active substances, in particular enzyme inhibitors or activators and the identification of active drug compounds. In the area of

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materials science, CDC has been used in the development of dynamic polymers, *dynamers*, of use in applications such as degradable materials and controlled release of active substances, supramolecular encapsulation, etc.

As a sign of high appreciation, Professor Lehn received from the Romanian President Ion Iliescu, the *Grand Officer* degree in the *Order of Cultural Merit in Romania* (Research division). On this occasion Professor Lehn gave a prestigious lecture at the “Contemporary Chemistry Conferences”, held at Athene Palace Hotel, in Bucharest on Mai 1st, 2008, *Perspectives in Chemistry: From Supramolecular Chemistry to Constitutional Dynamic Chemistry*. He also gave a Plenary Lecture at the European Young Investigator Awardees Symposium “EURYIAS-2008” – “Self-organization and Selection in Evolution of Matter, Molecules, Life and Society” held between April, 29 – May 3, 2008 at the International Center of Biodynamics, Bucharest, Romania (organizers Dr. Eugen Gheorghiu – the Director of the Center and Dr. Mihail Barboiu) under the auspices of Romanian Academy and the Romanian Research Ministry. Thereafter, Professor Lehn received a Doctorate Honoris Causa from University Babeş-Bolyai of Cluj-Napoca and the Costin Nenitzescu Medal and he became Honorary Member of Romanian Chemical Society.

Ten years later, on May 2, 2018, the University of Bucharest granted the honorary title of Doctor Honoris Causa to Professor Jean-Marie Lehn. In Laudatio Domini, academician Marius Andruh, a professor at the Faculty of Chemistry at the University of Bucharest, presented the impressive "scientific production of Professor Lehn, performed now over forty years with about 450 collaborators from over twenty countries has been described in about 1000 publications and review papers as well as 3 books.

Professor Lehn, was also involved in activities of general interest. They were as diverse as being Founding Chairman of a new journal “Chemistry, an European Journal”, created in 1995 and co-owned by 14 European chemical societies. It also gave the starting impetus to a range of European journals: European Journal of Organic Chemistry, European Journal of Inorganic Chemistry, ChemBioChem, ChemPhysChem) in a real European Spirit.

A major achievement was the foundation of a novel institute ISIS (Institut de Science et d’Ingénierie Supramoléculaires) inaugurated in December 2002 and generously financed by the local authorities and provided with equipment and positions thanks to the strong support of the French Ministry of Research. It made possible to assemble a number of high level senior scientists and promising junior scientists as well as research laboratories from companies in a very stimulating atmosphere.

The conclusion behind this story is highlighted by Professor Lehn: “*Supramolecular chemistry provides ways and means for progressively unraveling the complexification of matter through self-organization. Together with the corresponding fields in physics and biology, it leads toward a supramolecular science of complex, informed, self-organized,*

evolutive matter. Through progressive discovery, understanding, and implementation of the rules that govern the evolution from inanimate to animate matter and beyond, we will ultimately acquire the ability to create new forms of complex matter.” (Science 2002, 295, 2400-2403).

Many thanks to Professor Gheorghe Mateescu, Emeritus Professor at Case Western Reserve University in Cleveland, USA who contribute to this paper.

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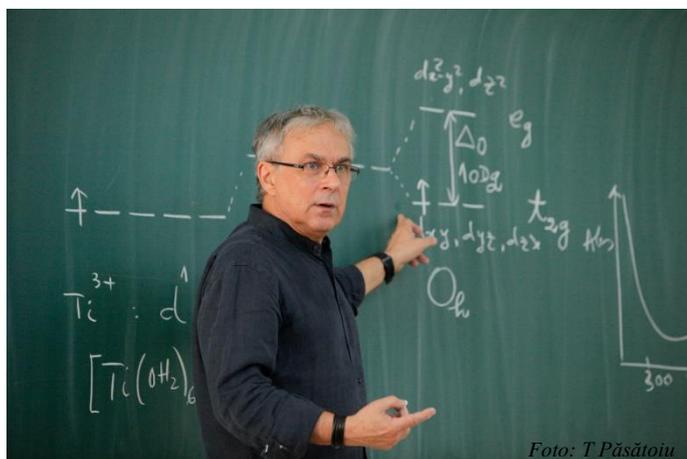
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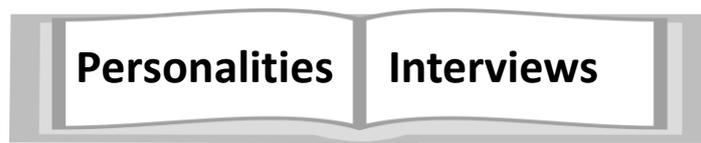
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THOUGHTS ABOUT AND FOR ACADEMICIAN MARIUS ANDRUH AT HIS ANNIVERSARY

We have all been captivated by the science of Chemistry, with its beautiful colours and crystals, and changes that could occur before our very eyes, but there are those for whom the passion for Chemistry and the desire to promote it began during school years and continued unrelentingly throughout their entire career. Winner of the National Chemistry Olympiad, exceptional student, dedicated professor and tireless researcher in the fascinating field of molecular magnetism, Acad. Prof. Marius Andruh aims for all those interested in our field to benefit from his experience and enthusiasm. President of the National Chemistry Olympiad for many years, Prof. Marius Andruh is involved in all aspects belonging to this event, seeing to its flawless organization and ensuring a professional yet relaxed atmosphere. The opening and closing festivities are events in themselves that remain vivid in the memory of audience members, young students and professors alike, each learning something new! It is noteworthy the moment in which Prof. Andruh announces which students have been selected for the national team, based on their results. These students will benefit from supplementary training in order to prepare for participating in the International Chemistry Olympiad and other international Olympiads and contests such as Mendeleev and Iacutia. Instead of simply reading their names, Prof. Andruh captivates the students with a game that allows them to guess for themselves, offering helpful information and increasing the excitement of the announcement. Since 2019 is the international year of the periodic table of the chemical elements, the suspense has been provided this year by making correlations between the participants and different chemical elements.

Prof. Mihaela HILLEBRAND,
Corresponding Member of the Romanian Academy





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After 45 years,

A meeting dating back to June, 1975, at the Faculty of Chemistry since then, situated in Splaiul Independentei, between the group of international chemistry olympics of Romania with another member from the team of previous years, Marius Andruh, has remained alive in my memory, perhaps as a desire to preserve the hopes of those years in a world of science and scientific scholarship. It was clear that the colleague's, Marius Andruh, experience would have been sent to us again, the four high school graduates, who were to represent our country in the contest, held in Bucharest.

The following years, during the faculty, took us in the same group and subgroup of students, in the same dorm room, in competitions or sessions of scientific communications for students, and especially in the research laboratories, as they were then equipped. I also remember now the Saturday evenings, in the tranquility of students' dormitories, when we listened to the trendy music of those years, and we read a lot about the ones listened to the various courses and laboratories. I do not know the day when we woke up at night to get to a bookstore in downtown Bucharest, and to buy the last (and it was the last, unfortunately) edition of the Organic Chemistry monograph, written by Professor C. D. Nenitescu. Likewise, I do not know the day of 1978, when Marius Andruh showed me the proof of his first scientific paper, published as a student, for which he was so happy about.

The years have passed and here we are at a respectable age! In the meantime, Marius Andruh became Professor, Head of his Department, Academician, but beyond the academic degrees, he has achieved a national and international recognition through the incontestable scientific achievements obtained with work, sacrifices and especially intellectual value. And last, but not least, I want to emphasize the love of my colleague and friend, Marius Andruh, for his university, the University of Bucharest, and in particular for the field of Inorganic Chemistry.

Prof. Dr. Victor DAVID

University of Bucharest, Faculty of Chemistry

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The legend tells us that Alexandru Marghiloman once said
"there are two things that you cannot get in Romania: enemies - for once you vanquished them they become your friends- and perfectly starched shirts".

But that was long ago... Today, there are a few more items difficult to find within the Romanian intelligentsia: an intellectual for whom excellence is the everyday natural, accompanied by the deep ethical sense of the cosmopolitan intellectual also present in important public debates, for whom the notion of academic compromise is completely absent.

Rarely you can find in Romania a man whose "academic shirt", as Marghiloman would metaphorically put it, is, *in all circumstances*, perfectly starched. An intellectual constantly at his very best –perfectly "starched"–, whether he wears the shirt of the Romanian Academy, the professor's or public intellectual's shirt, or even the daily shirt that he wears among college students, test-tubes or colleagues in libraries.

Why are, such figures dearly missed? Because Romania's moral and material reconstruction (what common words!) is impossible to start as long as we miss the main ingredient: catalyzing models that, well beyond excellence in their field, represent ethical landmarks standing the proof of time and edgy situations and having the intellectual amplitude that only deep (but also broad) philosophical, historical, and artistic roots can provide. Models who possess a natural and reverent patriotism, revealed by a cosmopolitan intellectual status; models who, through the ideas they spread, open new horizons to any prepared mind across the globe, but also, back home, have the reflex of gratitude, giving back to the country what they, themselves, once received.

Romania needs landmark intellectuals who are a source of inspiration both for the exacting audience of highly praised science publications and the 8th grade students in any countryside classroom. It needs the type of intellectual who finds comfort and fulfillment in the originality of the molecules in his student's test-tubes and the tenacity of his constant quest for excellence, rather than in public honors or academic praises (themselves too many to be mentioned). It needs a landmark intellectual who embodies excellence: from high-school to his full scientific accomplishment.

An intellectual who, met after a long time, enthusiastically brings into the conversation the details of the latest molecules synthesized by his students, brilliant ideas of how to improve the science and chemistry curricula, in short, inspires the audience with solutions that only his brilliant mind could see. An intellectual who teaches something even when he talks about his worldly pleasures, be it a fountain pen collection –each with a particular story–, or an original Bruckner or Shostakovich interpretation, an intellectual who, when returning from a newly-visited country, surprises you by subtle remarks about the spirit that inhabits the minds and souls of the locals, as well as how this is embodied into the local architecture.

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An intellectual who, when extracted from his equations or molecules, does not become a misfit –much like Baudelaire’s albatross– but instead radiates enthusiasm while explaining some hidden architectural jewelry of Bucharest, some forgotten episodes of recent history, a major artistic event, in a way at par with his originality in seeing molecules; a man whose presence among the power of the day imposes himself by the sheer power of his ideas’ content and the purity of his behavior. A man who, through content and attitude has a truly magnetic personality!

There is a dire need of intellectuals to consolidate, on a daily basis, a school of thought, a structure that will reproduce, years from now, the excellence that he once sown. An intellectual who increases the status of any institution to which he belongs, who opens new avenues of knowledge, rather than –as it is fashionable today in Romania–imports the scientific fashion discovered in congresses. An intellectual impossible to add to the list of his illustrious predecessors because one would be forced to place him ahead of them all; and that is impossible considering how uncomfortable would that make him.

An intellectual who remains a model for any 16 years-old youngster that listened to him talking about science, no matter what life will further offer; a man who overwhelms through his personality, long before knowing his numerous achievements; an inspiring person who makes you feel that “sky is the limit”.

Yes, Romania lacks the intellectual amplitude of such people but also lacks our capacity to recognize and praise them in the rare instances when we have them among us. Because it is not only their responsibility to be societal pillars, but also our obligation to recognize, promote and follow them.

One of the very few such intellectuals that Romania provided and kept (*malgré elle!*) is Marius Andruh. There is no need to enumerate the full list of awarded titles or the numerous signs of international recognition, or the number of articles, citations, discoveries or brilliant students, because it is not those metrics that make him unique. Rather, it is his accessible exceptionality, his high-school student-type of enthusiasm that makes you call him wholeheartedly “dear Marius” although you rationally know that given the circumstances it would be much more appropriate to address him “academician Andruh”.

The intellectual feast and, in fact, the privilege to have met Marius Andruh is like a mirror placed in front of us all, raising the inevitable question: “where would Romania be today if it had bet on these people instead of estranging them?”. Let us celebrate our privilege and wish Marius “Happy Birthday!” and many, many years of inspiration induced by his intellect and personality for all of us!

That is about the man himself. Because at the end of the day it is the man who makes the career, which, as impressive as Marius Andruh’s is, is only part of what Marius Andruh generously brings us! About the career Google and SciFinder will tell you all you need to

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know! It is easy to find, since there is one, and only one Marius Andruh!

P. S. This text is not a praise to Marius Andruh, but rather a reflection about ourselves and our intellectual life, seen through the lens of the uncompromising moral framework that Marius Andruh rightfully establishes. Praises are usually expressed towards the end of a career: Marius' career is moving full steam ahead!

Dr. Daniel FUNERIU

The day I have personally met Professor Marius Andruh was a very tense one (for me at least!) as it was during the selection exams for the Chemistry International Olympiads in Halle, Germany. It happened back in June 1989 (almost 30 years ago, already!) in Iasi, my hometown. We were about twenty high school students from all over the country competing for the four places of the Romanian team and I was having great expectations and hopes to be integrated in the team. I still remember very well a part of the inorganic chemistry problems, which were, as Marius confirmed me some years later, proposed by himself. I knew Marius before that day by his reputation and his excellent book of problems, a true best-seller, co-authored with Razvan Cimpoia. Then I had the occasion to exchange with him a few words in that day (I don't detail the circumstances here but it was really funny!) and told myself that it would be really great if I could keep contact with him and getting to know him better in the future. Well, it turned out that 10 years later, in December 1999, I met Marius again this time in Paris on the occasion of a French symposium in coordination chemistry where he was invited speaker. At that time I was just starting my scientific career as CNRS researcher in France and we decided that we have some common scientific interests. Then in 2003 I obtained for him an invited professor position at the University of Angers as we have clearly identified a complementarity in our research directions. Since then we have been engaged in a fruitful collaboration, have obtained bilateral French-Romanian grants, had a joint PhD thesis, two of his former PhD students were postdocs in my group, but on the top of that we established a longstanding friendship which certainly finds its roots in June 1989. Beside an outstanding research Marius is invested since so many years with unflagging enthusiasm and passion in the National and International Chemistry Olympiads therefore one cannot be other but appreciative for such a person.

Happy 65th Anniversary Marius!

Dr. Narcis AVARVARI
Directeur de Recherches CNRS
Université d'Angers, France

Personalities Interviews

Academician Professor Doctor Marius Andruh,

I know you from the first years since you honored with your presence the National Commission of the Chemistry Olympics as a member.

Right from the first moments, you've conquered us all: students and teachers participating in the contest. We were excited by the experiments you performed on the stage at the beginning of the contest, you have challenged us to take on increasing responsibilities because you have made the object of chemistry seem easier, raising the level of the contest. You encouraged us to be original in the proposed problems, you helped us to clarify the scientific notions we did not master so well. You also insisted on working with the pupils at the subjects from the International Olympiads and thus, through the gained performance and with the help of the team preparation, the students participated in several international competitions, winning for Romania medals and top rankings

In addition, you built confidence in us, in our students. Many of them made a passion for studying chemistry, went to faculties in Romania or abroad, and they got brilliant Ph. D. degrees, some becoming academics, researchers in different fields of chemistry. I, personally, enjoyed the success of students who were or still are your students: Ursu Andrei, Anghel Cătălin, Stoian Marius. We will never forget the respect or gratitude that we owe you.

