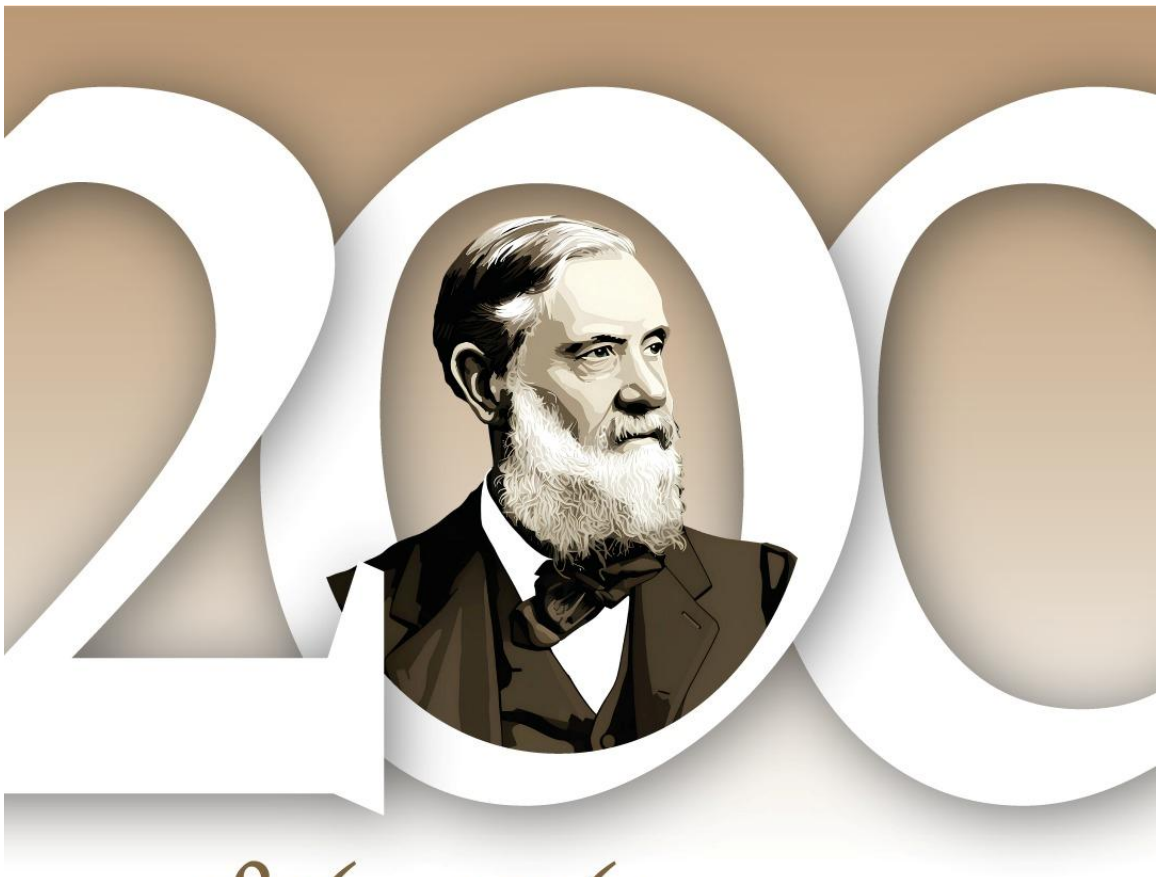

1826 – 2026:
Celebrating 200 Years of
Stanislao Cannizzaro

Palermo - Italy, 14 - 17 April

Università degli Studi di Palermo

Società Chimica Italiana

PROGRAM

April 14, 2026
Palazzo Chiaromonte – Steri

3:00–4:00 PM	REGISTRATION

OPENING SESSION

4:00–4:30 PM	*Institutional Greetings* • Massimo Midiri – Rector of the University of Palermo • Luigi Mondello – President of the Società Chimica Italiana • Vincenzo Nicolì – President of the Ordine Interprovinciale dei Chimici e dei Fisici della Sicilia
4:30–5:30 PM	PL#1 *Stanislao Cannizzaro, a Sicilian Chemist* Roberto Zingales – Gruppo Nazionale di Storia e Fondamenti della Chimica (GNFSC)
5:30–6:00 PM	*Chemical Instruments and Academic Heritage: the Paternò Collection* Giuseppe Cavallaro – University of Palermo
6:00–6:30 PM	*The Donation of Stanislao Cannizzaro Portrait to the University of Palermo: Characterization and Conservation of the Painting* Giulia D'Agostino – University of Rome "La Sapienza"
6:30–8:00 PM	WELCOME RECEPTION

April 15, 2026
Aula Magna – Department of Law

SECOND SESSION

9:00–10:00 AM	PL#2 *«The Chemical Brothers». Stanislao Cannizzaro and the Networks of Italian Scientists in the Nation-Building Process* Alessia Facineroso – University of Catania
10:00–10:30 AM	*The Hypotheses of Amedeo* Oliviero Carugo – University of Pavia
10:30–11:00 AM	COFFEE BREAK
11:00–11:30 AM	*Does the Tool Define the Chemist? Evidence From Nineteenth-Century Chemical Laboratories in Pisa* Luca Rocca – University of Pisa
11:30–12:30 AM	PL#3 *Cannizzaro in Paris (1849-1851)* Danielle M. E. Fauque – Université Paris Saclay, France
12:30–1:00 PM	General Discussion
1:00–3:00 PM	LIGHT LUNCH

THIRD SESSION

