Chemistry in a Multidisciplinary, Interdisciplinary World

by Chris Ober and Hemda Garelick

The World Chemistry Leadership Meeting (WCLM) is an integral part of the IUPAC General Assembly and offers a platform for representatives from National Adhering Organizations (NAOs) to meet and discuss emerging and pressing issues of global concern. Recent WCLMs have had a special focus on Young Observers (YOs) to provide them with the space to interact and discuss emerging issues and future challenges facing the world of chemistry.

The 2017 WCLM was held at the Sao Paulo World Chemical Congress and General Assembly. Its theme was multi/interdisciplinarity and diversity in chemistry, chemistry education and training [1]. It has been universally recognized that chemistry is an essential discipline and as a pre-eminent science it plays a significant role in many rapidly developing technical areas with vital societal impact. These concepts have been the topic of much debate since the turn of the century and their associated challenges of *"understanding the concepts underlying a discipline other than one's own, finding a common language to communicate ideas, trusting research you haven't the skills to assess yourself, and finding somewhere to publish"* [2]. Young chemists find this situation very natural, easily crossing disciplinary boundaries. Interdisciplinary areas in chemistry are forefront research topics and often the career focus of the younger scientist community. Whitesides and Deutsch [3] during the 2011 International Year of Chemistry advocated forcefully for *"do[ing] away with the old disciplinary structures. Disciplines mature, and must be subsumed into others. Chemistry should cluster its teaching and research around the exciting and uncertain future rather than the ossified*

historical past." Diversity enables the introduction of new points of view and outlooks both scientific and contextual. It takes us out of our disciplinary tunnels and into the open spaces shining new lights on things and it enables us to build complex pictures from multiple views of simple information.

The 2017 WCLM consisted of a half day symposium and half day workshop. In order to introduce the YOs to the activities of IUPAC, a combined reception and speed networking event was held on Monday evening of the General Assembly. While representatives of the many IUPAC Committees and Divisions were placed at tables, the YOs circulated among the groups in a pre-arranged sequence to learn about activities of IUPAC. This session was used as an educational and informational event not only for the YOs but also for the divisions themselves as an effective way to explain the major goals and focus of each division and committee. Those present felt that the speed networking event was a major success and will be part of future IUPAC events. For the remainder of the evening a reception and poster session further introduced the YOs to each other and to the IUPAC leadership.

At IUPAC, emerging and interdisciplinary areas combine interests of several well-established chemistry disciplines and lead naturally to cross-divisional and cross committee collaborations. Such efforts have catalyzed the formation of interdivisional groups, specifically, the Interdivisional Sub-committee on Materials Chemistry (ISMC) and more recently, the Interdivisional Committee on Green Chemistry for Sustainable Development (ICGCSD). Representatives of these groups (Valdimir Gubala (ISMC); Pietro Tundo (ICGCSD)) led a workshop on the topics of nanomaterials in health and sustainable chemistry, respectively. During the subsequent workshops, the YOs were divided into teams

Networking event bringing Young Observers (YOs), members of the International Younger Chemists Network (IYCN) and IUPAC working groups together.

Science through a molecular lens—navigating an interdisciplinary career path

To address the theme of interdisciplinary and collaborative work, Dr. LaFranzo chose to present on her diverse career path, starting from undergraduate education through the lessons learned through her interdisciplinary academic training. As a chemist now working in the field of genomics/biotechnology, Dr. LaFranzo was able to describe how her training in chemistry has provided significant advantages: specifically, that chemistry's molecular-level focus and required critical thinking skills may be applied to problems in biology and genomics, which can have great impact on human health.

Dr. LaFranzo also noted that the individual passions we have outside of chemistry provide us with both an outlet and an opportunity to enable creativity. Well-rounded scientists who also pursue athletics, the arts, cooking, etc. in addition to chemistry should be praised and supported by their mentors, professors and colleagues. Dr. LaFranzo noted her personal experiences as a college cheerleader and now collegiate cheerleading coach, which have provided her with a healthy outlet, and significant leadership, logistical, financial, and managerial training.

Finally, Dr. LaFranzo addressed how professional societies, such as the American Chemical Society (ACS),

IUPAC, and the newly-formed International Younger Chemists Network (IYCN) can provide benefits in terms of soft-skill training, interdisciplinary networking, and a social support system. Finding opportunities to discuss research problems and scientific questions with scientists from many different backgrounds can often provide new context and novel approaches to technical challenges. Volunteering in these Societies also provides opportunities for leadership development and training, in a safe environment. Furthermore, building a professional network of passionate, driven scientists can be immensely helpful for career advancement.

The future of chemistry must be inclusive—willing to contribute to a variety of technical challenges, eager to engage creative, passionate students, and driven to contribute to the betterment of society in collaboration with all other technical disciplines. Dr. LaFranzo encouraged those in leadership positions within academia and industry to support the development of younger chemists, and empower them to apply their own personal passions to the field of chemistry.

Natalie LaFranzo earned her BS in Chemistry from Bradley University, and her PhD in Chemistry from Washington University in St. Louis where her interdisciplinary research was aimed at developing new patterned surfaces to study neurobiology and neuronal development. During her graduate career, Natalie worked with multiple biotech start-ups and entrepreneurs as a Project Manager in the student/post-doc run consulting group, The Biotechnology and Life Science Advising (BALSA) Group. <<https://www.linkedin.com/in/natalie-lafranzo-5a0a5b1b/>>

Dr. Natalie LaFranzo gives a lecture on the advantages of interdisciplinary academic training at the IUPAC World Chemistry Leadership Meeting. She stressed a future for chemistry that is inclusive and collaborative.

