

NAO-CNR: The Italian voice at IUPAC

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Italy was a founding member of IUPAC in 1919. Italian participation is still vivid thanks to the proactive, collaborative spirit that motivated its initial support of the establishment of IUPAC. The National Research Council, CNR, the largest research institution for public research in the country, is the official representative of Italy at IUPAC through the National Commission operating as the IUPAC National Adhering Organization.

The main operational objectives of the NAO-CNR are: strengthening the Italian presence in the Union and opening new collaboration opportunities; identifying Italian experts keen to bring about collaborations in existing areas; and increasing the relationship between NAO-CNR and the Scientific Divisions of IUPAC to plan and promote initiatives, congresses, and schools at international level. In general terms, the National Commission will take part in the challenge of global sustainable development, exploiting its know-how and methods of chemical sciences to meet the demands of society and markets for sustainable solutions. NAO-CNR also aims to participate in IUPAC to advance chemistry worldwide, the overall goal of all the IUPAC NAOs.

Origin of the Italian membership at IUPAC

Italy has been a member of IUPAC for 100 years, since the very beginning. It was one of the five founder countries, together with Belgium, France, the UK, and the US. Since then, Italy has been an active member in the Union. In 1920, Rome hosted the first International Conference on Chemistry. Within this event, the equivalent to today's General Assembly met for the first time in the presence of Charles Moureu (1863-1929), President of IUPAC. In 1934, the Italian chemist Nicola Parravano, pupil of famous scientists such as Cannizzaro and Paternò, was elected President of IUPAC. He was the main chairman of the 10th International Congress of Chemistry, held once again in Rome, in May 1938. The event had the ambitious goal of showing to the world the benefits of Chemistry in the everyday life of humankind. The congress had a noteworthy participation, despite the difficult international geopolitical situation that led one year later to the outbreak of World War II [1].

The Italian National Research Council, CNR, represented Italy in IUPAC for decades. CNR is the largest public research body in the country and continues to play a noteworthy role—in agreement with other Italian chemistry actors—in planning, implementing,

and organizing international scientific and educational events at the facilities of CNR headquarters in Rome, and in other locations in Italy.

CNR represents Italy in more than 40 international Scientific Unions and international Institutions, and covers a very broad spectrum of scientific and technical disciplines as well as humanities. More specifically, the Department of Chemical Sciences and Materials Technologies, DSCTM-CNR, thanks to its role as the chemists' home for CNR researchers, is the point of contact in international organisms relevant for the national chemical community, such as the International Union of Crystallography (IUCr) or the Centre Européen de Calcul Atomique et Moléculaire (CECAM). Since 2019, DSCTM-CNR also serves as national representative in the International Science Council, ISC. IUPAC is indeed an active member of ISC participating in various initiatives with its IUPAC Divisions. Through the wide participation of Italian experts, DSCTM-CNR works to maximize benefits from cooperative and complementary actions and to strengthen the relevancy of the increased role of chemical sciences in the future societal challenges.

NAO-CNR, the Italian National Commission

The National Commission for IUPAC, NAO-CNR, gathers relevant chemists active in the academic, and industrial sectors in the largest chemistry association, *i.e.* the Italian Chemical Society, SCI. The two institutions, CNR and SCI, promote together scientific projects and events that, in most cases, receive IUPAC's endorsement and see the participation of Italian IUPAC Officers. In particular, in 2010, under the CNR Presidency of Luciano Majani, Mario Malinconico was appointed as CNR delegate for IUPAC and served in this role from 2011 to 2018.

During this period, the first National Committee for IUPAC was established in 2013 [2] to enable a larger collaboration of the Italian scientific community linking academia and industry, and to re-launch a stronger synergy with IUPAC's initiatives. This endeavor was well supported by IUPAC President Kazuyuki Tatsumi, who met CNR's President Luigi Nicolais and the Italian Committee in 2013 in an official visit. This new trend was also highlighted in the important national workshop "IUPAC and Italy: state of the art and future strategies," held in Rome one year later and officially opened by a joint opening speech from the presidents of CNR and SCI.

The Italian NAO National Commission is composed of 7 members nominated by CNR and is supported by experts, including IUPAC Italian Officers, to ensure

multidisciplinary competencies and activities. The current Commission, appointed by the President of CNR Massimo Inguscio, is chaired by Maurizio Peruzzini for 2019-2022 [3]. The National Commission has been promoting an ever-increasing participation of Italy in IUPAC, by providing technical and management support to international initiatives and projects carried out in the framework of the Union's activities. Efforts are devoted to increase the interest of communities of professionals, experts, and stakeholders working in the Italian scenario in each area of interest for chemical science and technologies, paying a special attention to the industrial sector, in strict collaboration with the

Italian Federation of Chemical Industry, Federchimica [4]. In particular, the National Commission highlights the role of chemical sciences in the fulfillment of the UN's Sustainable Developments Goals [5]. It is thus necessary to promote synergies of scientists, researchers, and professionals involved in the great challenges that humankind is facing in terms of sustainable economic growth, de-carbonization, and climate change mitigation.