3:00–4:00 PM	PL#4 *Stanislao Cannizzaro and the Karlsruhe Congress* Alan J. Rocke – Case Western Reserve University
4:00–4:30 PM	*The Idea of Science and the Value of The History of Science in the Thought of Stanislao Cannizzaro* Giovanni Villani – Gruppo Tematico di Epistemologia e Storia della Chimica – SCI
4:30–5:00 PM	COFFEE BREAK
5:00–5:30 PM	*From Play to Discovery: How the Cannizzaro Games Spark Early Scientific Thinking* Margherita Venturi – Divisione di Didattica della Chimica – SCI
5:30–6:00 PM	General Discussion

April 16, 2026
Aula Magna – Department of Law

FOURTH SESSION

9:00–10:00 AM	PL#5 *Beyond Rome* Giovanni Paoloni – University of Rome "La Sapienza"
10:00–10:30 AM	*Stanislao Cannizzaro and the "Laboratorio delle Gabelle": an Early Example of Scientific Approach within the Public Administration* Vincenzo Gambino – Agenzia delle Dogane e dei Monopoli
10:30–11:00 AM	COFFEE BREAK
11:00–11:30 AM	*Teaching the History of Chemistry at the Undergraduate Level Through Activities with Books, Historical Instruments and Primary Sources* Valentina Domenici – University of Pisa
11:30–12:00 AM	*The Theory That Illuminates the Data the Educational and Formative Value of Cannizzaro's Contribution* Antonio Testoni – Divisione di Didattica della Chimica – SCI
12:00–1:00 PM	PL#6 *Cannizzaro, Atomic Weights, Philosophy of Chemistry, and Attempts to Capture the Essence Of Elements* Eric R. Scerri – University of California Los Angeles (UCLA)
1:00–1:30 PM	General Discussion
1:30–3:00 PM	LIGHT LUNCH
3:00–5:00 PM	SOCIAL ACTIVITIES

SOCIAL DINNER – 8:30 PM
OSTERIA BALLARÒ VIA CALASCIBETTA, 25
90133 PALERMO

April 17, 2026
Aula Capitò – Ed. 7 Department of Engineering

PUBLIC EVENTS (IN ITALIAN)