Together with Mrs. General Inspector, Daniela Bogdan, you have contributed to the formation of a National Commission of the Chemical Olympiads where top topics have been proposed, the best students have been selected to represent our country in international competitions, some of them obtaining first place in the world making proud the country, teachers who trained them and their parents. Thank you for all this huge effort! We wish you to be healthy and to be proud of the students you have or will have guided in this difficult but beautiful way of studying chemistry.

Prof. Mariana ROSENSCHEIN,
„Gheorghe Vrănceanu” National College, Bacău

Behind the words are people

The first time I met Marius Andruh in 1994 at the National Chemistry Olympiad in Bacău. Even if in 25 years the contexts in which we have been reviewed have been occasioned mostly by the connection we both have with chemistry, they have always meant confirmations of the capacity that truly providential people have – to make any random event or any meeting, a moment of grace.

Academician Marius Andruh scientific personality has the magnitude of the domain to which he has dedicated himself and, as naturally, biographies, preoccupied to include everything in concrete data, speak about it. What lies beyond, in a different chemistry, of the human, is reserved for the privileged of having known him, and I am, fortunately, among them.

In an affective-admirable matrix in which I intended to include him, I think I would refer first to the original, intuitive but extremely insightful and profound way in which he manages to connect chemistry with seemingly incompatible or often intangible fields - music would be such an example. It is the expression not only of higher-level intelligence, but moreover of a sensitivity complementary to specific curiosity, which only those who look this science beyond its rigor and accuracy can develop. In the descent of this kind of sensitivity may lay the vocation to represent a model whose solidity and persistence are given not only by the constant admiration of the students, but also by the appreciation of the collaborators. This quality is happily associated with the vocation of discovering values and their unconditional cultivation. Excellence is a principle which marks out the manner in which Marius Andruh thinks, acts, evaluates.

If numbers can accurately fix timely events or successes in a person's life, the same is not the case for words. Sometimes they are poor, sometimes very few, always powerless, to include the essence of the providential people that I was talking about at the beginning. That is why for me the meeting with Marius Andruh and the 25 years that I had the chance to review him remain beyond the word, under the spectrum of admiration and gratitude that will always be something to confess.

Costel GHEORGHE,
"Vlaicu Vodă" National College, Curtea de Argeș



Foto: T Păștoiu

Why study CHEMISTRY?

THERMOCHEMISTRY AND LIFE

Thermochemistry? – is the application of the first law of thermodynamics.

Thermochemistry? – studies the thermal effects associated with chemical reactions

Thermochemistry? – is involved in chemical and biochemical energetic, in the elucidation of molecular structures, in the calculation of the binding energies and in the thermo-kinetic characterization of some chemical reactions [1].

Thermochemistry has important applications in the characterization and foundation of vital processes [2]:

- energetic metabolism
- the nutritional and energetic value of food
- the energy balance of glycolysis (catabolism) - anaerobic degradation of glucose (glycogen)
- energy balance of the Krebs cycle - aerobic degradation of glucose
- metabolic heat
- body thermoregulation

We chose to present a succinct treatment of energetic metabolism.

The organisms? – are open thermodynamic systems in which consecutive reactions occur. During these reactions a substance exchange occurs between the cells of the organism and the environment (active cellular substrate). These assembly reactions - substance exchange produces a dissipation of energy in the substrate [3].

Since metabolic systems are operating at constant pressure, their characteristic thermodynamic function is enthalpy, $\Delta H_{T,P}$.

For most metabolic systems, energy dissipation takes place at atmospheric pressure except for species living deep in the oceans.

A metabolic process can be schematically represented as follows:



with the variants:

- ✓ X and Y are different chemicals so the process is a chemical transformation of X, usually catalyzed by an enzyme;
- ✓ X and Y are the same substance in which case the process is a displacement of X (transport of glucose through muscle cell membranes).

An area has developed in biochemistry dedicated to the application of the first law of thermodynamics for the characterization of biological processes.

The calorific value of food? – dH (cal/g) is the amount of heat released from the oxidation of one gram of food by the finite metabolic products (CO_2 , H_2O and urea).

Why study CHEMISTRY?

This quantity is a direct application of the first law of thermodynamics that is determined by adiabatic combustion calorimetry.

Metabolism? – designates all physical and chemical processes taking place in the body in which substances are produced, maintained or destroyed and through which the energy is provided to the cells.

The energetic metabolism? – all gains and losses of energy occurring in the organism-environment relationship.

The energy source for any cellular reaction is made up of macro-energy compounds which are pre-synthesized and stored inside the cell. By consuming these reserves, the body exhausts its energy resources to ensure mechanical work and heat. The energy consumed must be replaced. This can be done through existing energy sources in food, by breaking up C-H chemical bonds through cell specific activity.

Not all existing C-H chemical bonds in nature can be broken down into the body (chemical bond from petroleum products cannot be broken down into the body).

Important! The products useful for the body are those having the structure similar to the structure of the constituent molecules of the cell.

As the cells are made up of proteins, carbohydrates and lipids, the nutrients are limited to these groups of compounds.

The first law of thermodynamics, known as the law of energy conservation, proposed for the energy metabolism the following balance equation:

$$M \pm W = R + C + E \pm S$$

where:

- M is the energy rate due to all metabolic processes;
- W is the energy rate (produced or consumed) due to current activities;
- R is the energy exchange (heat) of the body with the environment through radiation;
- C is the energy exchange (heat) of the body with the environment through convection;
- E is the heat loss rate due to water evaporation from the body;
- S is the rate of energy storage in the body.

Because the heat exchange through radiation, convection and evaporation is related to the surface of the human body, the terms in the equation are expressed in units of energy per area unit ($W \cdot m^{-2}$, $kcal \cdot m^{-2}$).

The energetic metabolism is determined by calorimetric methods. The energetic metabolism value is determined according to the energetic (caloric) value of the ingested food. The lost energy in the form of heat is permanently replaced by alimentation.

If the food intake exceeds the loss of heat and mechanical work, the extra energy is stored in the body and is lost from storage when ingestion of food is less than the loss of mechanical work and heat.

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The basal metabolic rate, BMR, or the basal metabolism? – is the minimum rate of energy consumption compatible with life. With other words, BMR is the minimum amount of energy in calories that the human body needs to keep alive in physical rest.

There are several ways to calculate the BMR, two methods of these for estimating energy consumption in rest are presented below, differentiated for men and women.

➤ Harris-Benedict method [4]

- Men BMR = $66.743 + 13.752G + 5.003H - 6.755V$ (kcal/day)
- Women BMR = $655.096 + 9.562G + 1.850H - 4.676V$ (kcal/day)

where: G - weight in kg;

H – height in cm;

V – age in years.

➤ Mifflin-St. Jeor method [5]

- Men BMR = $10G + 6.25H - 5V + 5$ (kcal/day)
- Women BMR = $10G + 6.25H - 5V - 161$ (kcal/day)

where G, H and V have the same meaning as in the Harris-Benedict equation.

To determine the daily calorie requirement, as accurately as possible, the values obtained with the Mifflin-St. Jeor equations are multiplied by the physical activity factor:

- 1200 for sedentary people or who exercise very little;
- 1375 for slightly active people, physical activity (1-3) days per week;
- 1550 for active people doing sports (3-5) days per week;
- 1725 for very active people doing sports (6-7) days per week;
- 1900 for highly active people doing exercise and sports at work.

The basal metabolism depends on weight, height, sex, age, diet, physical activity. World Health Organization (WHO) proposed a few equations for calculating the amount of calories based on weight (G) and height (H), collected in table 1.

Table 1. The equations obtained for the amount of calories based on weight (G) and height (H):

Age (years)	Men (cal/day)	Women (cal/day)
10 - 18	$16.6G + 77H + 572$	$7.4G + 485H + 217$
18 - 30	$15.4G - 27H + 717$	$13.3G + 334H + 35$
30 - 60	$11.3G + 16H + 901$	$8.7G - 25H + 865$
> 60	$8.8G + 1128H - 1071$	$9.2G + 637H - 321$

From the table it can be concluded that:

- a 36-year-old man weighing 75 kg and with a height of 1.85 m needs 1778 cal/day;

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- a 28-year-old woman weighing 55 kg and with a height of 1.65 m needs 1318 cal/day. These are the minimum required daily values and they may increase depending on physical activity, mental activity, temperature, etc.

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Prof. Dr. Viorica MELTZER

Lect. Dr. Elena PINCU

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☺ „Q: What did the chemist say when he found two isotopes of Helium?

A: HeHe.”

☺ „Q: You wanna hear a joke about potassium?

A: K.”

☺ „Q: You wanna hear a joke about nitrogen and oxygen?

A: NO.”

☺ „Q: Did you hear Oxygen and Potassium went on a date?

A: Yeah, it went OK.”

☺ „Q: What would you say if you lose your gold ring?

A: Au.”

[<https://www.thoughtco.com/chemistry-element-jokes-606028>]

Why study CHEMISTRY?

DETERMINATION OF FOOD ENERGY IN A BOMB CALORIMETER

The chemical energy produced by cellular respiration is derived from ingested foods and is called *food energy*.

Foods are based on the main ingredients that, after ingestion and their burning through breathing, produce an important amount of energy. Sugars, fats and proteins (90% of dry food) are present in the largest proportion. Vitamins and minerals, fiber, water and cholesterol represent a small percentage of the food weigh. Other components, present in very small amounts, are organic acids, polyols (polyhydroxy compounds) and ethanol. The energy value of the majority of food nutrients, expressed in kJ / g and kcal / g, was presented in a previous paper [1].

Fats and ethanol bring the highest energy contribution per gram, 8.84 and 6.93 kcal/g, carbohydrates and proteins have a contribution of about 4.06 kcal / g, in comparison to fibers having a caloric power of 1.91 kcal/g [2]. Some of the food components suffer from molecular breakdowns, so from sugars, cereals, and carbohydrates arrive in the body only simple components such as glucose, fructose, from animal and vegetable proteins, amino acids. Other compounds like vitamins, minerals and antioxidants are assimilated into the form in which they were ingested. From the biochemical decomposition of food results water, carbon dioxide and a significant amount of *energy* [3].

Energy released from food can be determined in different ways, either by the combustion heat, or by the amount of ATP (adenosine triphosphate) resulting from the metabolic process of food. Conventionally, the combustion heat is determined using a calorimetric bomb, plus corrections for digestion and absorption efficiency, production of urea and other substances in the urine. Important contributions to these corrections were made by Wilbur Atwater who proposed calculating the calorie content of foods using 4 kcal/g carbohydrates and protein and 9 kcal/g lipids [4]. The system was improved by Anabel Merrill and Berenice Watt [5].

In this paper we present the determination of the combustion heat for two assortments of biscuits and bread. The food products for which the caloric power was determined, namely the nutritional value, were Petit Beurre RoStar and Bio biscuits, respectively Savoria Toast Integral and Bio bread (shown in Figure 1).

The combustion heat is the thermal effect that accompanies the complete combustion of one mole of compound at the pressure of one atmosphere and at a given temperature. The combustion heat relative to the mass unit is called the *calorific power* (q).

A direct application of calorimetry in the combustion bomb consists in determining the calorific value of the food (the amount of heat released by oxidation of one gram of food to finite metabolic products). The obtained results can be used in establishing controlled diets.

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Fig. 1. Bio and non-bio biscuits and bread [6-8]

The calorific power can be calculated by using equation (1)

$$q = \frac{C_{\text{system}} \Delta T}{m} \quad (1)$$

- C_{system} – is the heat capacity of the calorimetric system ($\text{cal} \cdot \text{K}^{-1}$ or $\text{J} \cdot \text{K}^{-1}$);
- ΔT - is the temperature variation due to the burning of the food product (K);
- m – is the mass of the burned substance (g).

The calorimetric bomb is a cylindrical quasiadiabatic stainless steel vessel (Figure 2) with a sealed cap on which two electrical conductors are placed (with which burning are triggered) and a metal pipe with a tap (for feeding with oxygen). The bomb is positioned in a quasiadiabatic calorimeter containing 5 liters of distilled water, a thermometer and a stirrer.

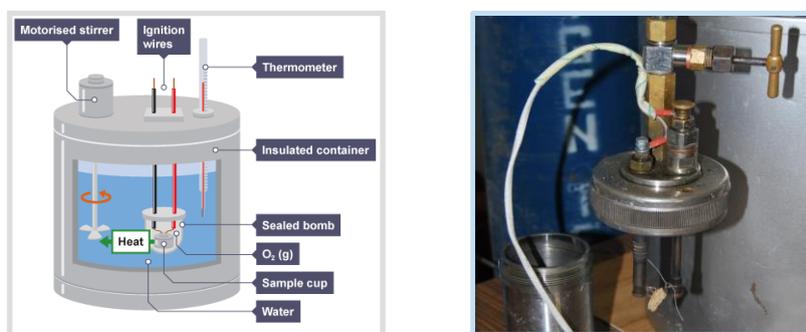


Fig. 2. Bomb calorimeter [9]

The heat capacity of the system (water, bomb calorimeter, thermometer, and stirrer) was determined by the chemical method, combustion of a standard substance (benzoic acid), for which the calorific power value is known ($q_e = 6318 \text{ cal} \cdot \text{g}^{-1}$). A mechanical pressed benzoic acid pellet was fabricated, weighed at analytical balance ($m_e = 0.5980 \text{ g}$) and mounted between the two electrodes. The bomb was closed hermetically and filled with oxygen. The bomb was immersed in the calorimeter, stirring was started and the temperature was established to a constant value, then ignition started. Exothermic reactions lead to increased temperature.

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After the thermal equilibrium was established, the temperature variation of the benzoic acid combustion ($\Delta T = 0.700$ K) was evaluated.

The heat capacity of the system, calculated with equation (2), was 5397.377 cal/K.

$$C_{\text{system}} = \frac{q_e m_e}{\Delta T} \text{ (cal} \cdot \text{K}^{-1}) \quad (2)$$

The experimental determination of the combustion heat for various foods is done in a similar way. Dry food samples are taken, weighed and then heated, determining the temperature variation of the combustion processes. Knowing the capacity of the previously determined calorimetric system and the burnt sample mass, the calorific power of the investigated substance can be calculated by using equation (1).

