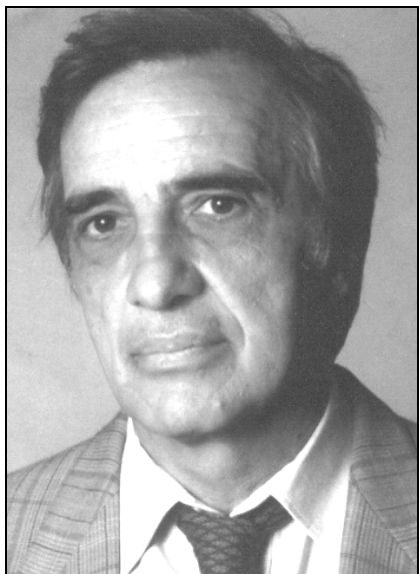


## Akademik, prof. dr DUŠAN R. VUČELIĆ (1938–2000)



Akademik, prof. dr DUŠAN R. VUČELIĆ (1938–2000), čovek neobičan po svojoj afirmaciji, volji i snazi, bio je redovni profesor Fakulteta za fizičku hemiju, Univerziteta u Beogradu. Rođen je 17. juna 1938. godine u Beogradu u učiteljskoj porodici. Na Fakultetu za fizičku hemiju doktorirao je 1970. godine. Teza "Relaksacioni fenomeni molekula na graničnim površinama" je bila iz nedovoljno poznate naučne oblasti sa do tada samo nekoliko objavljenih publikacija. Na istom fakultetu postao je 1971. godine docent na predmetu Fizička hemija čvrstog stanja, a u zvanje vanrednog profesora izabran je 1979. godine. U isto zvanje 1981. godine izabran je i za predmet Molekularna biofizika na Odseku za biologiju Prirodno–matematičkog fakulteta. Za redovnog profesora, izabran je 1986. godine za predmete Fizička hemija čvrstog stanja i Molekularna biofizika. Pored rada na fakultetu, veći deo naučne i stručne karijere sticao je u Institutu za opštu i fizičku hemiju čiji je saradnik postao 1965. godine, kada je izabran i za asistenta na Katedri fizičke hemije.

Direktor Instituta za opštu i fizičku hemiju bio je u periodu od 1978–1982. godine, a naučni rukovodilac istog Instituta do avgusta 2000. godine. Zahvaljujući prof. Vučeliću, Institut se afirmisao kao naučno–istraživačka institucija koja je u okviru projekata "Fizička hemija graničnih faza" i "Molekularna biofizika" kao i brojnih projekata od interesa za različite industrije uticala na politiku naučnog i tehnološkog razvoja zemlje.

Veoma rano je uspostavio kontakte sa inostranim naučnim institucijama. Tako je 1976. godine bio na usavršavanju na Odseku za neorgansku hemiju Univerziteta u Oksfordu; 1980. je boravio u laboratoriji za NMR, Stenford Univerziteta (SAD), a 1991. godine na Fizičkom fakultetu, Lomonosov Univerziteta u Moskvi, kao gostujuć profesor.

The academician, professor DUŠAN R. VUČELIĆ, Ph.D. (1938–2000), a man not ordinary by his reputation, will and energy, was a full professor at the Faculty of Physical Chemistry of Belgrade University. He was born in a family of teachers in Belgrade on June 17th, 1938. He obtained his doctorate at the Faculty of Physical Chemistry in 1970. His thesis "Relaxation of Molecules at the Boundary of Interphases" originated from an insufficiently known scientific field, with only a few publications existing at that time. In 1971 he became an assistant professor of solid state physical chemistry at the same faculty, and in 1979 an associate professor. He obtained the same rank for molecular biophysics at the Biology Department of the Faculty of Natural Sciences in 1981. He was elected to full professor of solid state physical chemistry and molecular biophysics in 1986. In addition to his work at the university, he spent most of his scientific and expert career at the Institute of General and Physical Chemistry an associate of which he became in 1965, when he was elected a research assistant in the Physical Chemistry Department.

He was the director of the Institute of General and Physical Chemistry from 1978 to 1982, and scientific director of the same institute till August 2000. Thanks to professor Vučelić, the Institute acquired the reputation of a scientific research institution, which, within the projects "Physical Chemistry of Interphases" and "Molecular Biophysics" as well as numerous projects of interest for various industries, exerted influence on the policy of scientific and technological development of the country.

