

# Crystallography in Croatia

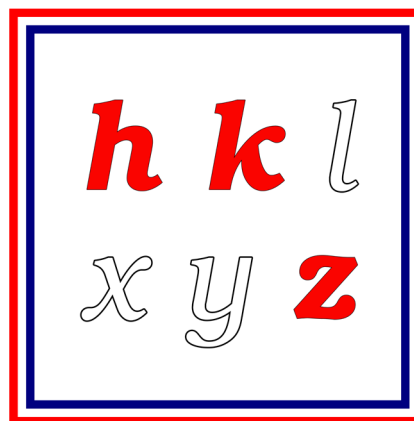
on occasion of the 25<sup>th</sup> anniversary of the foundation of the  
Croatian Crystallographic Association

by Stanko Popović

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**C**RYSTALLOGRAPHY in Croatia began with courses in mineralogy in the last decades of the 19<sup>th</sup> century. *M. Paić* used powder diffraction in his PhD studies at *Sorbonne* in Paris in the 1930's. In 1946, as the Head of the *Physics Department* of the *University of Zagreb*, he continued research in crystallography. *D. Grdenić* studied crystal structures of mercury compounds by single crystal X-ray diffraction (XRD) in Moscow in 1946–1948 with *A. I. Kitaigorodskii*. In 1948, he founded X-ray crystal structure analysis in Zagreb. Soon a group of talented younger crystallographers (*K. Kranjc*, *S. Ščavničar*, *A. Bonefačić*, *A. Bezjak*, *B. Kamenar*, *B. Matković*, *Z. Ban*, *M. Sikirica*, *M. Topić*, *B. Kojić-Prodić*, *S. Popović*) began studying crystal structure and microstructure.

In 1966, the crystallographers in the former Yugoslavia founded the *Yugoslav Centre of Crystallography (YCCr)*, which acted under the auspices of the *Yugoslav (now: Croatian) Academy of Sciences and Arts* in Zagreb. *D. Grdenić* was elected president and *B. Kamenar* secretary of the *YCCr*. That same year, *YCCr* joined the *International Union of Crystallography (IUCr)* during the 7<sup>th</sup> Congress of *IUCr* in Moscow). Most of the members of *YCCr* performed their research in Croatia. From 1966 to 1991, annual crystallographic conferences were held in Yugoslavia, mostly organized by the *YCCr* members from Croatia. The invited speakers at those conferences were eminent crystallographers from abroad: *M. Nardelli*, *G. Allegra*, *M. Mammi*, *G. Gilli*, *D. Viterbo* and *L. Randaccio* (Italy), *A. Kálmán* (Hungary), *S. C. Abrahams* (USA), *I. Olovsson* (Sweden), *M. Porai Koshic* and *Y. Struchkov* (USSR), *J. Helliwell*, *C. K. Prout*, and Nobel laureate *D. Hodgkin* (UK). Six joint *Italian-Yugoslav crystallographic conferences* were organized in



that period. Many crystallographers from Croatia were trained in prominent international laboratories. A number of scientists from other republics of the former Yugoslavia obtained MSc and PhD degrees in Zagreb.

In the seventies and eighties, the laboratories in Zagreb were equipped with modern instruments for XRD, TEM and associated methods, enabling research of crystal structures of inorganic, organometallic and organic compounds, as well as microstructure at ambient and elevated temperature. *YCCr* published a journal, the *Annual of the Yugoslav Centre of Crystallography*, containing papers based on plenary lectures and abstracts of short contributions given at annual conferences (in English), lists of publications of the *YCCr* members, titles of MSc and PhD theses of the *YCCr* members, and minutes of annual *YCCr* Assembly meetings. *YCCr* was also a member of the *European Crystallographic Committee (ECC)*; *B. Kamenar* was the

vice-president and president of the ECC in the period 1978–1984. Due to the war in Yugoslavia, the 13<sup>th</sup> European Crystallographic Meeting (ECM13) scheduled for Ljubljana, Slovenia, in 1991, was transferred to Trieste thanks to good relations among crystallographers in Italy (*L. Randaccio*), Croatia (*B. Kamenar*) and Slovenia (*L. Golič*). During the ECM13, a plenary lecture was given by the Nobel laureate *R. Huber* (Germany), and a satellite meeting on *Synchrotron radiation* was organized.