The ingredients of the experimentally studied products are:

- Simple biscuits Petit Beurre 300g RoStar: wheat flour, inverted sugar, non-hydrogenated vegetable fats (palm oil), water, maize starch, suspending agents (sodium bicarbonate, sodium pyrophosphate), iodine salt, emulsifier (soy), preservative (sodium metabisulphite), acidifier (citric acid), artificial flavor (ethylvaniline).
- Biscuits DLL Bio Petit Beurre 150g: wheat flour (gluten), cane sugar, butter 15.5% (milk), wheat starch (gluten), coconut rice, skimmed milk powder, marine salt, flavor natural vanilla, growth agent (sodium hydrogen carbonate, ammonium carbonate), powdered eggs. Certified organic farming.
- Savoria Toast Integral Bread: rich in fiber and magnesium, Savoria Toast Integral has as ingredients white wheat flour 650, black wheat flour 1350, water, wheat bran, graham flour, wheat gluten, rye flour, soybean meal, barley malt flour, rye malt flour, glucose syrup, rye powder, citrus fiber, enzyme, vegetable oil, yeast, iodized salt. Contains: gluten and soy.
- Savoria Toast Bio with Multicereal: rich in fiber, this brand is an important source of omega 3, omega 6 and magnesium and has ingredients like white wheat flour, organic whole wheat flour, organic oatmeal, wheat flour ecological spelt, ecological seed, ecological wheat gluten, ecological sunflower seed, iodized salt, dehydrated acid dairy (ecological rye flour), organic sesame seeds, organic sugar, organic barley malt flour, organic spices, enzymes, water, organic oil, organic yeast, sugar. Contains: ecological wheat gluten, organic soy and organic sesame seeds.

The nutritional values for investigated products are presented in table 1.

From the data presented in table 2 one can observe:

- the nutritional values determined in bomb calorimetric are consistent with those displayed on the product label;

Why study CHEMISTRY?

- Organic products, both biscuits and bread, provide more energy, being richer in fat, which has a higher caloric content than carbohydrates and proteins;
- The calorimetry in bomb calorimeter proved to be a very good experimental method for determining the nutritional value of assortments of biscuits and bread taken in the study and could also be applied to other food products.

Table 1. The nutritional values per 100 g product

Product	Energy value (kcal/100 g)	Protein (g)	Fat (g)	Carbohydrates (g)	Fibre (g)	Mineral (g)
Petit Beurre RoStar	426.65	6.50	9.25	78.00		0.200 (Na)
Petit Beurre bio	449.00	6.50	14.00	73.00	2.50	0.900 (Na)
Bread Savoria Toast integral	242.77	9.31	1.40	48.74	11.24	0.055 (Mg)
Bread Savoria Toast bio	27.00	10.00	6.00	46.00	8.49	0.046 (Mg)

The experimental results obtained for the four foods analyzed by combustion are shown in Table 2.

Table 2. Experimental data obtained from combustion in bomb calorimeter

Product	m (g)	ΔT (K)	q (cal/g)	Q/100 g experimental (kcal)	Q/100 g pack (kcal)
Petit Beurre Rostar	0.5113	0.400	4222.47	422.25	426.65
Petit Beurre bio	0.5129	0.420	4419.76	441.98	449.00
Bread Savoria Toast integral	0.4659	0.205	2374.89	237.49	242.77
Bread Savoria Toast bio	0.4671	0.235	2715.44	271.54	278.00

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JOKES

☺ I've asked a Spanish girl if she want to hear a joke about silicon? Her answer was „Si”.

☺ „All the elements are sitting at the dinner table and neon says "Helium don't eat too much! You're gonna get fat!" Helium says "No I'm not, I'm the second lightest here!""

[<https://www.thoughtco.com/chemistry-element-jokes-606028>]

Why study CHEMISTRY?

INORGANIC COMPOUNDS AS DRUGS

The human evolution has brought new affections or old ones with a different way of manifestation or that have acquired resistance to the available drugs. As a result, researchers are still searching either for new drugs or for new administration ways of the ones known in order to obtain a more effective treatment. Among the new development strategies for these products is the use of inorganic compounds, simple or complex combinations, either for the treatment of diseases associated with essential metal deficiency or for other diseases.

The most common conditions associated with essential metal deficiency are iron deficiency anaemia, Menkes disease and pernicious anaemia.

Iron deficiency anaemia comes from an iron deficiency, an element found in traces in an amount of 4.3 grams per person with an average weight of 70 kg. Iron deficiency occurs first by decreasing the amount of haemoglobin in the body, and simple and complex combinations of Fe (II) oral or Fe (III) in the injectable formulation [1] are administered for recuperation. Sulphate $[\text{Fe}(\text{OH}_2)_6]\text{SO}_4 \cdot \text{H}_2\text{O}$ (Ferrogradeum, Ferro sanol, Tardyferon), gluconate (Ascofer), glutamate (Glubifer) and iron fumarate (Ferronate) (pills or suspension) are used for this affection treatment, both for children and adults. The mixtures of Fe(III) hydroxide and sucrose (Venofer), polymaltose (Ferrum Hausmann) or dextran (Infed, Dexferrum, Inferon) are used as injections, either when a rapid iron supplementation is required or for persons who do not tolerate oral formulations.

Copper is an element widespread in most body tissues in traces, being the third transition metal as abundance with a content of 0.11g / 70 kg body. Menkes disease is a genetic disorder of copper metabolism due to the lack of a gene encoding the protein involved in the transport of this element through the intestinal membrane in the blood. In order to prevent the severe neurodegenerative problems associated with this disease, injections with Cu(II) complexes as acetate or histidinate are used [2].

Cobalt is present in ultra-traces in the human body in an amount of 2 - 5 mg / 70 kg body in the form of vitamins and coenzymes B₁₂, also known as cobalamins. For acquiring the vitamins B₁₂, the stomach secretes a glycoprotein called intrinsic factor. The lack of this glycoprotein in people suffering from atrophic gastritis, diabetes mellitus, hypothyroidism and gastric cancer results in pernicious anaemia, a disease that can be treated with B₁₂ derivatives (cyanocobalamin or hydroxocobalamin) injections [1, 2].

Inorganic species with non-essential metallic ions have led to the development of drugs either for the treatment or for symptoms amelioration of some diseases such as cancer, rheumatoid arthritis, ulcer, microbial infections or mental illness.

First inorganic drug for the cancer treatment was the complex of Pt(II) with ammonia and chloride as ligands (**1**) (Figure 1), introduced in 1979 as *cis* isomer for the genitourinary

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cancer treatment. With the trade name Cisplatin, Sinplatin or Platinol it is used in combination with organic anticancer drugs for the treatment of testicular, ovarian, neck and head cancer, but small cell lung and bladder cancers respond also to treatment.

Side effects and the resistance to treatment with this compound have resulted in complexes of Pt(II) with ammonia and 1,1-cyclobutanedicarboxylate (Carboplatin) (2) and 1,2-diaminocyclohexane and oxalate as ligands (Oxaliplatin, Eloxatin) (3) (Figure 1) development [2, 3]. Since 1986, carboplatin was preferred compared to cisplatin in the treatment of platinum sensitive cancers. It has an activity comparable to cisplatin in the treatment of ovarian cancer and is better than it in the testicular, head and neck treatment. It has less severe side effects compared to cisplatin but develops resistance to other tumours. Oxaliplatin has been approved for clinical use in 2002 for the treatment of colon or rectum metastatic carcinoma, in which cisplatin and carboplatin have no significant activity. The compound does not develop cross-resistance with cisplatin but develop neurotoxicity as a side effect [3].

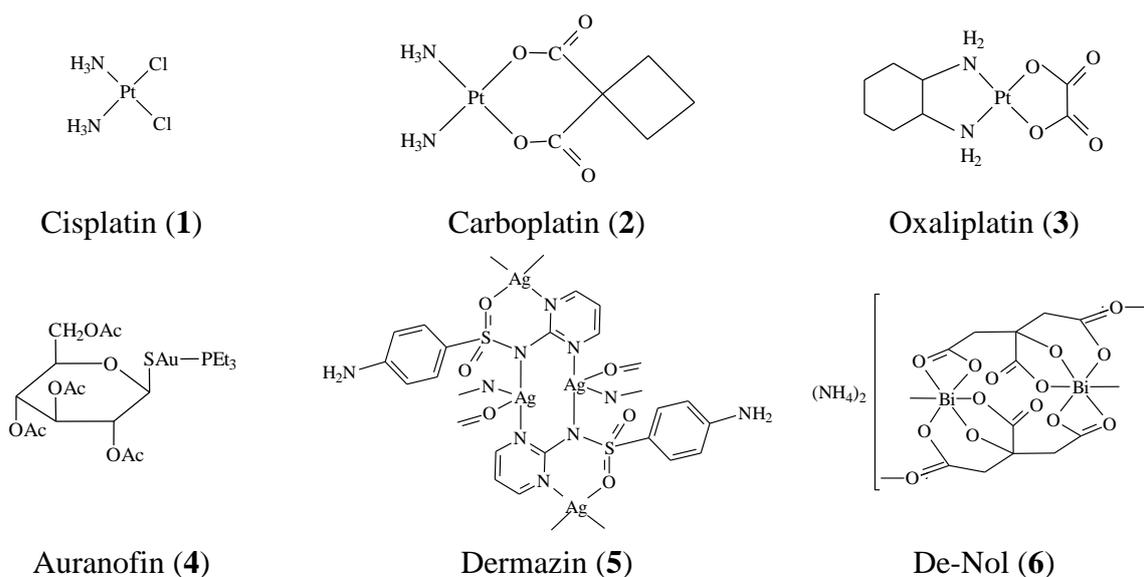


Fig. 1. Active species in inorganic drugs and their trade name

Auranofin (Aktil, Crisnor, Crisofin, Ridaura), an Au(I) complex with 2,3,4,6-tetra-*O*-acetyl-1-thio- β -D-glucopyranosyl and triethylphosphine as ligands is oral formulated in order to ameliorate the rheumatoid arthritis symptoms. The compound is administered only in severe cases that are not responsive to the treatment with organic drugs having in view its high toxicity [2, 3].

For the prevention and treatment of infections associated with second and third degree burns, a 0.5% AgNO_3 solution was used, but this not only destroys the bacteria cultures developed in the burned areas but also epidermal cells. Consequently, this solution is used today only as a prophylactic treatment for the prevention of eye infections in newborns. Instead,

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argentosulfadiazine (**5**) (Figure 1) which is the complex of Ag (I) with sulfadiazine, was introduced for the treatment of these infections. The compound is active against a large number of Gram-negative and Gram-positive bacteria as well as pathogenic fungi as a cream or 1% aqueous solution under the name Dermazin [2, 3].

Some Bi(III) complexes such as salicylate (Pepto-Bismol), citrate (De-Nol) and ranitidine citrate (Pyloride) are used for the treatment of gastric and duodenal ulcers and are also prescribed for the treatment of *Helicobacter pylori* infection, a Gram-negative bacteria associated with ulcer pathogenesis. Complexes of citrate type are water insoluble and have complicated structures with the citrate anion tetradeprotonate at both carboxylate and hydroxyl groups. These species contain dimers of $[\text{Bi}_2(\text{cit})_2]^{2-}$ (H_4cit - citric acid) (**6**) and the various formulations differ by the interactions between dimeric units, the nature of the counterion and the hydration degree [2, 3].

Lithium carbonate (Lithan) was the first modern psychotropic agent and is currently used for the treatment of bipolar disorders. The compound is orally administered, but its high toxicity required a well controlled dosage [2].

Hyperphosphatemia or elevated serum phosphate that appears as a clinical consequence at patients in end-stage of renal disease can be controlled with $\text{La}_2(\text{CO}_3)_3 \cdot 4\text{H}_2\text{O}$ (Fosrenol) which has replaced the treatment with aluminium and calcium compounds that generated undesirable side-effects [3].

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FAMOUS QUOTES

☞ - „Our true mentor in life is science.” – *Mustafa Kemal Atatürk* (founder of the Republic of Turkey) [<https://www.goodreads.com/quotes/28788-our-true-mentor-in-life-is-science>]

Why study CHEMISTRY?

AUTOMOTIVE CATALYSTS

The catalysts that we use to control automotive emissions are now a common feature of our cars, but how much do we know about them? What are these catalysts, what role do they play and how do they work?

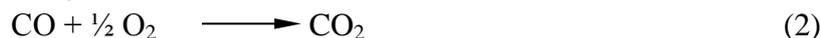
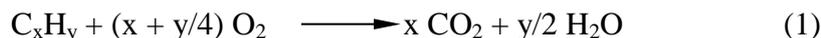
The history of automotive catalytic systems starts 70 years ago, after the Second World War, when the number of automobiles significantly increased and air pollution problems started to be noticed in large urban areas. A well-known case is that of Los Angeles city (USA). In the 1940s-1950s the city's atmosphere contained a yellowish-white haze causing eye irritation and difficult breathing, called "smog" by analogy with the London smog (*smog* = blending of the words *smoke* and *fog*). However, the main component of the Los Angeles smog was not SO_2 , but a group of substances resulting from the photochemical reaction (produced in the presence of sunlight) between some pollutants from air (hydrocarbons and nitrogen oxides) originating mainly from automobile exhaust gases. This group of compounds was named peroxyacetyl nitrates (PAN), and atmospheric pollution by these substances was called "photochemical smog" [1].

When gasoline is burned in the automobile engine, the carbon is converted to CO , CO_2 and soot (very small carbonaceous particulate material), hydrogen is transformed into water, sulphur compounds into SO_2 and SO_3 , while nitrogen compounds are converted to nitrogen oxides (designated as NO_x). Since gasoline oxidation was not very efficient, the exhaust gases contained significant amounts of CO , unburned hydrocarbons and smaller amounts of partial oxidation compounds (aldehydes, ketones, carboxylic acids etc.). At the high temperature in the engine, oxygen and nitrogen (from the air necessary for burning) react and form NO_x , that can reach concentrations above 1000 parts per million (ppm) [2]. The main pollutants in the exhaust gases – unburned hydrocarbons (designated as HC together with the oxygenated compounds that are formed in the engine), CO and NO_x – have negative effects on human health and on natural ecosystems, while their photochemical reactions lead to ozone, PAN and other toxic compounds (*note*: tropospheric ozone is toxic due to its highly oxidizing character, while stratospheric ozone is beneficial due to its role in absorbing UV solar radiation) [1]. The control of automobile exhaust emissions became possible by using catalytic control systems.

Catalytic removal of pollutants from automotive exhaust gases was first introduced in USA, in 1975 [3]. In the European Union, emission standards for cars were adopted in 1993, and since then they became stricter. Catalysts for oxidizing CO and HC were used in the beginning, the most active being those from the noble metals group, mainly platinum and palladium. In 2001, when the standards imposed also the control for nitrogen oxides emissions, the catalysts were modified to include rhodium for the NO_x reduction [2]. In EU, actual standards for emissions (named Euro 6) were enforced in 2015.

Why study CHEMISTRY?

The automotive catalysts have to remove the three main pollutants by performing three reactions: oxidation of hydrocarbons (reaction 1), oxidation of CO (reaction 2) and NO_x reduction (reaction 3), therefore they are known as **three-way catalysts (TWC)**:



These catalysts work in conditions that are very different from those for industrial catalysts: although they operate at relatively low temperatures, they have to withstand accidentally high values (~ 1000 °C), to preserve their activity in the presence of some poisons (e.g. sulphur compounds), and to withstand vibrations or sudden variations of the gas flow passing through the catalyst.

A major difficulty was to perform simultaneously two distinct processes: oxidation (reactions 1 and 2) and reduction (reaction 3), more so because the composition of the exhaust gases is continuously modifying (as a function of the air-to-fuel ratio in the engine) due to changes in driving conditions. This problem was solved by using a stoichiometric air-to-fuel ratio in the engine, equal to 14.7 (mass), that leads to excellent catalytic performances. The application of TWC requires: (a) a precise control of the amount of fuel entering the engine, in order to ensure a stoichiometric ratio between air and fuel, and (b) an oxygen sensor in the exhaust pipe, as a feed-back for the precise adjustment of the air entering the engine [2].