Early on he made contact with scientific institutions abroad. In 1976 he received advanced training at the Inorganic Chemistry Department of Oxford University, Great Britain; in 1980 he was at the NMR Laboratory of Stanford University, USA, and in 1991 at the School of Physics, Lomonosov University of Moscow, as a visiting professor.

Professor Vučelić was interested mainly in the field of physical chemistry, interface and molecular biophysics, as documented by more than 100 papers in leading international journals. He followed and confirmed the almost forgotten Van der Waals hypothesis that sorbed molecules are a separate thermodynamic phase and not independently sorbent–bound molecules.

In the period from 1969 to 1975 he determined a great number of physico–chemical parameters for sorbate–zeolite systems such as enthalpies, entropies and dynamic and relaxation heat capacities in phase depths. His study of phase transitions revealed the existence of several different energy levels in cations within the zeolite structure. The cation sublattice was

Glavno interesovanje prof. Vučelića bilo je područje fizičke hemije, međupovršinska i molekularna biofizika, što je dokumentovano sa više od 100 radova u vodećim međunarodnim časopisima. Sledio je i dokazao skoro zaboravljenu Van der Waals-ovu hipotezu da su sorbovani molekuli posebna termodinamička faza, a ne molekuli nezavisno vezani za sorbent.

Između 1969. i 1975. je odredio veći broj fizičko-hemijskih parametara za sistem sorbat-zeolit kao što su entalpije, entropije i dinamički i relaksacioni toplotni kapaciteti u dubini faza. Pri istraživanju faznih transformacija otkrio je postojanje više različitih energetskih nivoa kod katjona unutar strukture zeolita. Pokazao je da katjonske subrešetke veoma mnogo zavise od konkurencije između sorbovanih molekula i katjona. Tako su na jednostavan način vodeni kompleksi konstatovani unutar zeolitskih kaveza znatno pre njihovog direktnog posmatranja neutronskom difrakcijom. NMR i neizotermne metode su bile osnovne tehnike prof. Vučelića u istraživanju kompleksnih sistema. Primena ove dve tehnike vodila je dubljem razumevanju u slučaju kompleksnih molekula kerogena. Pokazano je da prethodno usvojena hipoteza o poreklu visoke katalitičke aktivnosti unutar amorfni faza uljnih škrljaca i kerogena nije opšte važeća. U stvarnosti postoje dva sistema, sa visokom i niskom katalitičkom aktivnošću, sa slobodnim radikalima koji igraju glavnu ulogu u sistemu sa nižom katalitičkom aktivnošću.

Početkom osamdesetih godina prošlog veka prof. Vučelić se zainteresovao za biofiziku. Interfaze su bile most prema ovom području, jer polazeći od membrane, čitava ćelija može da se posmatra kao međufaza. Ovaj pristup je ubrzo doveo do rezultata. Prvo, kombinovani bio-termotropski efekat je bio pokazan kod folnih i masnih kiselina. Drugo, poznati fiziološki fenomen da se masne kiseline sa dugim lancima apsorbuju u zidu digestivnog trakta, za razliku od onih sa kratkim lancem koje direktno prolaze u venu portu, bio je objašnjen na bazi termodinamike, jer samo masne kiseline sa dugim lancima obrazuju micelle. Takođe je pretpostavio da će transport D<sub>2</sub>O kroz membrane biti poremećen usled jačih vodoničnih veza, što je bilo potvrđeno i pokazano za kalcijumove kanale.

Primenjena istraživanja bila su jedna od preokupacija prof. Vučelića. Poslednjih nekoliko godina pokušavao je da primeni čiste biofizičke metode na medicinska istraživanja. Tako je došlo do nove metode za dijagnozu kožnih bolesti zasnovane na kretanju akustičkih talasa kroz kompleksne interfaze u koži i nove hipoteze o uzroku Balkanske nefropatije. Takođe je bilo razvijeno i više pomoćnih farmaceutskih preparata na bazi prerađenog pivarskog kvasca, kao rezultat istraživanja prof. Vučelića i njegovih saradnika.

Iako fizičko-hemičar po stručnom opredeljenju, laboratorijska istraživanja i njihova primena nisu mogla da zadovolje praktični duh prof. Vučelića, tako da se veoma rano okrenuo industriji. Aktivno se bavio hemijom prirodnih proizvoda, neorganskom hemijom i tehnologijama vezanim za zeolite, sepiolit i druge sorbente.

