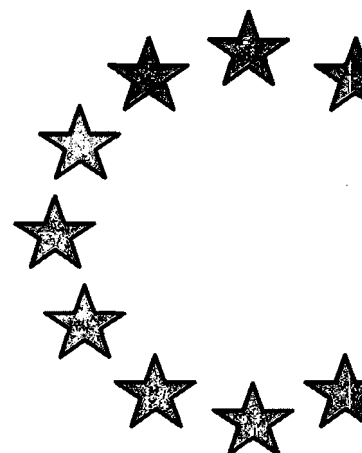


# Chemistry in Croatia

***Science in Croatia is not in good shape. Socialism and Serbian aggression in 1991 left their marks. But in fact Croatia can look back with pride and satisfaction upon a long history in chemistry. The country presented the scientific world with two Nobel prize winners – Lavoslav Ruzicka and Vladimir Prelog. Intensified international cooperation might serve to buttress Croatian chemistry, which despite its difficulties exhibits remarkable vitality.***



## Historical background

◆ One of the oldest pharmacies in Europe to be open to the general public was founded in the old city of Dubrovnik on the Dalmatian coast. The first chemical compound to be prepared as a cure is mentioned in a written document as early as 1271. Chemistry in Croatia – as in all other European countries – has its roots in medieval pharmacy and medicine and appeared as a distinct natural science in university-level education in 1856 in Zagreb, the capital of Croatia. At about the same time (1860), the Royal Agriculture and Forestry College was founded in the small town of Krizevci. One College facility was the first chemical laboratory for analysis of soil, fertilisers, plants and food products.

Chemistry was introduced at the University of Zagreb in 1876, when A. Veljkov (1847–1878) was appointed to the chairmanship of the chemistry department. Veljkov had received his chemical education first in Budapest and then in Berlin, where he worked for A.W. Hofman. Although only five students registered for chemistry in 1876, their numbers

grew to 17 the following year. When Veljkov died in 1878, the Czech chemist G. Janecek (1848 – 1929) was named to the chemistry chair. Janecek wrote the first manual for chemical laboratories in the Croatian language. At that time, the first modern chemical laboratory was built as well, serving both for instruction and chemical analysis for the up-and-coming industry. This beautiful building (Fig. 1) remains to this day the home of the Department of Organic Chemistry and Biochemistry of the University of Zagreb.

The next major step was the foundation of the High Technical

School in 1919, a predecessor of the contemporary Faculty of Chemical Engineering and Technology. The founding father of chemical engineering there was its first professor, V. Njegovan, who organised modern courses in analytical and inorganic chemistry within the chemical engineering curriculum of the time.

Under his guidance, the Zagreb branch of the Yugoslav Chemical Society was established in 1926, and renamed the Croatian Chemical Society in 1939. Professor Njegovan was president of this branch until 1939. He also inaugurated the first chemical journal *Archive for Chemistry*



Fig. 1.  
The old chemistry building in Zagreb, built in 1884.

Fig. 2.  
The modern plant  
for production of  
azithromycin in  
Pliva.



and Pharmacy in 1927, serving as its editor-in-chief until 1933. This journal was transformed in 1956 into the *Croatica Chemica Acta*, which evolved into a journal for all fields of chemistry. It is published by the Croatian Chemical Society, included today under *Current Contents*.

It is worth mentioning that the Advanced Polytechnic offered the chair of the organic chemistry faculty to Lavoslav Ruzicka (born in Vukovar in 1887), who was already famous at the time for his findings gained through research into terpenes, and who received the Nobel Prize for Chemistry in 1939. However, Ruzicka declined the proffered position, and the chair went to I. Marek, who made a name for himself by constructing an oven for elemental analyses that outperformed that of Liebig.

### Beginnings of the chemical industry

◆ The origins of the chemical industry can be traced to several Croatian cities in the second half of the 19<sup>th</sup>

century. The first furnace for processing mainly soil was built in Split in 1865, and the production of Portland cement began in 1880. One of the first European oil refineries began operations in Rijeka in 1882. This refinery supplied one third of the total demand of the former Austro-Hungarian empire for kerosene, paraffin wax, bitumen, tar and organic solvents. At the end of the 19<sup>th</sup> century the first gas plant was built in Zagreb; this plant produced not only gas for lighting but also tar, ammonia, gasoline and coke.

### Vladimir Prelog – a Croat born in Sarajevo

◆ 1935 was a very important year for organic chemistry in Zagreb: this was the year that Vladimir Prelog, winner of the Nobel Prize in chemistry in 1975, became an assistant professor at the Advanced Polytechnic. Prelog received his Ph.D. in chemistry in Prague. His position as assistant professor of chemistry in Zagreb was the first step in a long and very fruitful

academic career. Since the organic chemistry laboratory was poorly equipped and research funds virtually non-existent, Prelog was obliged to look for other sources to finance his ambitious research plans. He found them in the chemical industry and particularly in the small pharmaceutical company Kastel.