The catalyst, in its most usual configuration, is composed of several components: (a) monolithic substrate; (b) catalyst support; (c) active catalytic components; (d) promoters and stabilizers. Initially, the catalysts were used as pellets, the most usual form in the industrial catalytic reactors. But due to attrition (losing the catalyst as a powder in the exhaust through friction between pellets, caused by vibrations during driving), pellets were replaced by ceramic monolithic honeycombs (usually with channels having square section, see Figure 1).

The **monolithic substrate** is a structure composed of a large number of straight channels, that ensures the stability of the whole system to vibrations, mechanical shocks and high temperatures. Monoliths are usually made of a ceramic material called cordierite (2MgO·2Al₂O₃·5SiO₂), that has the properties required for this application, but sometimes metallic monoliths are used [1].

In order to ensure a higher distribution of the active components (noble metals), a high specific surface area compound is necessary (*specific surface area*, S_{sp} = total surface area of the material, including the pores, per unit of mass, m²/g). Therefore, the monolith walls are covered with a layer of **alumina support** (Al₂O₃), whose S_{sp} is approx. 100 m²/g. The whole assembly is surrounded by a fibrous material (glass wool type) and encased in a metallic housing, to protect it for the entire vehicle life [2].

Why study CHEMISTRY?

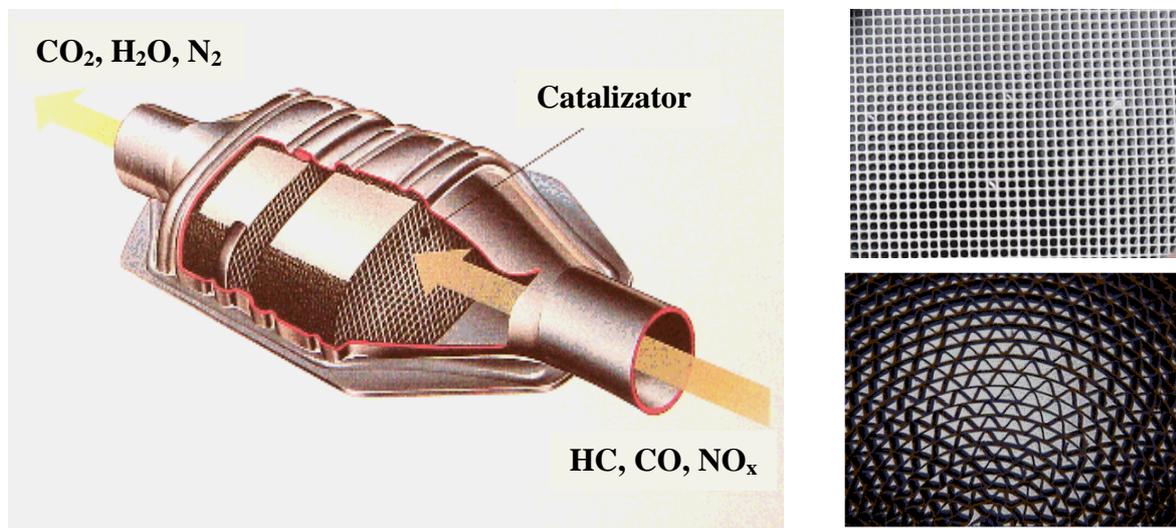
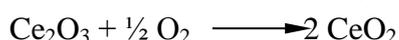


Fig. 1. Schematic representation of the catalytic system for automobiles (left); ceramic monolith (upper right) and metallic monolith (lower right) [1].

Promoters are metallic oxides, added in small amounts in the alumina support, aiming to facilitate certain reactions for the conversion of pollutants. One of the most important compounds is the cerium oxide (CeO₂), used for oxygen release in reducing conditions (oxygen deficiency compared to stoichiometric value – *rich conditions* driving), and to capture oxygen in oxidizing conditions (air excess compared to stoichiometric value – *lean conditions* driving), favouring oxidation reactions even when oxygen is deficient:



This property is called „oxygen storage capacity”, acting to minimize the oscillations in the composition of burned gases coming from the engine and also to increase the conversions of all three pollutants, but especially NO_x [2,4].

Another promoter is nickel, that favours the water gas shift reaction, contributing to the conversion of CO in rich conditions (when oxygen is deficient):



Stabilizers help stabilizing the catalyst in order to function properly for a long time. For example, they prevent the recrystallization of the alumina support from the γ form (with a high S_{sp}) to the α form (the thermodynamically stable form, with very low S_{sp}), that happens when the catalyst is working long times at high temperatures. During recrystallization the noble metal crystallites are trapped inside the support, leading to catalytic activity loss. An example of such a stabilizer is ZrO₂. This oxide also limits the diffusion of Rh under the alumina support, that takes place as a consequence of a solid state reaction between Rh₂O₃ and Al₂O₃, and that would limit the amount of catalytically active Rh [1].

Why study CHEMISTRY?

Active components are platinum group metals, mainly Pt, Pd and Rh, both as metals or as oxides, highly dispersed on the surface of the Al_2O_3 support as nanometric crystallites (Figure 2). The total amount of precious metals is small, only 1-2 grams per catalytic converter. Pd and Pt are used for their activity in HC and CO oxidation reactions, while Rh is used for the reduction of NO_x , since nitrogen oxides are reduced on this metal to molecular nitrogen, avoiding the formation of other nitrogen compounds (N_2O , NH_3) [1].

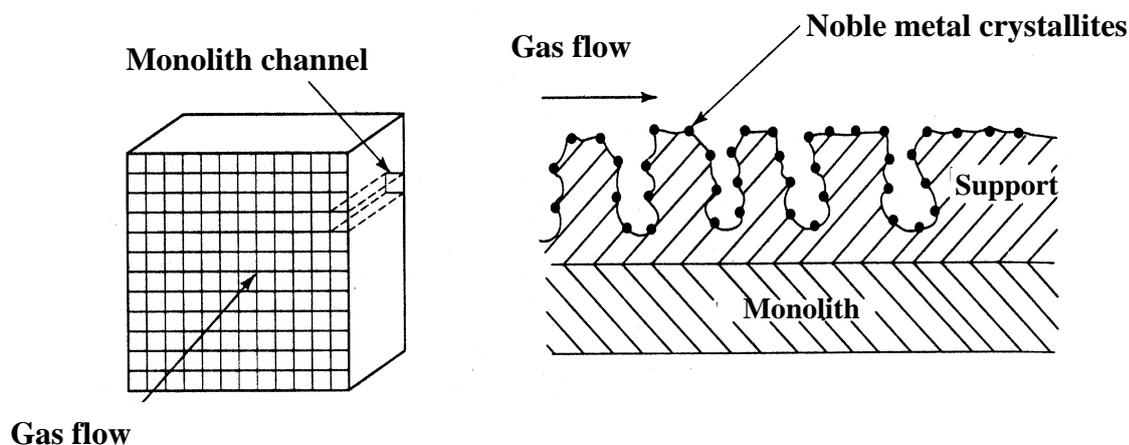


Fig. 2. Schematic representation of the channels in the three-way catalyst [1].

Contrary to what happens in the engines of gasoline-fuels cars, in diesel ones the oxygen is always in excess, thus favoring the oxidation of HC and CO. However, the control of NO_x emissions becomes very difficult because there are no reducing compounds to perform this reaction, and soot is formed in larger amounts than in gasoline-fueled cars due to the nature of diesel combustion [2]. The catalysts, containing platinum in a highly dispersed form, convert CO and HC still present in burned gases coming from the engine. For the NO_x conversion there are two possibilities: (a) oxidation of NO to NO_2 on a platinum catalyst and storage of NO_x as nitrates in a storage system based on alkaline-earth carbonates; this system is periodically kept in reducing conditions, when nitrates decompose to NO, then further reduced to N_2 on a Rh catalyst [5]; (b) selective catalytic reduction of NO_x with NH_3 or urea even in the presence of excess oxygen, using catalysts based on V_2O_5 .

Due to the progress in the manufacture of diesel engines, the problem of soot (particulate matter) emissions was significantly reduced, but because it has negative health effects it need to be eliminated. Monolithic catalytic filters made of porous materials (wall-flow filters) are used, with channels plugged alternately at the ends. The gases are forced through the porous walls, retaining the soot by filtration. Soot is converted to CO_2 and H_2O either by reaction with NO_2 , or by periodically increasing the filter temperature in order to „burn” the solid matter and to clean the filter.

Why study CHEMISTRY?

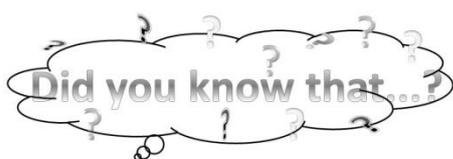
Since they were introduced, the automotive catalytic systems contributed to a substantial reduction in atmosphere pollution, and recent models have a very high efficiency. All these improvements are based on catalysis. The emission control systems are continuously developed in order to increase the performance of the automobiles and to improve the air quality in large urban areas [2].

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.... The hydrangea blooms act as a natural pH indicator for the soil in which the plant grows. The bloom

color reveals the pH of the soil, but with its distinguishing colors being the reverse of those for litmus paper. Thus the flowers are blue sepals when the shrub grows in acidic soil and red or pink when the soils are neutral to basic.



[<http://www.americanscientist.org/issues/pub/2014/6/curious-chemistry-guides-hydrangea-colors/1>]

The first steps in CHEMISTRY

WAS ALCHEMY A PRECHEMISTRY?

In general, we can say that alchemy was a prechemistry (indeed, it is a proto-science), as we can say as well that ancient (or prehistoric) metallurgy was a prechemistry. In fact, we could say that any discipline or action of man towards matter, towards nature, etc. has contributed in one or another way to the formation of the current exact sciences (chemistry, physics, biology, etc.). We know that throughout history (up to the formation of modern chemistry) there have been objective theories that have attempted to explain the nature. For example, the atom with which the modern chemist is constantly working is a term invented thousands of years ago by the ancient Greeks to explain the universe (the well-known atom of Democrit who lived between the 5th and the 4th centuries BC). So, alongside metallurgy, there was also a "scientific" discipline that studied nature. This discipline is philosophy, the origin of all sciences. Why? Philosophy asks questions. If a question (or an experiment) receives an exact answer then it separates itself from philosophy and becomes a science (or the basis for a science) [1]. Next, we will see why alchemy can not be considered a prechemistry and what distinguishes it from modern chemistry.

The alchemist knew many chemical operations and phenomena (such as the famous alembic of the Middle Ages), and maybe he had made many scientific discoveries, but he gave no importance to them. Why? And this is the great difference between alchemy and chemistry. The Alchemist expected from an experiment a manifestation of the sacred (Mircea Eliade calls this event hierophany), while the chemist seeks a measurable, concrete, accurate result. The alchemist does not monitor the effect of a chemical reaction, but something else, superior to the reality. For example, the famous philosophical stone is not an objective support, but a transcendental idea or the transmutation of metals into gold. A subtle metaphor is hidden in this desire of the alchemists, who do not literally want the turning of lead or tin into gold, but the perfection of their own souls.

For a better understanding, we will briefly address the ancient metallurgy that precedes alchemy or, in some cases, it was contemporary with it. Gold was among the first metals used by humans, being found as such in nature. A metal that represented a lively interest for man is iron. People first came into contact with meteoric iron, present in a reduced state in the meteorites. This is a connection with the "heaven," a sacred connection between man and the "celestial metal." When being asked where they got their iron for knives, the Aztecs showed up to heaven [2]. However, reduction of metals from oxides, sulphides, etc. is a more difficult operation (speaking of prehistory). The ancient artists used huge furnaces, requiring a high temperature to melt the ores they used to produce metals, and they used coal. Carbon from the coal reduces the metal from a higher oxidation state. Thus, the blacksmiths obtained metals, but this sacred operation required the initiation and purification of the man, so he practiced

The first steps in CHEMISTRY

asceticism and sacrifice. So, besides the fact that it was seeking the metal itself, the real desire was to substitute time (by accelerating the formation of metals) and God. Ores were considered "embryos" [3] that developed in the womb of the Earth-Mother, but in millions of years, and the creator could substitute for time thus, creating metals in a much shorter time. The iron cult was of considerable duration, thus constituting a special period called *protoistory*, but we do not insist upon it. This cult was lost almost completely, while a cult or attraction for gold lasted for thousands of years.

In conclusion, we can say that alchemy is and is not a prechemistry; alchemy (and metallurgy) acting on a *sacred* plane, while modern chemistry is found in a *profane* plan. The alchemist's and blacksmith's goal is to replace God and time (for example, for the alchemists, creating artificial human *homunculus*), while the purpose of a modern chemist is more pragmatic.

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☺ „What should you do if no one laughs at your chemistry jokes?

- Keep telling them until you get a reaction.”

[<https://www.rd.com/funny-stuff/chemistry-jokes/>]

☺ „Making bad chemistry jokes because all the good ones Argon.”

☺ „We would like to apologize for not adding more jokes... but we only update them.... periodically!”

[<https://www.inorganicventures.com/fun-chemists>]

INCLUSION COMPLEXES OF MACROCYCLIC RECEPTORS

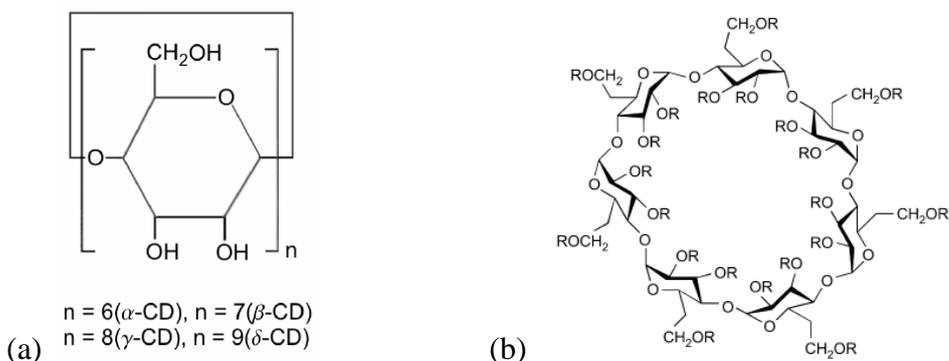
Part II

The macrocyclic receptors, as well as their derivatives, have the property to form stable and selective complexes with the proper substrate by means of non-covalent bonds. The stability of these complexes depends on the form, size and flexibility of both the substrate and the host.

Besides the crown ethers and cryptands, cyclodextrines, calix[n]arenes, cucurbit[n]urils, hemicucurbit[n]urils and pillar[n]arenes represent important classes of macrocyclic compounds with special properties, which found applicability in various fields (molecular devices, development of new materials, catalysis, separation processes or pharmaceuticals industry).