Nije mu bilo strano ni hemijsko inženjerstvo, pa je dao veoma značajan doprinos u projektovanju procesa i opreme za proizvodnju zeolita i drugih sirovina za deterdžente, za sušenje gasova i niz drugih procesa koji se i danas koriste u industrijskim postrojenjima, jer je više stotina njegovih rešenja zasnovanih na hemiji čvrstog

shown to depend very much on the competition between sorbed molecules and cations. Thus, water complexes were found within zeolite cages in a simple way considerably before their direct observation by neutron diffraction. NMR and non-isothermal methods have always been professor Vučelić's basic techniques that led to profound understanding of the cases of complex kerogen molecules. It was shown that the previously adopted hypothesis on the origin of high catalytic activity within amorphous phases of oil shales and kerogens was not valid at all. In reality, there are two systems, with high and low catalytic activity, and with free radicals playing the main role in the latter one.

In the early 1980s, professor Vučelić became interested in biophysics. Interphases provided the bridge to this field, as, starting from the membrane, the whole cell may be observed and regarded as an interphase. This approach quickly led to results. First, a combined bio-thermo-tropic effect was demonstrated with folic and fatty acids. Secondly, the well known physiological phenomenon that long chain fatty acids are absorbed into the digestive tract wall, in contrast to the short chain ones which pass directly into the venal port, was explained on the basis of thermodynamics, as only long chain fatty acids form micelles. He also assumed that D<sub>2</sub>O transport through membranes would be disturbed due to stronger hydrogen bonds, which was confirmed and demonstrated for calcium channels.

Applied research was one of professor Vučelić's preoccupations. In his later years he tried to apply pure biophysical methods to medical research. This resulted in a new method for the diagnosis of acoustic waves through complex skin interphases and in a new hypotheses on the cause of Balkan nephropathy. Also, a number of auxiliary pharmaceuticals based on processed brewers' yeast were developed, as the result of the research professor Vučelić and his associates carried out.

Although being a physico-chemist by vocation, laboratory research and its application could not satisfy professor Vučelić's practical spirit, so he turned to industry very early. He pursued interests in natural products chemistry, inorganic chemistry and technologies connected to zeolite, sepiolite and other sorbents.

Chemical engineering was not unfamiliar to him either, and thus his contribution to processes and equipment design for the production of zeolite and other raw materials for detergents, for gas drying and many other processes used in industrial plants even nowadays is substantial, since several hundreds of his devices, based on solid state chemistry and sorption, have been incorporated into production lines world-wide.

These engagements qualified him for a member of the Engineering Academy of Yugoslavia in 1998. Also, in a formerly neglected field in this country, management, he gave a considerable practical contribution to organizing and managing production on the level of large factory plants and corresponding production systems.

stanja i sorpciji, bilo inkorporirano u proizvodne linije širom sveta.

Ova angažovanja su ga kvalifikovala da 1998. godine postane član Inženjerske akademije Jugoslavije. Osim toga, u jednoj kod nas ranije zanemarenoj oblasti – menadžmentu, dao je znatan praktičan doprinos u organizovanju i vođenju proizvodnje na nivou velikih fabričkih postrojenja i odgovarajućih proizvodnih sistema.

Njegov najveći industrijski doprinos bila je konstrukcija više fabrika za proizvodnju zeolita po originalnom know-how. To su hemijski procesi i projektna rešenja u Tvornici glinice "Birač" kod Zvornika, jednom od najuspešnijih preduzeća hemijske industrije u bivšoj Jugoslaviji, kao i fabrici zeolita "Mira" (VE) u Italiji, koja i danas uspešno radi.

U Biraču je veliki kompleks od pet fabrika bio završen 1990/1991. godine. Zeolit A se proizvodio u velikim reaktorima i fabrika je postala jedan od najvećih svetskih proizvođača (220.000 tona godišnje). Fabrika je postala vodeća i u kvalitetu proizvoda. Proces proizvodnje bio je originalan, zasnovan na jeftinom, ali nečistom alumina-tnom rastvoru. Sličan pristup prof. Vučelić je koristio i u fabrici deterdženata Mira (VE) u Italiji, gde je proces zasnovan na meta-stabilnoj raspodeli katjona (otkrivenoj kroz fundamentalna istraživanja), što je dalo zeolit sa visokim brzinama izmene jona i bez povećanja utroška skupog natrijum hidroksida. Cilj ovih istraživanja bio je i zaštita životne sredine, ušteda energije i materijala kao i da se dobiju koncentrovani i kompaktni proizvodi. Da bi se došlo do odgovarajućeg tipa proizvoda od ključne važnosti je bilo razumevanje površinskih karakteristika čvrstog stanja, pa su fundamentalna i primenjena istraživanja u ovoj oblasti bila od velikog značaja. Brojni proizvodi sa različitim površinskim karakteristikama dobijeni su u laboratorijama i testirani u poluindustrijskim postrojenjima. Predviđanja prof. Vučelića su bila da će se nova generacija modifikovanih zeolita i materijala sličnih zeolitima proizvoditi u industrijskom obimu.