9:00–9:30 AM	*Saluti Istituzionali*
9:30–10:00 AM	*Stanislao Cannizzaro Chimico, Patriota e Politico* Roberto Zingales – Gruppo Nazionale di Storia e Fondamenti Della Chimica
10:00–10:30 AM	*Storie di Uomini, di Luoghi e di Idee. L'Università degli Studi di Palermo tra XIX e XX Secolo* Valentina Favarò – University of Palermo
10:30–11:00 AM	*L'università di Palermo Oggi* Cinzia Cerroni – University of Palermo
11:00–11:30 AM	*Contaminazioni tra Saperi e Nuovi Percorsi tra Ricerca e Innovazione* Clelia Dispenza – University of Palermo
11:30–12:00 PM	*I laboratori dell'Agenzia delle Dogane e dei Monopoli: un approccio scientifico al commercio, alla sicurezza e al controllo delle merci* Sergio Giuffrida – Agenzia delle Dogane e dei Monopoli
12:00–12:30 PM	Premiazione Contest Scuole Cannizzaro 2026
12:30–1:00 PM	CLOSING CEREMONY

Visit to the ADM Mobile Laboratory
Floriana Billeci and Gabriella Buscemi – Agenzia delle Dogane e dei Monopoli

Visit to the Library of the Department of Engineering Collection
Gloria Mangiaracina – University of Palermo

PL-1

STANISLAO CANNIZZARO, A SICILIAN CHEMIST.

Roberto Zingales

Gruppo Nazionale di Fondamenti e Storia della Chimica - Palermo,
robertozingales@outlook.it

Stanislao Cannizzaro was born in Palermo on 13 July 1826. He studied Medicine for three years at the University of Palermo, getting the lower qualification (*cedola di approvazione*).
While attending the Seventh Meeting of the Italian Scientists in Naples, in September 1845, he was introduced to Raffaele Piria (1815-1865), Professor of Chemistry at the University of Pisa, who hired him as *preparatore* (a sort of laboratory assistant). Cannizzaro remained in Pisa for two years, completing his chemical training under Piria's guidance.
Back in Palermo, he took part to the Revolution that began on 12 January 1848, and was subsequently elected to the Sicilian Parliament. In April 1849, Sicilians were defeated by the Bourbon Army, and many patriots were forced into exile. Cannizzaro fled first to Marseille and then to Paris, where, through letters of introduction from Piria, he was able to work in the chemical laboratory of Eugene Chevreul (1786-1889), under the direction of Stanislas Cloëz (1818-1883). There, he was the first to synthetize cyanamide, by reacting ammonia with cyanogen halides.
In 1851, he returned to Italy as Professor at the National College of Alessandria (Piedmont), where, by alkaline disproportionation of benzaldehyde, he was the first to obtain benzyl alcohol – a reaction now known as *Cannizzaro reaction*. In 1855, he was appointed Professor of Chemistry at the University of Genoa. There, in 1857 he married an English woman, Harriett Withers, and in 1858 published his renowned *Sunto*, a milestone in nineteenth century Chemistry. Starting from Avogadro's hypothesis, he clearly distinguished between atoms and molecules, and provided a method for determining the correct atomic weights of the elements. He later presented these ideas at the First International Congress of Chemistry in Karlsruhe in September 1860, where they were warmly received by Lothar Meyer (1830-1895) and Dmitrij Ivanovic Mendeleév (1834-1907).
In October 1861, Cannizzaro was appointed professor of Organic and Inorganic Chemistry at the University of Palermo, where he remained for ten years. During this period, he:

1. established a well-equipped laboratory at the University, to improve teaching of Chemistry;
2. founded a Technical Institute to train students for modern industry;
3. welcomed chemists from Palermo and abroad, encouraging research and the development of new scientific ideas;
4. launched a Journal, *Gazzetta Chimica Italiana*, which published the work of Italian chemists, and promoted scientific debate.