Cyclodextrines and functionalized cyclodextrines

Cyclodextrines (CD) are cyclic oligosaccharides composed of glucopyranosyl units linked by oxygen bridges at positions 1 and 4. They were discovered in 1891 by Villiers [1] and structurally characterized by Schardinger [2]. These molecules are fascinating for both researchers and technologists due to their ability to form inclusion complexes with a wide variety of compounds (drugs, perfumes, food flavors, dyes, and others) with special physicochemical properties. They are composed of 6, 7, 8 and 9 D-glucopyranosyl groups and are called α -, β -, γ -, and δ -cyclodextrin (Figure 1). There is no cyclodextrin with less than 6 glucose units due to the high internal tension occurring at the cyclodextrin ring. The development of enzymatic methods, the bioavailability of drugs, the design of supramolecular devices that imitate biological activities and functions and the chiral differentiation of optically active compounds lead to the use of these compounds in various fields.



Heptakis (2,3,6-tri-O-acetyl)- β -cyclodextrin; R= acetyl

Fig. 1. The structure of (a) natural cyclodextrins and (b) a β -CD derivative

By the synthesis of functionalised cyclodextrins the properties of cyclodextrins regarding their solubility, chemical reactivity, spectral and electrochemical parameters as well as their inclusion properties were improved. The main forces involved in the formation of inclusion complexes are hydrophobic and van der Waals interactions leading to the construction of new functional nanomaterials used in molecular recognition processes.

An example, the 1: 1: 1 inclusion complex of alkylamine, α -cyclodextrin and 18-crown-6 is shown in Figure 2 [3]. The guest molecule can penetrate into the cavity through one of the two cavity rings in equatorial or axial position, aspect studied by spectrometric techniques, such as those based on NMR and X-ray diffraction.

Cyclodextrins have also been used in the design of ionic channels. The first synthetic ionic channel based on β -cyclodextrins was developed by Tabushi [4] (Figure 3) and the transport activity via the butylene glycol functionalized cyclodextrin ionic channel was studied by Gin [5].

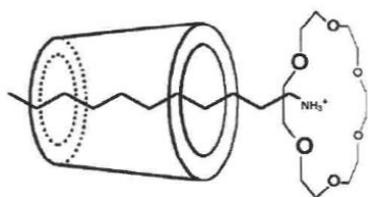


Fig. 2. 1:1:1 Complex formed of alkylamine, α -cyclodextrin and 18-crown-6 [3]

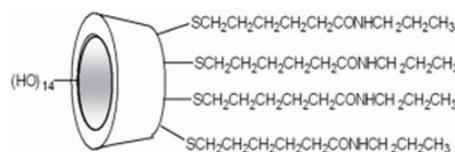
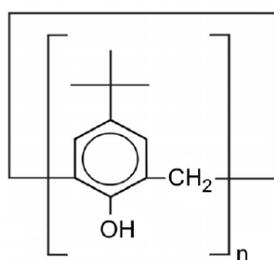


Fig. 3. Synthetic channel developed by Tabushi [4]

Calixarenes and functionalized calixarenes

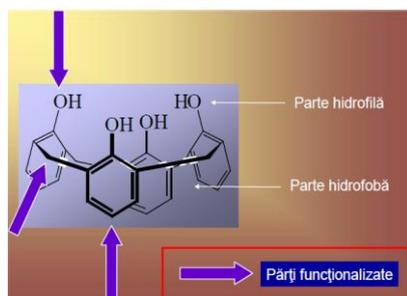
Calixarenes (Figure 4) are cyclic oligomers obtained by formaldehyde condensation with oligomeri ciclici obținuți prin condensarea formaldehidei with *p*-alkyl phenol in alkaline conditions. Due to their structural properties, namely a well-defined cavity, high steric flexibility, the ability to form inclusion complexes with different cations, alkaline metals or biological compounds, these are used as host receptors in supramolecular chemistry along with cyclodextrins, cucurbituril, cryptans, and crown ethers with interesting applications in chemistry, biochemistry, materials science and the drug industry. Due to the fact that they can be easily functionalized with carboxyl, amide groups, glycol chains or crown ethers (Figure 5), both at the upper part and at the lower part of the calixarene ring, as well as due to the cavities of different sizes, the calixarenes have become important receptors in molecular recognition, self assembling, obtaining new nanomaterials, drugs, sensors, separation processes. Furthermore, calixarenes contribute to understanding the specific biomolecular interactions present in molecular recognition

Recognition and formation of selective complexes reversible to biological compounds (amino acids, peptides, neurotransmitters, nucleobases, nucleotides, etc.) are among the most important applications of functionalized calixarenes and calixarenes.



$n = 4, 6, 8$

(a)



(b)

Fig. 4. (a) *p*-*tert*-butylcalix[*n*]arene, $n = 4, 6, 8$ and (b) tetrameric calixarene

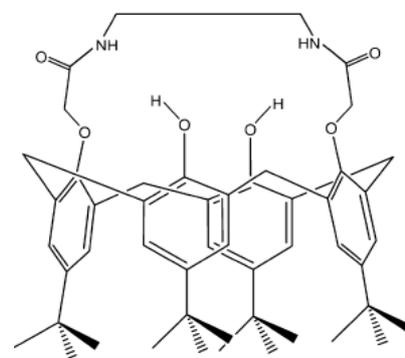


Fig. 5. Calix[4]arene-aza crown eter

The chiral receptor diamide functionalized calix [4] arene (Fig. 6) forms an inclusion complex with the ammonium ion, complex which can be extracted as an ion pair from an aqueous phase in the presence of picrate ion in dichloromethane [6]. Chiral functionalized calixarenes were also used as stationary chromatographic phases to separate chiral compounds

The calix[6]arene has a suitable cavity for the selective inclusion of small organic molecules. By its functionalization with aza cryptand, a calix[6]azacryptand receptor is formed which forms inclusion complexes with ammonium ions (Fig. 7) [7].

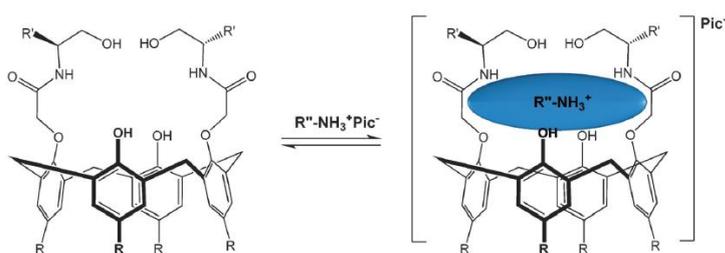


Fig. 6. The complex of functionalized chiral calix[4]arene – aminoacid [6]

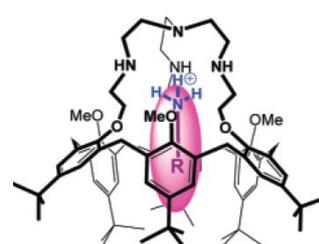


Fig. 7. Inclusion complex of ammonium with calix[6]azacryptand [7]

Cucurbit[*n*]uril

Cucurbit[*n*]uril (CB[*n*]), $n = 5-8, 10, 13-15$, Fig. 8) was synthesized in 1905 by the condensation of glycoluril with formaldehyde in acidic medium by R. Behrend [8] and then structurally characterized by W. L. Mock in 1981 [9], who calls it "cucurbituril" due to the similarity of its structure to that of a pumpkin, representative of the "*cucurbitaceae*" family.

Cucurbituril has a semirigid structure and a hydrophobic cavity of various sizes, which vary according to the number of glycoluril units in the structure, delimited by two portals made up of carbonyl groups conferring remarkable molecular recognition properties to this host compound. The cucurbituril homologues vary with the size of the internal cavity, the water solubility, the inclusion properties of the guests and the stoichiometry of the formed complexes.

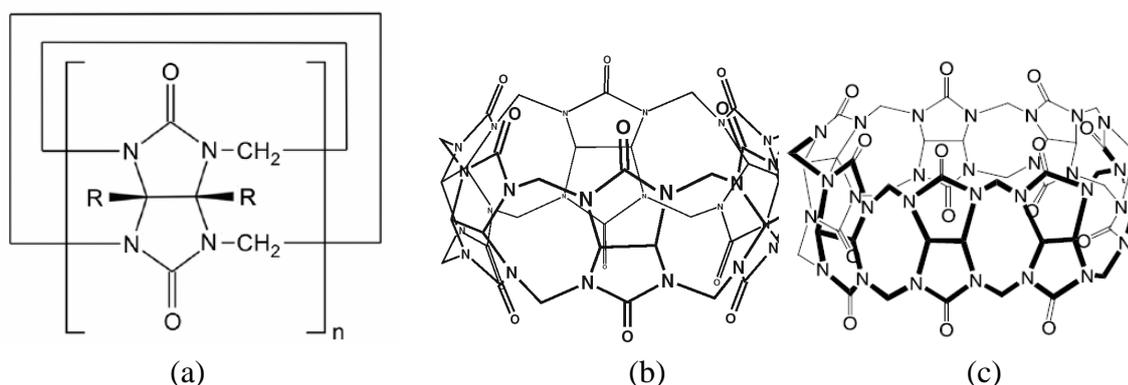


Fig. 8. Chemical structure of (a) CB[n], $n = 5-8, 10, 13-15$; (b) CB[6] and (c) CB[7].

CB [n] has the ability to form inclusion complexes with a wide variety of compounds via hydrophobic, ion-dipole, dipole-dipole interactions and hydrogen bonds. The steric complementarity between the receptor (host) and the substrate (guest) in terms of size and shape as well as functional groups present in the host structure influence the stability of the formed complex. The first structure of the host-guest complex CB [6] - *p*-xylylium was carried out by Freeman using X-ray diffraction [10] (Fig. 9).

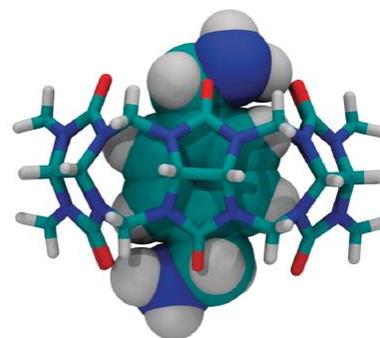


Fig. 9. CB[6]-*p*-xylylium complex [10]

CB [7], a member of the cucurbituril family, forms inclusion complexes with amino acids, nucleobases and peptides. The stability of the inclusion complexes formed with a series of peptides depends on the nature of the terminal amino acid, the amino acid position in the peptide structure and the number of amino acids in the peptide structure.

CB [8] has the property of forming 1: 1: 1 tertiary inclusion complexes with a methyl viologen molecule and a second guest compound. Under physiological conditions specific to the cellular environment, this system can be used for the recognition of relevant compounds in the biological system. Fig.10 presents schematically the 1: 1: 1 complex formed between 11-aminoundecanoic acid, α -cyclodextrin and cucurbit[6]uril [11].

The affinity of the cucurbit[7]uril sites for proteins (e.g. insulin, bovine serum albumin, human immunoglobulin G and carbonic anhydrase) has been studied, remarking its binding affinity for insulin [12] (Fig. 11). Thus, the molecular recognition by CB [7] of the aromatic amino acid, Phe at the N-terminal end of the B chain of the human insulin structure, an important application of the CB [7] receptor was accomplished.

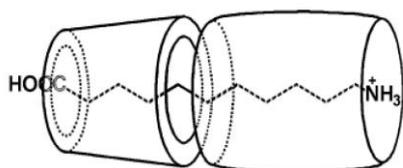


Fig. 10. The 1:1:1 complex formed between 11-aminoundecanoic acid, α -cyclodextrin and cucurbit[6]uril [11].

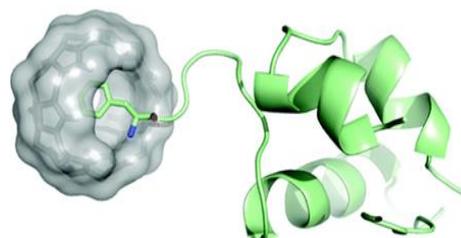
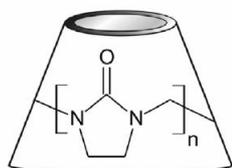


Fig. 11. The 11-aminoundecanoic acid, α -cyclodextrin and cucurbit[7]uril-insulin inclusion complex [12]

The ability of CB [n] receptors to preserve the therapeutic properties of the active substance by complexing and its controlled and constant release under the action of a stimulus leads to the use of receptors in the transport of drugs. Increasing the solubility and bioavailability of a drug are aspects that can be controlled by complexation with the macrocyclic receptor. CB [6] immobilized on silica was used as stationary phase in liquid chromatography for the separation of various alkaloids.

Hemicucurbit[n]urils, $n = 6, 12$

A new derivative of the CB[n] family is hemicucurbit[n]uril (HemiCB[n], $n = 6, 12$, Fig. 12) which presents half of the CB[6] and CB[12] molecules, respectively [13]. The HemiCB[n] compounds are composed of n 2-imidazolidin units linked by methylene bonds.



Hemicucurbit[n]uril ($n = 6, 12$)

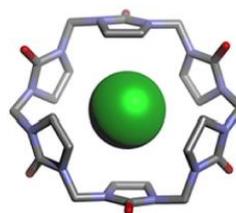


Fig. 12. HemiCB[n], $n = 6, 12$ and the complex hemicucurbit[6]-Cl⁻ [13].

The possibilities of molecular recognition of biological compounds by hemicucurbit[n]uril have been little studied to date. NMR and UV-Vis spectroscopy and fluorescence studies revealed the ability of HemiCB[n], $n = 6, 12$ to form inclusion complexes

with adenine and cytosine [14]. Also, the hemicucurbituril is an efficient transporter through liquid membranes for derivatized amino acids for the purpose of separating them.

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MAGIC CHEMISTRY – OSCILLANT REACTIONS

Chemical reactions usually proceed at rates decreasing monotonously over time, so that the reactants are consumed and the reaction products are continuously formed until the reactants are exhausted or the equilibrium is reached. There are some special and complex reactions where the concentrations of intermediates can oscillate in time. These reactions are called oscillating reactions and represent a very interesting field of chemistry.

Oscillatory reactions were discovered at the end of the 19th century but were not accepted by scientists until after 1950. This was primarily due to Belgian chemist Ilya Prigogine (1917-2004), who explained the observed oscillations by the variation of intermediates concentration in systems far away from equilibrium state [1].

One of the simplest oscillating reaction is the Briggs-Rauscher [2] reaction; the "recipe" is presented below: place a 100 mL beaker on a white sheet of paper and add equal volumes (e.g. 20 mL) of the following solutions [3]:

- a) H_2O_2 6% (25 mL H_2O_2 30% + 100 mL H_2O);
- b) 4.4 g KIO_3 dissolved in 100 mL H_2O + 1.5 mL H_2SO_4 6M;
- c) 1.56 g malonic acid + 0.34 g $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ dissolved in 100 mL H_2O + 1.5mL of a 1% solution of freshly prepared soluble starch.

The glass can be stirred lightly to achieve mixing. Shortly after adding the last component, the color of the mixture becomes yellow, then dark blue, after which the mixture becomes colorless (Figure 1). The cycle is repeated several times, after which the solution becomes black. Also, gas evolution is observed during the reaction.