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and began in a short time to develop IUPAC proposals inspired by these interdisciplinary topics, with the goal of producing a short presentation on the idea and project ideas that might be suitable for the interdivisional committees or for the divisions to explore as interdivisional projects.

A key part of this workshop and teaming exercise was the participation of the new International Young Chemists Network (IYCN) in both planning the WCLM and in running the workshop [4]. Formed in 2017 and recognized by IUPAC, representatives of the group guided the project development process. This new network will connect many existing young chemist committees that already existed among the different

national chemical societies. Several of the IYCN members are returning YOs and were able to share their experience in project planning efforts from their participation in the WCLM at the 2015 General Assembly [5].

The conclusion to the WCLM was the plenary session consisting of three inspiring presentations. They addressed the pertinent issues related to the status of chemistry in the future of the role of interdisciplinarity and diversity, the role of young observers and the complex context in which chemistry is being practiced both in academia and industry.

- Future of the Chemical Sciences—preparing for an uncertain future [6] by Alejandra Palermo FRSC, Manager, External Relations

Innovation—a key to essential development

Brazil is rich in oil, gas, biodiversity, mineral and rare earth metals. In a talk given by Mr. Marcos Antonio de Marchi, leader of Abiquim, the Association of the Brazilian Chemical Industry (a non-profit organization founded on June 16, 1964, to unite small-, mid-, and large-sized chemical companies) the chemical opportunities available to Brazil and the planet in general

and how they can be tackled in a sustainable fashion were described.

Abiquim's goal is to grow the competitiveness of the Brazilian chemical industry in a sustainable way. The planet consumes 50 % more than can be produced, absorbed or regenerated. 16 % of the world's population uses 78 % of its resources. 1 billion people do not have safe drinking water.

Today, Brazil invests 1.3 % of its GDP in R&D. Abiquim's goal is to commit 2 % of the GDP to research by 2020. In comparison, most developed economies have rates above 3 % GDP for research investment. Brazil has the highest biodiversity in the world which leads to chemicals from renewable raw materials. The global market for renewable chemicals is expected to grow from USD 3.6 billion to over USD 12 billion. By 2025 about 40 % of the world's economy will be based on sustainable biotechnology.

Brazil is an agro powerhouse and is among the top producers and exporters of sugar, ethanol biofuel, orange juice, coffee, soybeans, beef, poultry, pork and

related products. Brazil has established policies to promote sustainable agriculture, including goals to mitigate green house gas emissions.

Brazil offers competitive feedstock prices, a long history of using sugar cane as a source of chemicals and energy, experience in production and distribution of biofuels, and developing other renewables such as wood and soybeans. The government, private organizations and civil society are all working towards more sustainable development. As for the chemical industry, between 2006 and 2015, waste production has been reduced 43 %, reduced water use by 36 %, reduced CO₂ emissions by almost 30 % and cut electricity use by 19 % per ton produced.

To summarize, the Brazilian chemical industry believes that it should be a vital part of the solution to achieve UN sustainable development goals, by helping other industries and agriculture become more sustainable, and that investment in innovation, new forms of cooperation and new business models will be needed for a sustainable economy. Mr. de Marchi concluded that Brazil has the conditions to become a world leader in the low carbon economy. New investments will be needed to transform Brazil but the current actions and efforts by the Brazilian chemical industry show that this transformation is possible.

Marcos Antonio De Marchi spoke as Chairman of the Board of Directors of Abiquim (Brazilian Chemical Industry Association). He spent most of his career at Rhodia in several management and technical positions including CEO of Rhodia Latin America and Member of Management Committee of Rhodia Group from November 2005 to March 2012. Since 2012 he leads Elekeiroz S.A. where he is CEO and plays other important roles.

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- Science through a molecular lens—navigating an interdisciplinary career path (side bar) by Natalie LaFranzo, PhD, Director of Scientific Projects and Market Development, Cofactor Genomics, and Chair, American Chemical Society Younger Chemists Committee
- Innovation—a key to essential development and views from the Brazilian Chemical Industry (side bar) by Marcos De Marchi, Abiquim's President of the Board and CEO of Elekeiroz

As we closed the World Chemistry Leadership Meeting, international teams of YOs described ideas for projects, the starting point of all activities in IUPAC, that ranged from new ideas on the role of patents in chemistry to drug detection to ideas on how to raise the profile of IUPAC and celebrate its centenary. The plenary speakers who formed a panel to discuss the ideas presented were uniformly impressed and a number of these project ideas were taken up immediately by the IUPAC100 committee, the group charged with making plans to celebrate the IUPAC centenary.

The abstracts and presentations from the plenary session are available from the project webpage. 🏆

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See iupac.org/project/2016-032-2-020 for details

References

1. *Chem Int* April 2017, p. 43
2. E. Pain, 2003; <http://www.sciencemag.org/careers/2003/01/multidisciplinary-research-todays-hottest-buzzword>
3. G.M. Whitesides and J. Deutsch 2011; *Nature*, Vol 469, pp 21-22; <http://dx.doi.org/10.1038/469021a>
4. Lori Ferrins, Evijola Llabani and Christine Dunne, *Chem Int* July 2018, p. 11
5. <http://iupac.org/project/2015-004-1-020>
6. Alejandra Palermo, *Chem Int* July 2018, p. 4

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