After the disintegration of Yugoslavia and proclamation of independence of Croatia in 1991, the Presidency of the Croatian Academy of Sciences and Arts (CASA), dissolved the YCCr and, following the suggestion of the Advisory board (*B. Kamenar*, *B. Kojić Prodić*, *S. Popović*, *B. Gržeta*) and the support of all crystallographers in Croatia, founded The Scientific Council for Crystallography of the CASA–Croatian Crystallographic Association (CCA; Hrvatska kristalografska zajednica, HKZ) on February 28, 1992. *B. Kamenar* was elected president and *S. Popović* secretary of the CCA. The CCA joined the European Crystallographic Association (ECA) in 1992, during the ECM14 in Enschede, and the IUCr in 1993, during the 16<sup>th</sup> Congress of IUCr in Beijing.

Since 1992, CCA and the Slovenian Crystallographic Society (SCS) have been organizing annual joint Croatian-Slovenian/Slovenian-Croatian Crystallographic Meetings (CSCM/SCCM) with international participation, alternately in Croatia and in Slovenia. Twenty four meetings have been organized so far.<sup>#</sup> The reports on the meetings have been published in the *IUCr Newsletter*. Invited speakers at the Meetings have been, among others: *C. Giacovazzo*, *G. Zanotti* and *M. Zema* (Italy), *M. Kaftory* (Israel), *I. Hargittai* (Hungary), *M. Jaskólski* (Poland), *W. Duax* (USA), *H. Flack* and *N. Ban* (Switzerland), *P. Naumov* (Japan), *R. Dinnebier* and *H. Fuess* (Germany), *B. Kobe* (Australia), *E. and G. Dodson* (UK), *E. Tillmanns* (Austria). Papers based on plenary lectures have been occasionally published in *Croatica Chemica Acta* (for CSCMs) and *Acta Chimica Slovenica* (for SCCMs). Members of the CCA edited a special issue of *Croatica Chemica Acta*, Vol. **82** (2009), a *Festschrift* dedicated to *D. Grdenić* on occasion of his 90<sup>th</sup> birthday.

Following the invitation of the Editorial Board of *IUCr Newsletter*, an extended paper on the history, activities and

achievements of the CCA has been published in *IUCr Newsletter*, **19** (2011) 5–18, as the first paper on crystallography in 14 South-East European countries.

Today, about one hundred twenty scientists are members of the CCA, conducting research in a number of laboratories in departments of universities, scientific institutes and industry. The Croatian crystallographers study biologically active molecules, proteins, organometallic compounds, pharmaceuticals, microstructure of composites and its relation to physical, chemical and biological properties. All the members of the CCA represent the Assembly, and the Assembly elects the CCA Executive Committee for a period of four years.<sup>##</sup> *D. Balzar* was a member of the IUCr Commission on Powder Diffraction, *B. Kojić Prodić* is a co-editor of *Acta Cryst. C*, *S. Popović* was a member of the European Powder Diffraction Committee, and *M. Đaković* is a member of the ECA Executive Committee.

One of the most important days for CCA was August 27, 2011, when the ECA Council accepted the bid presented by the representatives of the CCA and decided, by a great majority of votes, that the 29<sup>th</sup> European Crystallographic Meeting, ECM29, would be held in Rovinj, Croatia, in August 2015. This represented a great recognition of crystallographic achievements in Croatia by the international scientific community. The CCA Executive Committee elected the Organizing Committee of the ECM29, chaired by *A. Višnjevac* and *M. Đaković*, and the Croatian members of the Programme Committee, chaired by *N. Ban*; *M. Luić* has been elected the Chair of the ECM29.

In September, 2012, the organization of ECM29 was undertaken by the Croatian Association of Crystallographers (CAC; Hrvatska udruga kristalografa, HUK), a legal unity consisting of a group of crystallographers emerged from the CCA (the members of the previous Organizing Committee of the ECM29). The agency *Globtour Event* was chosen to help the organization of the ECM29. In order to provide financial support for the activities and promotion of the ECM29, the CAC prepared several project proposals and applied to various authorities. The CAC was in a permanent connection with the ECA Council and ECA Executive Committee, giving regular progress reports on the advancement in organization of the ECM29.