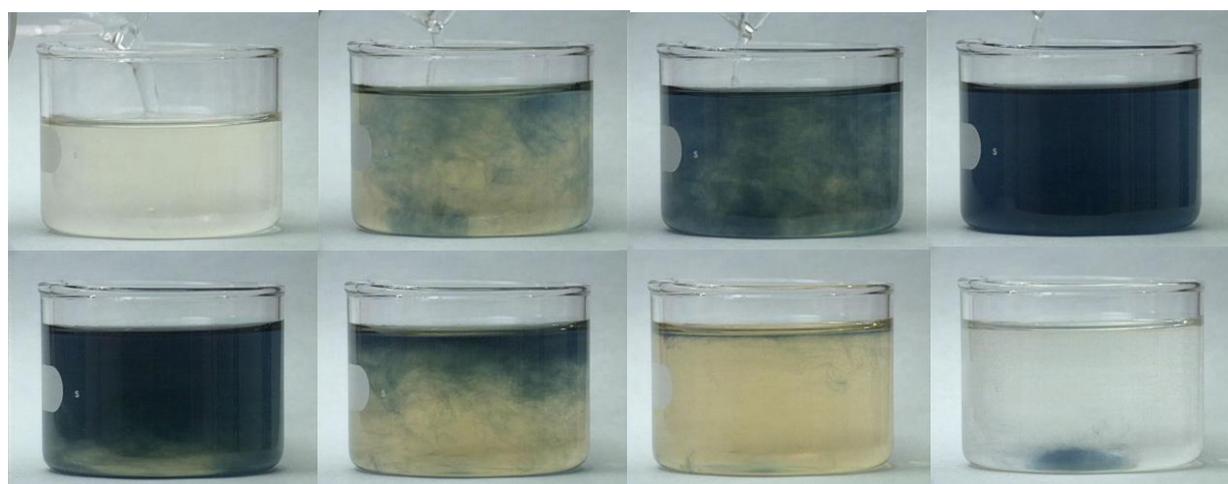
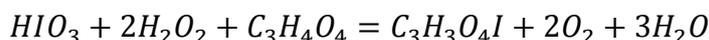


Fig. 1. Time evolution of color for Briggs-Rauscher reaction (the experiment was made in the kinetic laboratory from the Faculty of Chemistry, University of Bucharest)

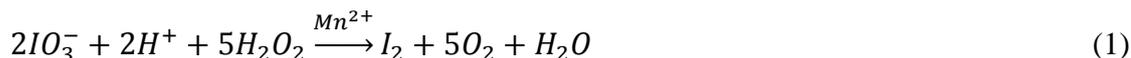
CHEMISTRY as passion

What's going on?

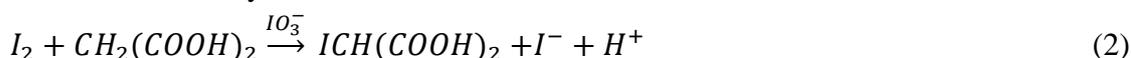
Oscillations can be explained taking into account coupled reactions taking place in the system [4]. The global reaction is:



In the first step, iodate reacts rapidly with hydrogen peroxide, forming the iodine, which the amber colour to the mixture.



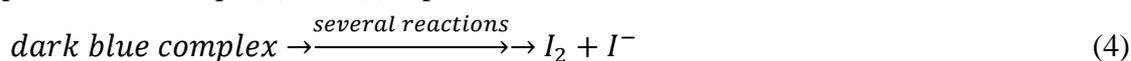
Next, iodine slowly reacts with malonic acid and forms iodide ions:



Iodine reacts very quickly with iodide ions, generating the negative ion I_3^- which forms a dark blue complex with starch:



After a period of time, I_3^- ions are converted to iodine and iodide, so the blue color disappears and the steps (2) and (3) repeat:



After approximately 15 cycles, stage 3 becomes dominant and the reaction ends with the accumulation of iodine, obtaining a dark blue to black color.

Oscillations occur due to the combination of slow and fast reactions that take place simultaneously. Intermediates (I^- and I_3^-) work like switches; depending on their concentration, the global reaction goes on a reaction path or the other as a pendulum.

The researchers tried to study these reactions in order to be able to see at what ranges of initial concentrations the oscillations occur, how big they are and how long they last. Since the oscillating reactions are formed by many coupled reactions (the Briggs-Rauscher reaction has at least 11 component reactions), simpler kinetic models have been proposed that produce sustained oscillations. The first and easiest model was proposed by the american biophysicist Alfred James Lotka (1880-1949), who proposed in 1920 a three-stage model, of which the first two are autocatalytic [5]:



Although Lotka tried to find a chemical system, examples of this kind are found mainly in ecology, so the model is also called the predator-prey model. Let us consider, for example, that **A** is a grassland that has rain and sunshine in optimal quantities, and **X** represents the number of a rabbit family that, by favorable conditions, multiply (stage L1). Let us also consider that **Y** represents the number of a family of foxes that can only multiply if they can feed on rabbits (stage L2) and die in stage L3. The net effect of the three stages is of

CHEMISTRY as passion

the form $A \rightarrow P$. The time evolution of the two species X and Y can be studied by computer, and under appropriate initial conditions leads to sustained oscillations of the X and Y species.

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FAMOUS QUOTES

✍ - „Think that you are part of a big construction called science and you are not just a chemist but you are scientist. Be modest but proud. Modest because you know you will not be able to solve other problems because your life is too short. But be proud because you are contributing to it. Some people will bring a small stone to the building and some people will bring a big one but nevertheless no one can take that stone away from you. Yes, you will be happier if you bring a big stone but not everyone has the right occasion or has the right person at the right place at the right moment to be able to do that.” – *Jean-Marie Lehn* (Nobel Prize in Chemistry, 1987)

✍ - „Modifying ourselves is a natural process because we are a product of nature and what we do is a product of nature.” – *Jean-Marie Lehn* (Nobel Prize in Chemistry, 1987)

[<https://www.lindau-nobel.org/interview-with-jean-marie-lehn-chemistry-is-trying-to-answer-the-biggest-questions/>]

SUPERCRITICALS

*”For some criticism leads to science;
For others, all science only leads to criticism”
(Nicolae Iorga)*

The use of supercritical fluids has become a common practice in industrial processes and analytical control laboratories. Due to the advantages, this technique has been imposed as an accepted variant in the processing of environmental samples and in obtaining substances with practical applications in various fields [1,2]. The most important property of supercritical fluids in extraction processes is given by the ability to adjust the solubilization power through physical parameters - temperature and pressure, so that a supercritical fluid can extract a group of analytes of various polarities and molecular dimensions [2].

A supercritical fluid (SCF) is defined as a compound located in the phase diagram (Figure 1) above its critical pressure (P_c) and temperature (T_c) defining the critical point above which a substance is neither gas nor liquid but possesses the properties of both states [3].

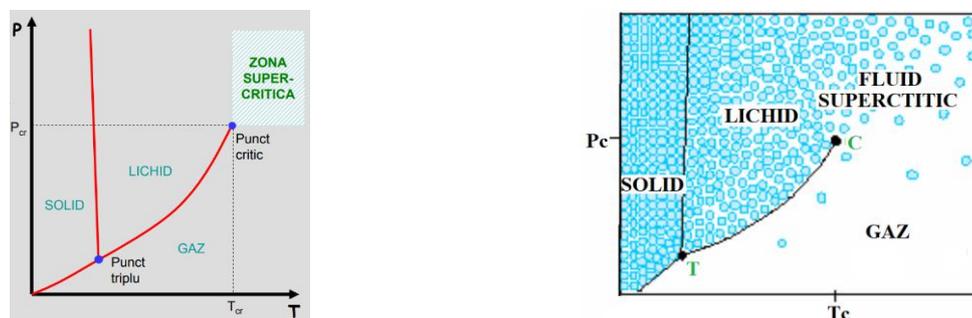


Fig. 1. Phase diagram for supercritical area [1]

Supercritical carbon dioxide ($scCO_2$). The application of $scCO_2$ emerged in the 1970s during the energy crisis facing the world economy. Distillation separation processes are among the largest energy consumers in the chemical industry [3]. Unlike CO_2 produced by burning fossil fuels, CO_2 removed from processes where it is used as a supercritical solvent does not contribute essentially to global warming because it is a by-product of the chemical industry that would be released anyway into the atmosphere. Supercritical CO_2 has very low superficial tension, low viscosity and high diffusion rate, it is completely miscible with many gases over a wide range, and can be removed by a simple system pressure reduction [3]. These properties are the basis of the selective purification processes in the extraction of natural products and can be applied equally to isolate certain products from the reaction mixtures and/or recuperation of the catalytic systems. The most important applications of

scCO₂ are those of extraction solvent and reaction solvent [1]. Carbon dioxide has interesting and often unusual properties for a solvent. Being nonpolar, it would be expected to be a good solvent for hydrocarbons, but the high polarizability makes it a very good solvent for small polar molecules such as methanol and caffeine. The main advantages and disadvantages of using scCO₂ are presented in Table 1.

Table 1. Advantages and disadvantages of using scCO₂ as a solvent [2]

Advantages	Disadvantages
non-toxic, easy removal, recycling potential, non-flammable, high solubility of gases, poor solvation, high diffusion rates, ease of properties control, good mass transfer, available	use of high pressure equipment, relatively expensive equipment, in some cases relatively weak solvent, reactive with strong nucleophiles, possible heat transfer problems

Such approaches, however, find important applications for relatively expensive areas such as the production of fine chemicals and commercial processes [2].

Extraction processes in scCO₂. Extraction of caffeine from wet coffee beans is one of the first and most widespread extraction processes carried out in scCO₂. The process used, before 1980, dichloromethane as extraction solvent with potential adverse health effects and chlorinated residue generator in decaffeinated coffee [4].

The field of microproduction is aimed at obtaining products used in food preparation or in maintaining health due to active principles. Presently, the technique is mostly used (Table 2) for: processing vegetable oils and animal fats; extracting various valuable ingredients (flavors, dyes, vitamins, pigments, etc.); drying raw materials; decaffeinating coffee and tea; studying enzymatic reactions (hydrolysis, esterification reactions, etc.); studying the stability of enzymes in supercritical fluids under different conditions of temperature and pressure; obtaining polysulfonic membranes; performing laboratory analyzes to identify compounds by supercritical fluid chromatography [4].

Another commercial success of applying scCO₂ technology is dry cleaning [1]. Most dry cleaning processes use chlorinated solvents, initially CCl₄ and then perchloroethane - C₂Cl₄ ("perc"), which have disadvantages like: soil contamination, groundwater contamination, and "perc" is a carcinogen suspect. Applying the scCO₂ process has many technical advantages: materials that cannot be cleaned with "perc", such as leather, fur and some synthetics, are cleaned with scCO₂ and refresh the colors of fabrics [6].

Supercritical water. The conditions required for obtaining scH₂O are extremely harsh, therefore its use is limited for most organic syntheses, thus many syntheses of inorganic solids have been studied in scH₂O. A success in this field has been the synthesis of quartz crystals

used in microelectronics [1].

Table 2. Applications for the scCO₂ use a solvent [5]

Herbs and spices	arnica, eucalyptus, parsley, aniseed seeds, mint leaves, basil, black pepper, chamomile, garlic, rosemary, ginger, chili, marjoram, cinnamon, noodles, cloves, thyme, coriander, paprika
Special oils	grape seed, wheat germ, seeds of raisin, seeds of sesame, pumpkin seeds, oats oil, soybean oil
Fats	lecithin production, algae oil, fractionation of lipid and phospholipid mixtures, tocopherol (Vitamin E)
Other applications	decaffeinated tea, decaffeinated coffee, extraction of antimicrobial hop formulas, cholesterol extraction from animal products, tobacco processing - nicotine extraction, skimmed-milk cocoa, protective coatings for fruits
Industrial applications	dyeing of textiles, production of reflective materials, drying of polymers, silicas, polymerization of fluoropolymers, synthesis of formic acid, production of microcrystals in the pharmaceutical industry, sterilization agent

A particular current application of scH₂O is the remediation and treatment of waste under oxidizing conditions. The technique is known as supercritical water oxidation (SCWO) or hydrothermal oxidation (HTO) and is ideal for treating high-diluted wastewater (1% organic waste) so that concentrated waste can be diluted before it is introduced into the process [1].

Decontamination of waters polluted with industrial waste difficult to treat, such as polyaromatic hydrocarbons and polychlorinated biphenols, has been very effective in scH₂O. The technique is applied not only to organic compounds, but also to inorganic compounds such as nitrates or other metal salts [1,7]. The removal of organic pollutants is accomplished in scH₂O with 100% efficiency [1,7]. The major advantage of applying SCWO is that when nitrogen pollutants are destroyed, the formed nitrogen oxides are converted into molecular nitrogen. Oxidation of halogenated and sulfur-containing compounds leads to the formation of hydrochloric and sulfuric acid, which produce reactor corrosion but this can be catalytically solved [1].

The search for alternative solutions for crude oil led to the process of gasification of biomass with supercritical water. The biomass components (cellulose, starch, lignin) are dissolved and cleaved in scH₂O. Under appropriate conditions (~ 600 °C, ~ 35 MPa), the gasification is complete and the main products of gasification are: H₂, CH₄ and CO₂ [1].

CHEMISTRY as passion

Sub-critical water as reaction solvent. The corrosive properties of supercritical water have limited its use as a reaction medium. The use of sub-critical water as solvent has been increasingly studied in recent years. From the point of view of organic chemistry, the use of water as a solvent has many advantages but also a number of drawbacks. In this case, the production of contaminated waste water can have a significant environmental and economic impact. For example, the concentration of water contaminated by distillation is a costly process due to the high temperature requirement. Syntheses of organic compounds in living organisms occur very efficiently in water [1]. Water has many interesting properties (Table 3) that have now begun to be exploited in synthetic chemistry: with the rise in temperature, the ionic product of water increases while density and polarity decrease.

Table 3. Advantages and disadvantages of using sub-critical H₂O as solvent [2]

Advantages	Disadvantages
non-toxic, opportunity to replace VOC (volatile organic compound), available from natural sources, cheap, non-flammable, high heat transfer capacity - control of exothermic reactions	high temperature distillation, contaminated water can be difficult to treat before spill, high heat transfer capacity - difficulty in cooling and rapid heating

Thus, at temperatures of about 200 °C, at high pressures, water begins to possess many of the properties of organic solvents and at the same time becomes a stronger acid and base.

At 300 °C the water exhibits solvation properties similar to acetone. Replacing organic solvents with water can be done for environmental, cost or technical reasons. In the perfume and aroma industry, where the presence, even in traces of volatile impurities, can easily be detected, the process costs decrease significantly due to the water-using technology as a solvent [1].

The use of supercritical fluids as solvents in different industrial and biotechnological processes is due to the following advantages that can be grouped into four categories: environmental benefits; benefits for health and safety of use; benefits in terms of process conditions; advantages related to physicochemical characteristics.

Supercritical fluids allow fabrication of specially structured materials (which cannot be obtained by conventional methods), open new paths in extraction, chromatographic separation and toxic waste disposal [1].