In this role, the Commission pays constant attention to well-established IUPAC such as the Gold Book update project, as well as to recent IUPAC initiatives like the translation of the Periodic Table Challenge

10th IUPAC CONGRESS, ROME, 1938—SCIENCE AND PROPAGANDA*

by *Marco Taddia*

Although two nations, specifically France and the United Kingdom, played a leading role in the birth of IUPAC, the history of the Union reminds us that even Italy, along with Belgium and the United States, has been among the first nations that have actively cooperated in the foundation. Italian participation arose from the singular dynamism that at the beginning of the 20th century led to the organization of the VI International Congress of Applied Chemistry, which was held in Rome from 26 April–3 May 1906. The Proceedings of the Conference were edited by the distinguished chemists Emanuele Paternò (1847-1935) and Vittorio Villavecchia (1859-1937), formerly students of the famous Stanislao Cannizzaro (1826-1910). A proof that the Italian involvement was not a flash in the pan was the Union's first General Assembly organized in Rome in June 1920. Two more general assemblies were held in Italy. The 13th IUPAC General Assembly was held in Rome together with the 10th IUPAC Congress (14–21 May 1938). The event took place in a particular socio-political context. The fascist regime was on the top of its (*pseudo*) colonial fortunes and enjoyed popular support. Two years earlier (5 May 1936) the Italian army had entered Addis Ababa and conquered Ethiopia. In May 1938 the Führer Adolf Hitler made an official visit to Italy: the arrival in Rome welcomed by Benito Mussolini. The Chemistry Congress was affected by the heavy rhetorical atmosphere which



Nicola Parravano (2nd from left) and Congressmen's homage to the Unknown Soldier

pervaded Rome and was a showcase for the fascist State. The President of the Organizing Committee Nicola Parravano (1883-1938), a prominent professor of General Chemistry at the University of Rome, was a supporter of the regime and held important positions. He and his colleagues appeared at official events in fascist uniform (picture above). Parravano died the same year (August 10) so the editor's name is not indicated in the conference proceedings. Despite the propaganda a merit must be acknowledged. Unlike previous meetings organized by academic subject areas, the 10th IUPAC Congress was structured in eleven thematic sessions, some of which concerned topics as food, health, hygiene and energy still relevant today.

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contest into Italian and the dissemination at the national level of the Top 10 Key Emerging Technologies [6]. In particular, the themes covered by the 10 Key Emerging Technologies issued in 2019 and relaunched in 2020 outline the need for chemical sciences to move towards an interdisciplinary approach, with evident points of contacts with biology, materials science, engineering, and information technologies, as well as to promote greater attention to sustainability, at environmental, economic, and societal levels. The National Commission participates with working groups to increase communication, knowledge, and outreach in areas of interest for the Italian chemical, scientific, and technical community, as well as for education and public opinion. Indeed, IUPAC, thanks to its supranational, non-commercial, and apolitical nature, represents an outstanding observation point to monitor and share the most revolutionary and innovative trends in the field of chemistry that are ready to be easily transposed from the laboratory level to commercially-available technologies.

The Italian Commission therefore started leveraging the value of IUPAC's message at the national level [7]. Such IUPAC initiatives are also relevant for providing chemists and researchers with sources of inspiration as well as guidelines at the international level to move towards challenging problems of global interest. The National Commission wishes to enable collaborative work by improving the active relationship with IUPAC's prestigious international reputation and to cooperate in projects sharing the latest developments and results.

Recent activities and scopes

Since 2014, the presence of Italian delegates gradually increased in IUPAC Divisions and Committees, holding positions as Titular Members, Associate Members and National Representatives. In 2015 the election of Pietro Tundo as a member of the Bureau represented a remarkable result for Italian participation in recent IUPAC's activities.

For the period 2020-2021, several Italian experts hold leadership roles in IUPAC Divisions: Lidia Armelao, Vice President of Division II—Inorganic Chemistry; Pierangelo Metrangolo, Vice President of Division I—Physical and Biophysical Chemistry; Roberto Terzano, Vice President of Division VI—Chemistry and the Environment; and Francesco Nicotra, Past-President of Division III—Organic and Biomolecular Chemistry.