This cooperation had important consequences for both organic chemistry and for Kastel itself, which grew into the very modern pharmaceutical works Pliva (Fig. 2). It was Pliva that developed the antibiotic azithromycin, known today by the brand name Sumamed in Central and Eastern Europe and as Zithromax in Western Europe and in the United States, where the license was sold to the pharmaceutical company Pfizer.

The influence of Vladimir Prelog on organic chemistry in Zagreb was immense. By 1941, when he joined the laboratory of L. Ruzicka at the Swiss Federal Institute of Technology (ETH) in Zurich, Prelog had brought together in Zagreb a group of young organic chemists who played important role in developing chemistry at several new faculties established after World War II. A number of his collaborators continued their research at Pliva both in its research institute and in its production facility. Pliva became one of the leading European pharmaceutical works and the largest, in terms of sales, in Central and Eastern Europe.

In the late 1940s, new factories were built mostly in the fields of petrochemicals and polymers. In fact, the chemical industry was one of the protagonists of the economic development of the Republic of Croatia. In the course of time, several new universities were founded in Rijeka, Osijek, Split and Sisak, all with chemistry as part of their curricula.

### The Rudjer Boskovic Institute

◆ A milestone in the development of natural sciences in Croatia was the establishment of a new research institute, the Rudjer Boskovic, in 1950 (Fig. 3). This institute was one of three nuclear research institutes

Fig. 3.  
Part of the Rudjer  
Boskovic Institute  
with the statue of  
Rudjer Boskovic by  
the Croatian sculptor  
I. Mestrovic.





founded in the former Yugoslavia, but its founding father, Ivan Supek, managed to transform it into a modern multidisciplinary scientific research centre. Basic research at this institute spans a wide spectrum of natural sciences, from theoretical physics to molecular biology and medicine. Chemistry occupies the central position in this spectrum, and about 200 chemists working at the institute represent the largest chemical community in Croatia. Some of the finest contributions to physical chemistry, organic synthesis, physical-organic chemistry, quantum chemistry and materials chemistry have resulted from research at the Rudjer Boskovic Institute.

The Centre of Marine Research of the Department for Environmental Research of the Rudjer Boskovic Institute is located on the Adriatic coast in the town of Rovinj. This centre – which later became one of the most important marine institutions in the Adriatic – had been founded by the Deutsche Akademie der Wissenschaften zu Berlin back in 1891. An outstanding feature of research conducted at the Rudjer Boskovic Institute is its interdisciplinary character and strong international ties, resulting in joint projects with scientists abroad.

#### ◆ European Symposium on Organic Reactivity

The 8th ESOR, organised by the Rudjer Boskovic Institute, will take place September 1–7, 2001, in Cavtat (Dubrovnik), Croatia. This symposium continues a long and distinguished series of conferences of physical organic chemists from Europe and the rest of the world. The emphasis will be on interdisciplinary approaches encompassing both experimental and theoretical methods. This symposium will constitute another opportunity for improving existing international ties and forming new ones. More information at [www.esor8.irb.hr](http://www.esor8.irb.hr).

#### Chemistry in Croatia today

◆ The present state of chemistry in Croatia is not satisfactory, as is that of science generally in the former socialist countries now making the transition to a market economy. The difficulties of this time are also a consequence, however, of the brutal aggression of the proserbian Yugoslav army and Serbian paramilitary units in 1991.

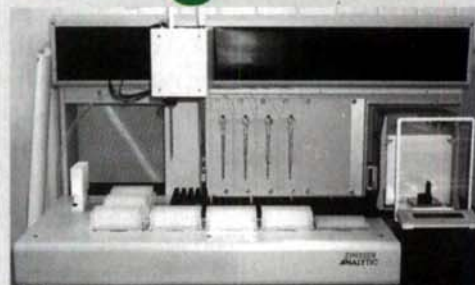
Finally, Croatia suffered years of isolation as a result of the misguided notion that changes under a democratic regime take place too slowly. It is therefore hardly surprising that petrochemistry and the chemical industry in general are presently in a shambles, with many factories and plants either closed or operating at less than capacity. These plants are now being restructured and reorganised to accommodate competition on the global market. However, this phase has been successfully completed only by some pharmaceutical companies (Pliva and Belupo) and by some food production manufactories and companies (Podravka).

The decline in industrial production was followed by an increase in the number of unemployed chemists and chemical engineers. At the same time, the chemical brain drain to West European countries and the U.S.A. continues unabated.

An additional problem is the meagre government funding of education, research and development. Since the chemical industry has its own difficulties to cope with, it shows, with very few exceptions, little interest in financing research. It is no exaggeration to say that almost all research projects are financed by the Ministry of Science and Technology, which also sees to university-level education. The funds available are limited, since the GNP is low in itself and the amount set aside for science

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Das Einwiegen vieler unterschiedlicher flüssiger Substanzen in Probenfläschchen ist außerordentlich zeitaufwendig und bedarf größter Konzentration, um Verwechslungen zu verhindern. Die Erfassung der Einwaage und Verwaltung der Daten ist manuell kaum zu bewältigen.