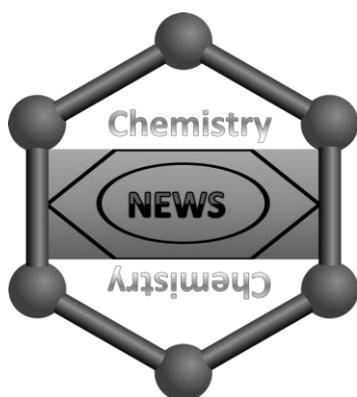
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Daily experience has shown that at extreme temperatures the usual adhesive tapes lose their adhesiveness and leave an unwanted residue behind. Recently, a group of Chinese researchers developed adhesive tapes made of films or ultra-thin wires of precisely aligned nanotubes (SACNT). These double-adhesive tapes, effective over a wide temperature range (-196 to 1000 ° C), adhere to van der Waals forces on the surface of many types of materials (metals, nonmetals, plastics, ceramics), their adhesion being better on smooth surfaces than the rough ones. SACNT tapes can be easily removed from the surface where they have adhered even after exposure to extreme temperatures. It is believed that SACNT adhesive tapes can be made cost-effective in large quantities (hundreds of meters) and can be applied in electronic devices for components that are heated at high temperatures during use.

[X. Jin, et al. Continuous, Ultra-lightweight, and Multipurpose Super-aligned Carbon Nanotube Tapes Viable over a Wide Range of Temperatures, *Nano Lett*, 2019;
<https://www.acs.org/content/acs/en/pressroom/presspacs/2019/acs-presspac-july-10-2019/carbon-nanotube-tape-stays-sticky-in-extreme-temperatures.html>]

Experimental CHEMISTRY

ELECTRICAL ENERGY SOURCES AT HAND

Alternative electrical energy sources are devices where the free energy of some redox reactions is directly transformed into electrical energy. Regarding their components, electrical energy sources are obtained from at least two metals with opposite electrochemical potential that are being in direct contact through an electrolyte solution.

The fruit battery

Materials: a fruit (orange, lemon, kiwi, apple, pear) or a vegetable (potato, cucumber), a galvanized nail, an aluminium can from a soft drink, emery paper, a multiparameter.

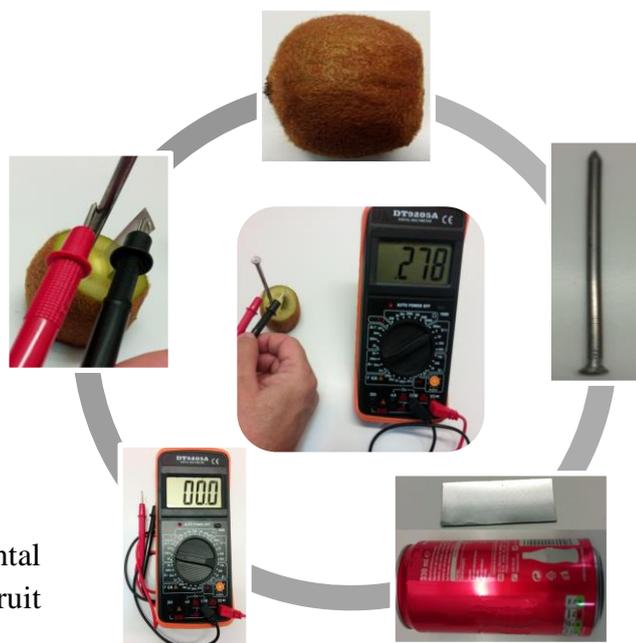


Fig. 1. The experimental steps for obtaining a fruit battery

Let's experiment! The aluminium can is cut into 5cm² pieces and with the help of some emery paper, one shall remove the protective coatings found on both sides of the can. By removing these protective coatings, one may reach the metallic part of the can (an aluminium alloy), which will be used as an electrode in the fruit battery. The aluminium probe and the galvanized nail shall be inserted in the chosen fruit/vegetable at a distance of at least 5mm. The multiparameter should be set on the scale of voltage measuring (V $\overline{=}$ constant current, 2V), and its testers will be set on the aluminium sample and on the galvanized nail.

What do we see? On the apparatus screen we will measure the voltage generated by the battery.

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THE EUROPEAN YOUNG CHEMISTS' NETWORK

The European Young Chemists' Network (EYCN) is the young division of the European Chemical Society (EuChemS), which gathers chemists under the age of 35 that belong to a European fellow society. The EYCN was founded in 2006. The idea of the EYCN within EuChemS appeared during several meetings of young scientists in Europe. On 31st of August 2006, during the 1st European Chemistry Congress (ECC) in Budapest, a paper entitled "Aims, Tasks and Goals of EYCN" was written. In March 2007, Jens Breffke (Germany) and Csaba Janáky (Hungary) invited all societies to send their young representatives to Berlin in order to set the rules of the EYCN, which were later confirmed by the Executive Committee of EuChemS. Meanwhile, the EYCN reached out to all young chemists within the European Chemical Society framework to exchange knowledge, experiences and ideas.

The EYCN has a board with four individual teams (Membership Team, Networks Team, Science Team and Communication Team) who have specific responsibilities, and each is managed by a Team Leader. Being one of the most active divisions of EuChemS, the EYCN's main goal is to support and mentor students, early career researchers and professionals through awards (best poster and best oral presentation prizes, the European Young Chemist Award - EYCA), exchange programs (congress fellowships, Young Chemists Crossing Borders - YCCB program) and educational activities (conferences, Career Days, soft-skills symposiums).

It is important to say that the EYCN successfully collaborates with other early-career chemistry networks in Europe and beyond. It has built a particularly fruitful collaboration with the American Chemical Society - Younger Chemists Committee (ACS-YCC) and is now actively cooperating with the International Younger Chemists Network (IYCN).

In addition to the financial support from EuChemS, the EYCN has been supported for many years by EVONIK Industries.

Dimitra POURNARA
for the EYCN Networks team.



CHEMISTRY Competitions/Activities /Events

NEW PERFORMANCES AT INTERNATIONAL CHEMISTRY OLYMPIADS IN 2019

Year 2019 had a very special meaning for the international chemistry competitions and were all held under the auspices of the International Year of the Periodic Table, as declared by UNESCO to celebrate 150 years from the first publication of the Mendeleev table [1]. **The 51st International Chemistry Olympiad** [2] was held during 21st - 30th of July 2019, in Paris [3] and gathered more than 300 pupils from over 80 countries. The competition was honorably presided by the 2016 Nobel Laureate in Chemistry, prof. Jean-Pierre Sauvage, who has also given a talk to students during the Opening Ceremony, held in *Maison de la Chimie*. The exams took place at *Lycée Pierre-Gilles de Gennes* (Figure 1), which is an impressive educational institution, equipped to highly train pupils for Chemistry, Physics and Biology. Its unique nature, even in France, was visible once you have stepped in. Each floor (out of 12) is dedicated to a special area in one of the above mentioned fields.



Fig. 1. Moments of 51st IChO in Paris

Another imposing architectural venue was *La Maison Internationale*, where all discussions and translation occurred, in *Cité Internationale Universitaire De Paris*. Each of the 10 days of chemistry festival was accompanied by a newspaper, entitled *Catalyser*, with news, interviews and pictures of both children and mentors.

CHEMISTRY Competitions/Activities /Events

The preparation for the practical exam of the organizing and scientific committees was of very high quality. The tasks were clearly formulated and the students were happy to be able to achieve the targets. Our team had an amazing performance in the practical exam, very close to the perfect score. Congratulations!

As a result, in 2019, our team, led by Acad. Marius Andruh won one gold medal and three silver medals: (from left to right in Figure 2)

Ana Florescu Ciobotaru - 11th grade, International Computer High School of Bucharest - **silver medal**, *prof. Lina Chiru*;

Tudor Lile - 10th grade, National College „Moise Nicoară” Arad - **silver medal**, *prof. Dan Rotariu*;

Mircea-Raul Bodrogen - 10th grade, International Computer High School of Bucharest - **gold medal**, *prof. Lina Chiru*;

Ioana Maria Popa - 12th grade, National College Iași - **silver medal**, *prof. Gianina Grigoraș* [4].



Fig. 2. Pupils composing team of Romania after closing ceremony

The Mendeleev International Chemistry

Olympiad (MICH O) [2] has also brought excellent results for the Romanian team. It was held between 20th - 27th of April 2019, in Sankt Petersburg, the city of Mendeleev and the pupils



Fig. 3. Team of Romania and Republic of Moldova at MICH O 2019

had the great opportunity to visit the places where the extraordinary Russian chemist lived and worked. The contest consisted in three rounds (2 theoretical and one practical). The difficulty of the exams were counter balanced by the beauty of the Russian sights and the results they obtained: three gold medals, two silver medals and one bronze medal (from left to right in Figure 3):

Mircea-Raul Bodrogean - International Computer High School of Bucharest - **gold medal**, *prof. Lina Chiru*;

Ana Florescu Ciobotaru - International

Computer High School of Bucharest - **gold medal**, *prof. Lina Chiru*;

Emeric Claudiu Ardelean - National College „Gheorghe Șincai” Baia Mare, - **gold medal**, *prof. Nicoleta Predoiu*;

Sandra Saade - National College Iași - **bronze medal**, *prof. Mărioara Lăcătușu*;

CHEMISTRY Competitions/Activities /Events

Teodora Stan - International Computer High School of Bucharest - **silver medal**, *prof. Lina Chiru*;

Tudor Lile - 10th grade, National College „Moise Nicoară” Arad - **silver medal**, *prof. Dan Rotariu*.

The 26th edition of the **International Tuymaada Olympiad in Mathematics, Physics, Chemistry and Informatics** [2] grew in number of participants this year as the organizers opened the doors for many other highschool teams besides each national team. The chemistry contest occurred for seniors (above 10th grade) and juniors (below 10th grade). Romania had excellent results both through the participants from the National Team, but also from the other teams. **Eugen Piron** - National College „B.P. Hasdeu” Buzău, *prof. Viviana Gaitanovici*, and **Emeric Claudiu Ardelean** - National College „Gheorghe Șincai” Baia Mare, *prof. Nicoleta Predoiu* won **silver medals**.

Thus, the Romanian pupils have done an amazing job at the International Chemistry Olympiads in 2019, perfectly celebrating the Year of the Periodic Table. It is worth mentioning the efforts of all the preuniversity teachers and university chemistry professors who made possible these results together with the pupils, for whom we all should send many thanks and appreciations!

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3. <https://icho2019.paris/en/>
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University of Bucharest, Faculty of Chemistry
Prof. Daniela BOGDAN,
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Lect. dr. Mihaela MATACHE,
University of Bucharest, Faculty of Chemistry

CHEMISTRY Competitions/Activities /Events

THE NATIONAL CHEMISTRY CONTEST “HOW IT’S MADE?”, 2018 EDITION

The National Chemistry Contest “How it’s made?”, the most beloved project of the volunteers from the Young Chemists Section-Branch B2, which has already become a tradition handed out every year by new generations of students, took place between 25th and 28th of October, gathering again in Bucharest a lot of pupils from all over the country.

This project is addressed to mid- and high-school students who are passionate about chemistry and it involves the presentation of a subject of their choice, eventually related to the implications of chemistry in everyday life.

The contest takes place in two stages: a preliminary on-line one, evaluating the capacity of the contestants to briefly present their project, but also their motivation to participate at the competition; the second stage takes place in Bucharest at the Faculty of Applied Chemistry and Materials Science, where the qualified participants have to present their subject in front of a specialized jury. The aim of the National Chemistry Contest “How it’s made?” is the information and the personal development of the pupils passionate about chemistry. Also, the objectives of the project are the presentation of the academic medium, the presentation of the student’s organizations that the pupils can join and the presentation of Bucharest from a social and cultural point of view.

The activities of the contest took place over two days. In the first one the pupils came into contact with the university environment of the Faculty of Applied Chemistry and Materials Science. In this edition, the contestants have had the occasion to participate in one of the Teens Lab or Kids Lab interactive laboratories, where they have performed experiments on topics of major importance in the present, like water purification or circular economy. After this activity they went to one of the newest building of the “Politehnica” University of Bucharest, the Center of Advanced Research for Materials, Products and Innovative Processes (CAMPUS) where they were introduced to the state-of-the-art techniques and equipments used in current research. The second day of the contest was one full of emotions because the participants had to present their projects in front of a jury consisting of faculty professors and representatives of the students’ organizations.

We are glad that with this successful edition we managed to give the young students beside pleasant memories, also a new vision of chemistry, science that is always present in our everyday life.

*Eng. Robert ȚINCU
Young Chemists’ Section, B2 Branch*

CHEMISTRY Competitions/Activities /Events

THE CONTEST “CHEMISTRY – ART AMONG SCIENCES”.

Faculty of Applied Chemistry and Materials Science from University Politehnica of Bucharest organized on 19th of May the first edition of the Contest “**CHEMISTRY – Art among Sciences**”.



The Contest “**CHEMISTRY – Art among Sciences**” was organized with the help of the General School Inspectorate of Bucharest Municipality, professor Luminita Doicin – county inspector, respectively.

Highschool students from the 9th-12th grade had the opportunity to test their knowledge on Inorganic or Organic Chemistry. 337 students applied for the Contest on the website. The contest was held within the Faculty of Applied Chemistry and Materials Science from Polizu Campus, 1-7 Gh. Polizu Street, Bucharest.

The award Ceremony was in “Radu Voinea” auditorium of University Politehnica of Bucharest, 313 Splaiul Independentei.

All the participants were well prepared and they proved to have solid knowledge on Chemistry. We congratulate the students, their professors and parents who supported them for this contest.

The final results were posted on the website of the Faculty of Applied Chemistry and Materials Science in the contest section: <http://www.chimie.upb.ro/concurs>

The winners of the Contest “**CHEMISTRY – Art among Sciences**” (Ist, IInd, IIIrd prize and award mention) are directly enrolled in the Faculty of Applied Chemistry and Materials Science after they get the baccalaureate diploma.

This Contest was a good opportunity to promote the CHEMISTRY SCIENCE among the high school teenagers.

CHEMISTRY Competitions/Activities /Events



We started this first edition of the contest “CHEMISTRY – Art among Sciences” in 2019 when our faculty celebrates 81 years of activity and the University Politehnica of Bucharest 201 years.

We hope that the passion for science and especially for chemistry to be continuously recognized through the valuable results of the high school students – the future students of our faculty.

Prof. Dr. Eng. Cristina ORBECI
Dean of the Faculty of Applied Chemistry and Materials Science
University POLITEHNICA of Bucharest



FAMOUS QUOTES

☞ - „ Nothing can be more certain than this: that we are just beginning to learn something of the wonders of the world on which we live and move and have our being..” – *William Ramsay* (Nobel Prize in Chemistry, 1904)

[<https://www.famousscientists.org/brilliant-chemistry-quotes/>]

CHEMISTRY Competitions/Activities /Events

„THE UNKNOWN ELEMENT - TELL ME WHO YOU ARE ACCOMPANYING TO TELL YOU WHO YOU ARE”

*an outreach event organized by the University of Bucharest, Faculty of Chemistry in order to
celebrate 150 years of Mendeleev’s Periodic Table Of Chemical Elements*

*“Science which deals with the infinite, is itself without bounds”
(Dmitry Mendeleev).*

The Periodic Table of Chemical Elements is considered by UNESCO as „one of the most important and influential achievements in modern science, reflecting the essence not only of Chemistry, but also of Physics, Biology and other disciplines” [1]. The Periodic Table is not just a typical wall decoration in highschool classrooms, but an exceptional tool for scientists to understand and even predict the properties of all the elements.