<sup>#</sup> SCCM1 - 1992, Otočec, Slovenia; CSCM2 - 1993, Stubičke Toplice, Croatia; SCCM3 - 1994, Kranjska Gora, Slovenia; CSCM4 - 1995, Trakošćan, Croatia; SCCM5 - 1996, Zreče, Slovenia; CSCM6 - 1997, Umag, Croatia; SCCM7 - 1998, Radenci, Slovenia; CSCM8 - 1999, Rovinj, Croatia; SCCM9 - 2000, Gozd Martuljek, Slovenia; CSCM10 - 2001, Lovran, Croatia; SCCM11 - 2002, Bohinj, Slovenia; CSCM12 - 2003, Plitvice Lakes, Croatia; SCCM13 - 2004, Bovec, Slovenia; CSCM14 - 2005, Vrsar, Croatia; SCCM15 - 2006, Jezersko, Slovenia; CSCM16 - 2007, Petričane, Croatia; SCCM17 - 2008, Ptuj, Slovenia; CSCM18 - 2009, Varaždin, Croatia; SCCM19 - 2010, Strunjan, Slovenia; CSCM20 - 2011, Baška, Croatia; SCCM21 - 2012, Pokljuka, Slovenia; CSCM22 - 2013, Biograd, Croatia; SCCM23 - 2014, Logarska dolina, Slovenia; CSCM24 - 2016, Bol, Croatia.

<sup>##</sup> Members of the CCA Executive Committee (elected by the Assembly of the CCA in 2012 for the period of four years): Stanko Popović, *Chair* (spopovic@phy.hr), Dubravka Matković Čalogović, *Vice-Chair* (dubravka@chem.pmf.hr), Marija Luić, *Secretary* (marija.luc@irb.hr), Mario Cetina (mccetina@ttf.hr), Marijana Đaković (mdjakovic@chem.pmf.hr), Ana Šantić (asantic@irb.hr), Darko Tibiljaš (dtibiljas@geol.pmf.hr), Antun Tonejc (atonejc@phy.hr), Aleksandar Višnjevac (aleksandar.visnjevac@irb.hr).

The CCA Assembly, held on November 23, 2016, elected a new Executive Committee for the period of four years: Dubravka Matković Čalogović, *Chair*, Marija Luić, *Vice-Chair*, Marijana Đaković, *Secretary*, Mario Cetina, Andrea Čobić (ancobic@geol.pmf.hr), Biserka Prugovečki (Biserka.Prugovecki@chem.pmf.hr), Željko Skoko (zskoko@phy.hr), Ana Šantić, Aleksandar Višnjevac.

ECM29 was a great success: 1060 scientists from 55 states, from all continents, attended the Meeting, more than at all previous ECMs. The programme included two plenary lecturers, 16 invited lecturers, 250 oral and 520 poster presentations, distributed among 50 microsymbiosia. There were also ten satellite meetings. From Croatia, 47 participants delivered 8 oral and 35 poster presentations. B. Kojić Prodić talked on *History of Crystallography in Croatia*, and S. Popović gave a lecture *Nikola Tesla, scientist and inventor—discovery of X-rays*. The Croatian crystallographers may be proud for an excellent organization of ECM29; they received a lot of congratulations from eminent members of the international crystallographic community.

In spite of great efforts in organization of the ECM29, the crystallographers in Croatia performed a series of activities during the *International Year of Crystallography, IYCr2014*, proclaimed by the *General Assembly of the United Nations*:

- 1) Scientific meeting *Contemporary Crystallography in Croatia* (chaired by S. Popović), dealing with the present studies and perspectives, was held in Zagreb on September 30, 2014 and organized by the CCA under the auspices of the CASA.
- 2) *Proceedings of the Scientific meeting Contemporary Crystallography in Croatia* (25 reviewed papers, in Croatian with extended abstracts in English), published by the CASA, Zagreb, in 2015; Ed. S. Popović.
- 3) *Hot Topics in Contemporary Crystallography*, a workshop (chaired by A. Višnjevac) for young crystallographers held in Šibenik, Croatia, from May 10<sup>th</sup> to 15<sup>th</sup>, 2014, organized by the CAC; lecturers were eminent European crystallographers.
- 4) *23<sup>rd</sup> Slovenian-Croatian Crystallographic Meeting* was held in Slovenia on June 18–22, 2014 and organized by the SCS and the CCA; the Meeting was devoted to IYCr2014.
- 5) *Websites of the CCA* ([www.hazu.hr/kristalografija](http://www.hazu.hr/kristalografija)) and of the CAC ([www.hrvatska-udruga-kristalografija.hr](http://www.hrvatska-udruga-kristalografija.hr)) were continuously updated containing news on IYCr2014; web masters were A. Višnjevac, A. Šantić and Z. Štefanić.
- 6) A series of *popular lectures on Crystallography* were given in professional societies (Croatian Chemical/Physical/Biological/Geological/Pharmaceutical... Society) and in secondary schools, presented by members of the CCA and the CAC; one of the sources of information was the Promotion brochure *Crystallography matters!*, edited by IUCr and UNESCO, translated in Croatian.
- 7) *English-Croatian Dictionary of Crystallography, Physics of Condensed Matter and Materials Science*, containing 1710 terms with a short description of each term, the authors being S. Popović, A. Tonejc, and M. Mihaljević, published in 2014 by the *Institute of the Croatian Language and Linguistics*.
- 8) A review *Hundred years of Crystallography*, by B. Kojić Prodić, and K. Molčanov, was published in Croatian journal *Kemija u industriji (Chemistry in Industry)* **62** (2013) 247–260.
- 9) A review *Chemical Crystallography before X-ray Diffraction*, by K. Molčanov and V. Stilinović, was published in *Angewandte Chemie Int. Ed.* **53** (2014) 638–652.
- 10) A lecture *IYCr2014—one hundred years of exploring the world of atoms* was presented by S. Popović before the CASA, Zagreb, April 24, 2014.
- 11) A lecture *Nikola Tesla, scientist and inventor, and the discovery of X-rays* was presented by S. Popović before the CASA, Zagreb, November 11, 2014.; also published in: *Distinguished Croatian Scientists in the World*, Croatian-American Society & Croatian Heritage Foundation, Ed. J. Herak, **7** (2014) 122–134, 250–262; *Matematičko fizički list* **64** (2013/2014) 241–250.
- 12) *Postgraduate courses on contemporary crystallography* were held by senior scientists and university professors, the members of the CCA and the CAC.
- 13) Presentations on *popular crystallography* were presented by members of the CCA and the CAC on TV and radio.
- 14) *Crystal-growing competition* was organized by E. Meštrovic, CAC and CCA in PLIVA; participants in competition were pupils in secondary schools; the best works were rewarded; the valuable results of competition will be used for the moving exhibition and promotion of crystallography in Croatia.
- 15) The Promotion brochure *Crystallography matters!*, edited by IUCr and UNESCO, was translated in Croatian and published in the Croatian journal *Kemija u industriji (Chemistry in Industry)* **63** (2014) 217–225.
- 16) A special issue of the Croatian journal *Priroda*, No. 6, 2014, was devoted to IYCr2014, containing 12 papers on crystallography written by members of the CCA and the CAC; editors were N. Judaš and V. Stilinović.

Taking into account all the achievements mentioned above, the *ECA Council* decided that the *3<sup>rd</sup> European Crystallography School, ECS3*, would be organized by the CAC in Bol in 2016. That event followed immediately after the *24<sup>th</sup> Croatian-Slovenian Crystallographic Meeting, CSCM24*, which also took place in Bol and organized by the CCA and the SCS. These two events represented the *Summer of Crystallography in Croatia*. This is the report on the *CSCM24* submitted to the *IUCr Newsletter*:

*CSCM24* was held from September 21<sup>st</sup> to 25<sup>th</sup>, 2016, in a small town of Bol, the oldest town on the Island of Brač,

situated in the middle of the Croatian Adriatic. Bol is an extraordinary tourist oasis, well known of its sandy *Golden Cape*.

The Meeting was held under the auspices of the CASA. The Chair of the Organizing Committee was *M. Cetina* (CCA). The Chairs of the Meeting were *S. Popović* (CCA) and *A. Meden* (SCS). Overall 98 scientist participated in the Meeting, mostly from Croatia (59) and Slovenia (12), but also from nine other countries: Austria, Germany, Italy, Korea, Poland, Serbia, South Africa, Switzerland and United Kingdom.