CALLI löst diese Probleme schnell und zuverlässig. Mit einem Barcode versehene Probenfläschchen werden identifiziert, anschließend gewogen, um das Taragewicht zu erfassen. Dann werden sie automatisch zurück in das Transportblech gestellt oder gleich mit Probenmaterial befüllt, 4 Stück gleichzeitig. Nach dem Dosieren wird das Einwaagegewicht ermittelt, der Barcode kontrolliert und schließlich das Fläschchen in das Transportblech zurückgestellt. Alles läuft automatisch, einschließlich der Übergabe der Wägedaten (Barcode, Tara, Einwaage). Für schwierige Proben, die erst noch gelöst oder gemischt werden müssen, kann CALLI mit einem Vortexer ausgestattet werden, der das Probenmaterial selbst in Deepwellplatten zuverlässig löst und mischt.

CALLI ist ein Beispiel moderner Workbenchautomation auf Basis eines Pipettierroboters mit integriertem Greifer und 4 variabel spreizbaren Dosiernadeln. Die Laborwaage mit automatischer Türbetätigung ist außerhalb der Arbeitsfläche, aber im Zugriff des Roboterarms aufgestellt, um die Übertragung von störenden Schwingungen auf die Waage zu vermeiden.

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and university education is about 1.2% of the GNP. And only 30% of this amount is earmarked for scientific research!

Not surprisingly, most experimental equipment is either outdated or missing altogether, so that modern research is next to impossible. The poor condition of information technology infrastructure and the absence of centres for advanced computation make the overall situation even worse. There is also constant difficulty about the availability of scientific literature.

Despite all this, some surprisingly good papers have been published in the leading chemical journals in the last decade, thus witnessing both creativity and vitality of Croatian chemists.

#### International cooperation

◆ It is unfortunate that Croatia was – for political reasons – left out of the Phare program, the 5th Framework Program and other current forms of European cooperation. COST activities are a positive exception. It is gratifying that bilateral cooperation between Croatia and many European countries and the U.S.A. was much better in both basic and applied research. The Alexander von Humboldt and DAAD Foundations played a particularly useful role in this respect by making specialisation and modern research work possible for a large number of Croatian chemists at numerous German Universities, not to mention donations of the scientific equipment. Cooperation with German chemists was supported by other foundations, agencies and organisations such as the Volkswagen Foundation, the Deutsche Forschungsgemeinschaft (DFG) and Forschungszentrum Jülich, too.

There is some collaboration with other European countries (Great Britain, Italy, France) and with the

U.S.A., as mentioned earlier, but to a lesser extent, a situation which will hopefully be improved in the future.

Particularly conducive to international cooperation are the scientific workshops and symposia organised in Croatia. These are often scientific melting pots, which contribute to the shaping of joint research projects of common interest. This kind of cooperation is essential, because modern research and scientific progress depend upon different kinds of experts being able to tackle intricate problems from different angles, using different methods and techniques.

It is beyond doubt that the scientific challenge of the 21<sup>st</sup> century will be met only by multi- and interdisciplinary efforts. The scientific research of the future will be of necessity a multinational, polycentric and collective endeavour. Croatian chemists are looking forward to participating in this process.

In sum, chemistry in Croatia needs help in joining European integration processes. Such integration would enable Croatian chemists to contribute more efficiently and effectively to European and world science and thus to shoulder their share of scientific responsibility for the benefit of mankind.

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## National Notes



### Congress in Italy on Trends in the Chemical Industry

◆ The Industrial Chemistry Division of the Italian Chemical Society is organizing the international conference RICH-MAC 2001. This congress on new trends in the European chemical industry will be held from October 2nd to October 4th 2001 in

Milano, Italy. During the first day experts will outline a scenario on topical issues ranging from industrial catalysis and e-chemistry to fuel reformulation and environmental cleaning. More information at [www.dcci.unipi.it/~bea/scidci/richmac2001.pdf](http://www.dcci.unipi.it/~bea/scidci/richmac2001.pdf) or contact Isabella Bellini, SCI-Sezione Lombardia, Piazzale Morandi 2, 20121 Milano, Italy, phone and fax +39 02 784545, e-mail: [scidci@tin.it](mailto:scidci@tin.it).



### MPs get Manifesto Message from UK Scientists and Engineers

◆ At a unique gathering of the Members of Parliament, scientists and engineers in February 2001, the importance of ensuring that the UK continues to be strong in science and engineering was highlighted by the launch of a Charter for Science and Engineering. The event reflects the increasing collaboration between the many prestigious bodies representing science and engineering in the UK and highlights the importance of the continued dialogue between those who practice science and engineering, legislators and the public at large.

„Science is the key to the Nation's health, well being and national prosperity and should be at the heart of all party manifestos. The Charter for Science and Engineering provides a sound basis on which to develop science policy across all government departments,” said Sir William Stewart, President of the British Association for the Advancement of Science.

The Charter for Science and Engineering highlights 10 articles that need to be addressed by the next Government.

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