The development of the Periodic Table has been attributed to the scientist Dmitry Mendeleev who, on March 6th 1869, made a formal presentation to the Russian Chemical Society entitled „The Dependence between the Properties of the Atomic Weights of the Elements”. The original drafts made by Mendeleev would be found years later and published under the name „Tentative System of Elements”.

To honour Mendeleev’s contribution, element 101 was named „Mendelevium”. This is actually an even rarer distinction than winning the Nobel prize: only 50 scientists have elements named after them, while 180 chemists have received a Nobel Prize in Chemistry.

Since this year we celebrate the 150th anniversary of the establishment of the Periodic Table of Chemical Elements, the United Nations General Assembly and UNESCO proclaimed 2019 the „International Year of the Periodic Table of Chemical Elements” (IYPT2019).



To honor it, on April 12th a special event took place at the Faculty of Chemistry of the University of Bucharest. The event consisted of a contest entitled „*The unknown element - tell me who you are accompanying to tell you who you are*” [2] and addressed to highschool children, in which the participants had to create a piece of art related to the periodic table (song, poem, drawing, etc. the list was opened to anything the kids were able to think of) so as to celebrate this important

year in Chemistry. Thus, pupils across the country (and not only) were expected to celebrate with the academic community the IYPT2019.



CHEMISTRY Competitions/Activities /Events

More than 75 papers have been submitted to the competition by a number of 148 highschool children, covering various topics related to chemical elements, from their discovery to applications and involvement in everyday life, in the form of drawing, painting, poetry, essay, poster, film or game.

Following a prior selection at the end of March, 35 teams were invited to the Faculty of Chemistry, University of Bucharest to present their creations to students and staff. This was a very good opportunity for networking between kids, students and employers of chemists, since during the same day ChemJOBS also took place, which is a small job fair organised by the Faculty of Chemistry for its students.

The opening ceremony of the event included a brief speech held by the Dean of the Faculty of Chemistry, Prof. Dr. Andrei Medvedovici, and a conference held by Acad. Marius Andruh related to the Periodic Table.

The 35 teams were divided into 3 categories: the “Valency” section, which included drawings, poetry, essays and paintings, the “Periodicity” section, which featured movies and presentations, and the “Isotopes” section that comprised games.

The best works were awarded with various prizes, all related to Chemistry and IYPT2019, and each student enrolled in the contest received a participation diploma and a small souvenir.

Although all the works presented in the contest were extremely interesting and very well executed, the lucky winners of the three sections were the following:

1. “Valency” section:

- First place: ***Polonium and the genius behind the woman’s face***, Nescu Horia, ”Carol I” National College, Craiova, Dolj county, coordinating teacher Tigae Camelia
- Second place: ***Oxygen: the element of life***, Banu Iustina Elena, Buche Miruna Nicola, Radu Theodora Andreea, Voiculescu Adriana, ”Mihai Eminescu” National College, Bucharest, coordinating teacher Purdilă Magdalena
- Third place: ***The little house of the elements***, Vărzescu Ana, Secondary school no. 24 „Ion Jalea”, Constanța, coordinating teacher Borandă Janeta Violeta
- Special prize “The Romanian Chemical Society”: ***Mendeleev and elements***, Bulborea Letiția Florina, ”Constantin Brâncoveanu” High School, Horezu, Vâlcea county, coordinating teacher Avram Iulia
- Special prize “The Romanian Chemical Society”:



CHEMISTRY Competitions/Activities /Events

Uranium – nuclear disaster, Dumitru Ioana Georgiana, Stănel Oana Carina, Iulia Hasdeu National College, Bucharest, coordinating teacher Ciupercă Diana

- Honourable mention: *The universe of elements*, Andreescu Ștefania, Cîrcu Alexia Miriana, Rocsin Roxana, Jianu Elena Diana, Central School, Bucharest, coordinating teacher Spînu Cristina
- Honourable mention: *Time goes, the elements remain*, Ioniță Cristian, Răzvan Ștefan, Balcoș Ana Ioana, "B.P. Hasdeu" National College, Buzău, coordinating teacher Raicu Viorica
- Honourable mention: *Intelligentium*, Mădulărea Ioana, Șerbănescu Tania Minea, Ișfan Cristiana, Ilioiu Roxana, "Dinicu Golescu" National College, Câmpulung Muscel, Argeș county, coordinating teacher Gheorghe Irina Anca
- Honourable mention: *Mercury – the mysterious element*, Năstase Raluca Maria Nicoleta, Dan Andreea Livia, "Iulia Hasdeu" National College, Bucharest, coordinating teacher Ciupercă Diana
- Honourable mention: *Dimitri Mendeleev - a personality that left traces*, Sima Carmen Maria, "Mihai Eminescu" National College, Bucharest, coordinating teacher Purdilă Magdalena
- Honourable mention: *Right judgment of the elements*, Prepeliță Mihaela, Ion Creangă High School, Ungheni, Moldova Republic, coordinating teacher Buga Alina

2. "Periodicity" section:

- First place: *Narcissium*, Bucoveanu Andra Elena, Iacob Toni Constantin, Simionescu Florentina Miruna, Hamza Miruna, "I. L. Caragiale" National College, Ploiești, Prahova county, coordinating teacher Popescu Irina Elena
- Second place: *The Proti Raku element*, Oprina Elena, Coman Denisa, Baci Petronela, "Dinicu Golescu" National College, Câmpulung Muscel, Argeș county, coordinating teacher Gheorghe Irina Anca
- Third place: *The Miercurium element*, Bordei Alexandra-Ioana, Alexe Anca, "Ionel Teodoreanu" Secondary School, Bucharest, coordinating teacher Vasilescu Valeria
- "Chimie_UB_Alumni" Special prize: *From A to Zinc*, Benegui Daniela, Săvulescu Mihaela, Paraschiv Alexandra, Amza Alexandra, "Ion Barbu" High School, Bucharest, coordinating teacher Crețu Laura
- Honourable mention: *The Carbon*, Roșca Bogdan, "Jean Monnet" High School, Bucharest, coordinating teacher Cristea Iuliana



CHEMISTRY Competitions/Activities /Events

“Isotopes” section:

- First place: **ChimTab**, Vrabie Marius, Ion Creangă High School, Ungheni, Moldova Republic, coordinating teacher Buga Alina
- Second place: **Periodic table – a game of discovery**, Cârlan Alexandra, Ciotei Cristian, Mihai Viteazu National College, Bucharest and Tudor Vianu National College, Bucharest
- Third place: **Game of elements**, Bănanu Alexandra-Ioana, Butcă Elena Ștefania, Comeagă Ana-Maria, Dobre Daciana, ”I. L. Caragiale” National College, Moreni, Dâmbovița county, coordinating teacher Răcășanu Rodica
- Honourable mention: **Chemical Scrabble**, Constantinescu Teodor-Ion, Ionescu Denis-George, Vremăroiu Maria Diana, Ioniță Daria Maria, ”I. L. Caragiale” National College, Moreni, Dâmbovița county, coordinating teacher Răcășanu Rodica
- Honourable mention: **Chemical cubes**, Ilinca Ioana Alexandra, Alexandrescu Bianca Teodora, Secondary school no. 200, Bucharest, coordinating teacher Trașcă Liana



The event concluded with a virtual presentation of the Faculty of Chemistry given by Vicedean Lect. Dr. Delia Popescu.

The event has been very successful and the organizers declared that the same format might be used for similar activities in the future. The works were also exhibited at the 9th International Conference of the Chemical Societies of the South-Eastern European Countries on “Chemistry a Nature Challenger”, which took place in Târgoviște between 8th and 11th of May and we hope to become a permanent corner in our institution.

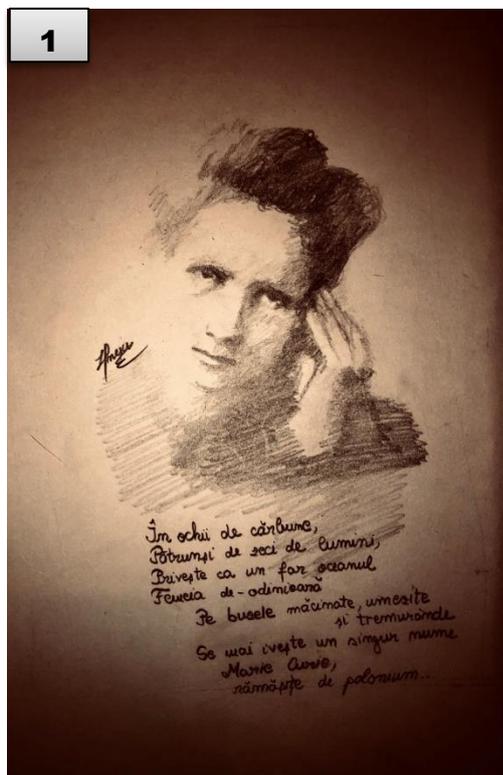


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Assist. Dr. Ioana NICOLAU
University of Bucharest, Faculty of Chemistry

STUDENTS'
CHEMISTRY

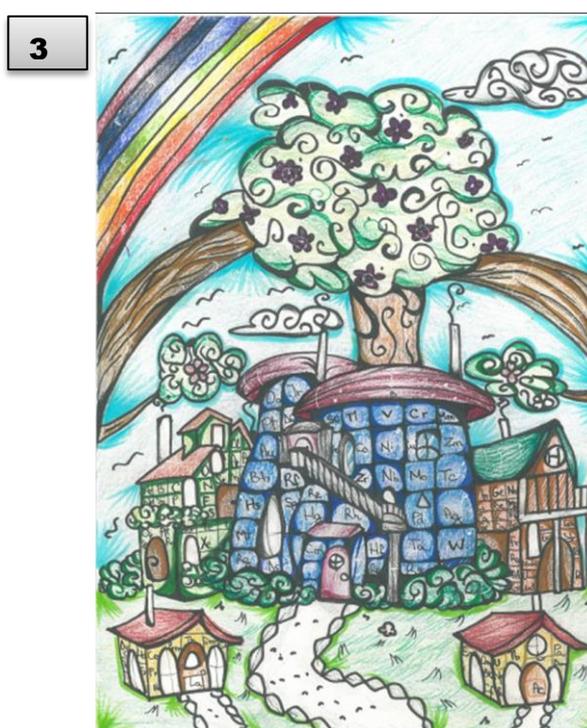


"THE UNKNOWN ELEMENT – TELL ME
WHO YOU ARE ACCOMPANYING TO TELL
YOU WHO YOU ARE" – "Valency" section

1st Prize - *Polonium and the genius behind the woman face*, Neșcu Horia, 9th grade, coordinating teacher Tigae Camelia, „Carol I” National College, Craiova, Dolj county

2nd Prize - *The Oxygen: Element of Life*, Banu Iustina Elena, Buche Miruna Nicola, Radu Theodora Andreea, Voiculescu Adriana, 10th grade, coordinating teacher Purdilă Magdalena, „Mihai Eminescu" National College, Bucharest, District 4

3rd Prize - *House of elements*, Vărzescu Ana, 7th grade, coordinating teacher Borandă Janeta Violeta, Gymnasium School 24 „Ion Jalea”, Constanța, Constanța county



Solutions of the exercises and problemes proposed in



PLAYING WITH CHEMICAL ELEMENTS

<i>Ne</i>	<i>Xe</i>	<i>Ar</i>	<i>Kr</i>
<i>Kr</i>	<i>Ar</i>	<i>Xe</i>	<i>Ne</i>
<i>Xe</i>	<i>Ne</i>	<i>Kr</i>	<i>Ar</i>
<i>Ar</i>	<i>Kr</i>	<i>Ne</i>	<i>Xe</i>

	1	K	R	Y	P	T	O	N			
2	C	A	R	B	O	N					
	3	P	L	A	T	I	N	U	M		
		4	U	R	A	N	I	U	M		
	5	P	H	O	S	P	H	O	R	U	S
		6	B	I	S	M	U	T	H		
			7	L	I	T	H	I	U	M	
			8	S	U	L	P	H	U	R	
	9	B	R	O	M	I	N	E			



Problemes for beginners

1. $100 - 12,3 = 87,7\% \text{ Cu}$

Cu $87,7 : 64 = 1,370$

Al $12,3 : 27 = 0,455$

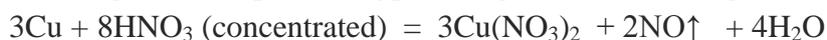
Cu $1,370 : 0,455 = 3$ (3 Copper atoms)A

Al $0,455 : 0,455 = 1$ (1 Aluminum atoms)

Chemical formula : Cu_3Al

2. Copper doesn't react with the hydrochloric acid (it doesn't replace the hydrogen from the acids, its chemical reactivity being low).

The concentrated nitric acid attacks Cu at low temperature and makes copper nitrate (II), releasing brown vapors of hypo-nitrogen. The following reactions take place:



Prof. Şuică Marinela
„Sf. Nicolae” Elementary School, Bucharest

Solutions of the exercises and problems proposed in



Problems for Enthusiasts

FLUORIMETRIC DETERMINATION OF QUININE CONTENT OF TONIC WATER

$$I_{e_1} = k \times C_{\text{quinine}_1} = k \times \frac{V_{\text{juice sample}} \times C_{\text{juice sample}}}{10} \quad (1)$$

$$I_{e_2} = k \times C_{\text{quinine}_2} \quad (2)$$

$$\text{from (1) and (2)} \rightarrow \frac{I_{e_1}}{I_{e_2}} = \frac{C_{\text{quinine}_1}}{C_{\text{quinine}_2}} \quad (3)$$

$$V_{\text{sample}} \times C_{\text{juice sample}} + V_{\text{standard}} \times C_{\text{quinine standard}} = 10 \times C_{\text{quinine}_2} \quad (4) \rightarrow$$

$$C_{\text{quinine}_2} = \frac{V_{\text{sample}} \times C_{\text{juice sample}} + V_{\text{standard}} \times C_{\text{quinine standard}}}{10} \quad (5)$$

$$\text{din (3) și (5)} \rightarrow \frac{I_{e_1}}{I_{e_2}} = \frac{C_{\text{juice sample}} \times V_{\text{juice sample}}}{V_{\text{sample}} \times C_{\text{juice sample}} + V_{\text{standard}} \times C_{\text{quinine standard}}}$$

$$\frac{8,62}{17,57} = \frac{C_{\text{juice sample}} \times 0,1}{0,1 \times C_{\text{juice sample}} + 0,15 \times 50}$$

$$C_{\text{juice sample}} = 72,23 \text{ ppm}$$

$$C_{\text{juice sample}} = 0,07223 \text{ mg/mL}$$

$$m_{\text{quinine}} = 500 \times 0,07223 = 36,12 \text{ mg}$$

The analyzed sample respects the FDA requirements ($72,23 < 83 \text{ ppm}$)

Assoc. Prof. Iulia Gabriela DAVID
University of Bucharest, Faculty of Chemistry