Five plenary and eighty short oral contributions were presented. The plenary lecturers were: *Mariusz Jaskólski* (A. Mickiewicz University & Polish Academy of Sciences, Poznan, Poland), *Handling crystal pathologies in macromolecular crystallography*; *Lee Brammer* (University of Sheffield, UK), *Flexibility, Dynamics and Chemical Reactions in Solids: Molecular Crystals to Framework Materials*; *Goran Dražić* (National Institute of Chemistry, Ljubljana, Slovenia), *Direct imaging and quantification of crystal structures at the atomic level using C<sub>s</sub> corrected scanning transmission electron microscope*; *Michele Zema* (International Union of Crystallography, Chester, UK), *Crystallography and Society: outcomes of IYCr2014*; *Željko Skoko* (University of Zagreb, Croatia), *Thermosolient crystals - acrobatics on the nanoscale*. Short oral contributions dealt with modern development of crystallography and closely related fields.

Participants of the Meeting emphasised a high scientific level of presentations, as well as familiar and welcoming atmosphere. The fact that all participants presented their short contributions orally (as was the same at all previous CSCMs/SCCMs) provided an excellent opportunity for young participants to obtain an experience in being presenters in front of a large scientific audience.

As there was no registration fee for this Meeting, the Organizing Committee is thankful for financial support to the sponsors: Ministry of Science and Education (Croatia), PANalytical/Renacon (The Netherlands/Croatia), Rigaku (UK), Bruker/Aparatura (Germany, Austria, Croatia), Douglas Instruments (UK), Stoe (Germany), Dectris (Switzerland), PLIVA Croatia Ltd., Croatian National Tourist Board, Bluesun Hotels (Croatia). All information about the meeting can be found on <http://cscm24.org/>.

A half-day excursion for all participants was organized to a picturesque small town of Pučišća (where participants visited the *Klesarska škola/Stone-carving School*), and to the *Vidova Gora Peak*, the highest peak of the island of Brač (788 m above the sea level).

These are the letters of the plenary lecturers after the Meeting:

*M. Jaskólski*: Thank you very much for your unsurpassed hospitality and excellent organization of CSCM24. The scientific level and the atmosphere of the Meeting were really remarkable. Also the Island of Brač and Bol have left unforgettable impressions and memories. I am sure that the ECS3 was equally successful.

*L. Brammer*: Thanks again for the invitation and for the help and hospitality during the Meeting. It was an enjoyable Meeting, some very nice work being done in Croatia, and the Meeting format provides excellent opportunities for students to get experience in giving presentations to a larger scientific audience. The Meeting certainly had the familiar, welcoming feeling. I hope that the ECS3 that followed the Meeting also went well, and certainly hope to see Croatian colleagues in the future.

*G. Dražić*: Thank you again for inviting me to the Meeting and give me the opportunity to talk about my work. It was my great pleasure to meet so many colleagues and I enjoyed the lectures, discussions and your hospitality. I learned many new things and surely I will attend the future meetings.

*M. Zema*: I'd like to express my warmest and most sincere congratulations on a wonderfully organized Meeting. I enjoyed the atmosphere, the presence of so many young and promising crystallographers and all discussions and conversations. Not to mention the beautiful scenario of Croatia and Bol in particular! Thanks again for your kind invitation.

The next meeting, the *25<sup>th</sup> Slovenian–Croatian Crystallographic Meeting, SCCM25*, will be held from June 15<sup>th</sup> to 17<sup>th</sup>, 2017 in Ljubljana, Slovenia.

The ECS3 was attended by 78 postgraduated students and young scientists (22 from Croatia) from 24 states. They listened to 25 lecturers who were eminent scientists, mainly from Europe. The students presented their studies on posters, the best ones were awarded. The scientific Committee was chaired by *M. Đaković* and the Organizing Committee by *J. Popović*. All information on the ECS3 can be found on <http://ecs3.ecanews.org>.

The second meeting entitled *Hot Topics in Contemporary Crystallography, HTCC2017*, (<http://htcc2017.org>), will be held in Poreč, Croatia, April 22<sup>nd</sup> – 26<sup>th</sup>, 2017, and organized by the CAC, immediately after the *25<sup>th</sup> Croatian Meeting of Chemists and Chemical Engineers*, Poreč, April 19<sup>th</sup> – 22<sup>nd</sup>, 2017.

Stanko Popović, Chair of the CCA, 2006–2016  
December 12, 2016