The activities brought forward by Italian delegates and officers as well as the complete rebuild of the web page of the Italian National Commission for IUPAC (<http://www.iupac.cnr.it/>) increased IUPAC's



9th IUPAC International Conference on Novel Materials and Synthesis (NMS-IX), October 2013. Mario Malinconico, Italian delegate for IUPAC, receives the Distinguished IUPAC Award from Makoto Shimizu from Mie University, Japan, winner of a previous edition of the Distinguished Award.

scientific visibility by organizing and promoting initiatives in emerging fields of chemistry [8]. Some of these achievements are worth mentioning.

Great efforts have been devoted in dissemination and awareness-raising activities to attract new generations of chemists towards Green and Sustainable Chemistry principles. Such a novel approach to chemistry marked a great change in the late 1980s and early 1990s after the scarce attention paid to environmental aspects in the previous decades. This led to the definition of the 12 principles of Green Chemistry in 1998 [9]. At the same time, this gradual change of perspective prompted the Italian members to design and organize a series of international summer schools on sustainable chemistry under the aegis of IUPAC and specifically addressed to PhD students and young scientists with non-permanent positions. Recently, it is worth mentioning the achievement of the Green Chemistry Post-graduate Summer School, held in Venice in July 2018. Building on this success, the 2020 edition of the school was held in the same city on July 6-10, involving 30 lectures and more than 190 participants from 43 countries all around the world. Due to the travel restrictions imposed by COVID-19 pandemic, the school sessions were managed online, in remote mode [10].

Italy hosted a major event to gather the supramolecular chemistry community, namely the 14th International Symposium on Macrocyclic and Supramolecular Chemistry, ISMSC2019, held in Lecce in June 2019, under the Chair of Vice-President of Division 1, Pierangelo Metrangolo. The symposium was attended by 712 participants from 43 different countries and addressed a wide range of key topic areas such as organic electronics, nanotechnology, biology, medicine and materials science, all sectors in

NAO-CNR: The Italian voice at IUPAC

which supramolecular chemistry is a common tool for developing innovative materials, devices, macromolecules, or nanovectors [11]. Supramolecular chemistry is indeed flourishing across traditional borders and moving towards new interdisciplinary areas of research at the interface between chemistry, medicine, biology, and materials science.

Italian experts actively participated with the working group on nomenclature that has been continuously working on the definition of the names and terms in Italian of novel chemical subjects according to IUPAC's guidelines. An example worth mentioning is the project led by Italian coordinators, dealing with the definition of halogen bonding and other non-covalent interactions involving halogen atoms [12] or the basic terminology for crystal engineering, whose ambitious scope is to bring together world-renowned scientists working in various areas of crystal engineering [13]. In this framework, they completed the definition of Italian names of the most recent transuranic elements, whose discovery completed the seventh period of the Periodic Table of elements. Dissemination initiatives have included conferences for undergraduate and high-school students, interviews on newspapers, magazines, and TV programs, explaining to the public some scarcely known details about the long pathway from the initial discovery in the lab to the attribution of the name for a new chemical "object." This dissemination campaign culminated in the celebration of the 150th anniversary of the Periodic Table of Chemical Elements, with a broad series of events throughout 2019 and concluded in December in Milan, with the "X-mas Lecture" by Fabio Parmegiani.

Promotion and organization of congresses in Italy characterized the intense activity of IUPAC Divisions III (Organic and Biomolecular Chemistry) and II (Inorganic Chemistry). Italy offers attractive locations with excellent academies for top-level international scientific events. In the last few years Italy hosted the 22nd International Conference on Organic Synthesis in Florence in 2018, the 33rd International Conference on Organometallic Chemistry in Florence in 2018, and the 25th International Symposium on Glycoconjugates in Milan in 2019. Important Conferences programmed in Italy for 2020 under the aegis of IUPAC, such as the 44th International Conference on Coordination Chemistry scheduled in Rimini in July 2020, and the 31st International Symposium on Chemistry of Natural Products expected to be held in Naples last October, have been deferred and reprogrammed due to the current health emergency for the COVID-19 pandemic.

Italian Members promoted the organization of several national events in the framework of larger international IUPAC initiatives, such as or the 2020 edition of the Global Women Breakfast.

An authoritative delegation of the National Commission attended the 100 IUPAC Celebration and General Assembly 2019 in Paris and got a full understanding of the people who work for this great community and important related activities.

In this scenario, considering that multiple Italian actors have gained a recognized international role, the Italian Commission considered aspects that require particular attention in the next years. In detail:

1. Enhanced sharing of information on IUPAC's initiatives, and intensification of participation in



6th International IUPAC Conference on Green Chemistry, September 2016, Venice, Italy.