Poslednjih godina prof. Vučelić je sa saradnicima istraživao sorpcione i druge karakteristike minerala sepiolita (hidratirani magnezijum silikat) i njegovu primenu u obliku hartije za adsorpciju gasova i katalizu, a i kao punioca za gumu i reološkog agensa.

Prof. Vučelić se angažovao i na opremanju nove biološke i biofizičke laboratorije.

Od mnogih nagrada, priznanja i funkcija treba navesti da je prof. Vučelić bio predsednik IUPAB Komisije za radijaciju i biofiziku životne sredine. Smatrao je da je "najvažnija dužnost naučnika da gleda što dalje u budućnost i da zaštititi čovečanstvo". Ugledna "Steinkopff-Preis" nagrada, koja se dodeljuje za dostignuća u rešavanju problema zaštite životne sredine i industrije, korišćenjem metoda koloidne i fizičke hemije međufaza, bila je 1993. dodeljena profesoru Vučeliću.

Radni elan nije napuštao prof. Vučelića do kraja životnog puta. Tako je u proleće 2000. godine, na osnovu projekata Instituta pod rukovodstvom prof. Vučelića realizovana fabrika praškastih deterdženata "Delta-In" u Zrenjaninu, kao poslednji njegov doprinos razvoju deterdžentske industrije u nas.

Preranim odlaskom prof. Vučelića prekinuto je jedno plodno stvaralaštvo, kako na polju fundamentalnih tako i primenjenih istraživanja.

His largest industrial contribution was the construction of several factories producing zeolite by original know-how. These are the processes and project solutions at the aluminium hydroxide factory "Birač", near Zvornik, YU, as well as at the zeolite plant "Mira" (VE) in Italy, which operates successfully even nowadays.

At "Birač" a large complex of five plants was finished in 1990/1991. Zeolite-A was produced in huge reactors and the plant became one of the world's largest producer (220,000 ton/year). The plant became the leading one by product quality as well. The production process was original, based on inexpensive, but impure aluminate solution. Professor Vučelić also used a similar approach at the "Mira" (VE), Italy, detergent plant, where the process was based on meta-stable cation distribution (discovered through fundamental research), which resulted in zeolite with high ion exchange rates and without increased consumption of expensive sodium hydroxide. The aim of this research was environmental protection, saving of energy and material, as well as to obtain concentrated and compact products. In order to obtain the appropriate type of product, understanding of the surface properties of solids was of key importance, and thus fundamental and applied research in this field were of great importance. Numerous products with a variety of surface properties were obtained in laboratories and tested in semi-industrial plants. Professor Vučelić anticipated the new generation of modified zeolites and materials similar to zeolites to be produced on an industrial scale.

In recent years professor Vučelić and his associates studied sorption and other characteristics of sepiolite (hydrated magnesium silicate) and its application in the form of paper for the adsorption of gases and catalysis, as well as a filler for rubber and a rheologic agent.

Professor Vučelić was also engaged on providing equipment for a new biological and biophysical laboratory.

Of all his awards, recognitions and offices one should mention that professor Vučelić was the President of the IUPAB Commission for "Radiation and Environmental Biophysics". He considered that "the most important duty of a scientist was to look into the farthest possible future and to protect mankind" The reputable "Steinkopff-Preis" awarded for achievements in solving problems in environmental and industrial protection, by means of colloid and physical chemistry interphase methods, was awarded to professor Vučelić in 1993.

His enthusiasm for his work did not leave professor Vučelić up to the very end of his life. So in the spring of 2000, on the basis of the projects of the Institute headed by professor Vučelić, a factory for powder detergents "Delta-In" was realized in Zrenjanin (YU), as his last contribution to the development of the detergent industry in this country.

Professor Vučelić's too early departure stopped a fruitful creativity both in the field of fundamental and applied research.