NAO-CNR: The Italian voice at IUPAC



14th International Symposium on Macrocyclic and Supramolecular Chemistry, ISMSC2019, June 2019, Lecce, Italy

various contexts: academic institutions, public and private research sectors, industries, and scientific associations.

2. Support to initiatives targeting high-level educational programmes for young researchers; in particular fostering the presence of Italian participants in IUPAC's Young Observer Programme, with a thorough selection of candidates at national level.
3. Reinforcement of the participation of Italian experts and delegates in the Union's divisions and committees.
4. Definition of priority domains that are strictly related to sustainable development and circularity, in which competences and excellence by Italian actors can be exploited, with an increasingly stronger commitment.

These target domains are directed towards:

- decarbonization in energy and economy (CO₂ capture, storage and valorization; C₁ chemistry; "solar" fuels through innovative photochemical, photobiological, thermochemical, and/or electrochemical approaches; hydrogen production, storage and utilization);
- green and sustainable processes (high-efficiency low-impact catalysis; reduction or phase-out of critical materials in production processes; enzymatic technologies; biorefinery-derived intermediates and products);
- design, set-up and implementation of innovative

next-generation materials (energy production and storage; 2D-materials; smart materials with unprecedented performance and/or functionalities; materials and bio-materials for targeted drug delivery and advanced medical diagnostics);

- next generation biobased polymers and polymeric materials; remediation strategies for microplastics and polymeric environmental micropollutants;
- health and medicinal chemistry (novel molecules for old and new pathologies; strategies against aging and chronic degenerative diseases; enabling methodologies in pharmaceutical chemistry; synthesis and characterization of new markers and molecules for molecular recognition).

In addition to these priority topics, in which several projects led by Italian experts were funded by IUPAC and are currently in progress, the recent outbreak of the global health emergency caused by the COVID-19 pandemic clearly highlighted the pivotal role of chemical sciences and technologies in the multidisciplinary struggle against SARS-CoV-2 coronavirus.

Therefore, the Italian Commission is planning activities, endorsed by IUPAC, for educational and awareness-raising purposes as well as to foster contrasting actions against this new pathogen in terms of detection, prevention, protection, and diagnostic capabilities [14].

In the coming months, the National Commission

aspires to gather experts from various professional backgrounds to increase projects and activities of international relevancy attracting also financial support.

International relations and cooperative activities are indeed a fundamental factor coming from Italian participation in IUPAC networks. To maximize benefits, it is also relevant to establish a continuous exchange between Italian officers in the IUPAC Divisions and Committees and the members of the National Commission of the Italian NAO. In order to accomplish this goal, other synergies are becoming relevant between IUPAC with other relevant international organisms, such as the European Chemical Society, EuChemS, or the Organization for the Prohibition of Chemical Weapons, OPCW, whose ultimate mission is the safe, sustainable and ethical use of Chemistry [15].

Conclusions

Starting from the unique and authoritative role for the definition of the official nomenclature of chemical compounds and the standardization of chemical quantities, IUPAC has become, in 100 years, the reference institution for scientists and professionals working in pure and applied chemistry—related disciplines in academic as well as in industrial sectors. For this reason, in coming years, the National Commission for IUPAC, NAO-CNR, aims to promote the participation of a larger number of experts in IUPAC international activities, with a special emphasis on the involvement of the last generations of chemists. NAO-CNR will therefore play the important role of catalyst for initiatives and actions proposed by the Italian chemical community to meet IUPAC's priorities and the UN's Sustainable Developments Goals. This will be carried out by promoting the organization of high-level international congresses, workshops, and educational events to be held in Italy. NAO-CNR will work with IUPAC to advance chemistry worldwide, the overall and common goal of all the IUPAC-NAOs.

Thanks to a stronger and more fruitful synergy among Italian universities, research agencies, chemical companies, and international organizations, it will be possible to meet the request of sustainable solutions and the needs of the society and market, for today's life and future wellbeing. 🏆

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3. The current National Committee was appointed on 19 April 2019. Members are Fabio Aricò (University of Venice), Angela Agostiano (University of Bari), Lidia Armelao (University of Padua and CNR Padua), Silvia Borsacchi (CNR Pisa), Matteo Guidotti (CNR Milan), Francesco Nicotra (University of Milan Bicocca), Maurizio Peruzzini (Chair, CNR Florence), Alessandra Sanson (CNR Faenza), Roberto Terzano (University of Bari) and Pietro Tundo (University of Venice).
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