While in Palermo, he was also actively involved in improving public education, particularly for women and workers. He contributed to the foundation of the *Scuola di Applicazione per Ingegneri* (Engineering Faculty) and played a role in combating the

cholera epidemic of 1867, by preparing disinfectant chemicals for houses, streets and sewers.
In November 1871, Cannizzaro was appointed Senator of the Kingdom of Italy and Professor of Organic Chemistry at the University of Rome. Before accepting the post, he requested that a suitable building be provided to house the Institutes of Chemistry, Physics and Physiology, along with sufficient funding for modern equipment and materials. In 1873, the Institute of Chemistry was established in the former convent of *San Lorenzo in Panisperna*, and under Cannizzaro leadership it became a leading centre for scientific research and education.
In his political career, he also promoted (1878) the creation of a chemical laboratory to improve tobacco production in Italy. This initiative led to the establishment of the *Laboratorio Chimico delle Gabelle* (Customs Chemical Laboratory) in July 1886. He was furthermore involved in healthcare reform and served on the Superior Council of Public Education.
After his retirement in 1909, his health rapidly declined, and he died on 10 May 1910. He was buried in the Testaccio Cemetery in Rome, beside his wife. In 1926, on the occasion of the second National Congress of the Italian Association of General and Applied Chemistry, their remains were transferred to Palermo. On 21 May 1926, they laid to rest in the Church of *San Domenico* - the Pantheon of the distinguished Sicilians - where the sculptor Giovanni Nicolini created a monumental tomb in his honour.

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3. A. M. Maggio, R. Zingales ed., *Stanislao Cannizzaro, scienziato e politico all'alba dell'unità d'Italia*, Roma (2011) Aracne.

OC-1

CHEMICAL INSTRUMENT AND ACADEMIC HERITAGE: THE PATERNO COLLECTION

Giuseppe Cavallaro

Department of Physics and Chemistry E. Segrè, University of Palermo, Viale delle Scienze, Ed. 17, giuseppe.cavallaro@unipa.it

The "Paternò Collection" is the historical collection of chemical instruments preserved at University of Palermo (UNIPA) though the management of the University Museum Systems. The Collection is located at Department of Physics and Chemistry E. Segrè in the Building 17 (entitled to Stanislao Cannizzaro) of the main UNIPA campus in Viale delle Scienze. The "Paternò Collection" houses laboratory equipment and apparatus used by chemists at University of Palermo since the second half of the 19th century. The Collection, which consists of three exhibition rooms featuring laboratory benches and display cases, is a tangible demonstration of Cannizzaro's work at University of Palermo. The oldest pieces of the Collection are from the chemistry laboratories developed by Stanislao Cannizzaro during his activity as Professor of Inorganic and Organic Chemistry at University of Palermo. Moreover, the Collection shows the traces of the prestigious international chemical school that Cannizzaro was able to establish during his stay in Palermo (1862-1871) as clearly demonstrated by a display case containing some crystals synthesized by Körner in 1867 in relation to his pioneering studies on benzene derivatives.

Nowdays, the "Paternò Collection" is committed to support the cultural identity and the mission of University of Palermo by Education, Research and Public Engagement actions. Within educational activities, the Collection carries out fruitful collaborations with the UNIPA courses of "Chemistry" and "Conservation and Restoration of Cultural Heritage". The "Paternò Collection" cooperates with INAF (Istituto Nazionale di Astrofisica) and the UNIPA PhD course "Physical and Chemical Sciences" supporting the research activities related to diagnostics and conservation of historical scientific instruments as well as to the monitoring of museum environments.

Primarily, the "Paternò Collection" is dedicated to public engagement though various cultural activities, which are aimed to disseminate the UNIPA Heritage to the entire community. In this regard, guided visits to the Collection are included in the programs of PCTO and Open Days organized by UNIPA. In addition, the "Paternò Collection" is visited by high school students within national initiatives ("La Settimana STEM" and "La Settimana dello Studente"). The Collection is regularly appreciated by researchers from both Italian and foreign universities within private visits or organized events.

Finally, the "Paternò Collection" is an open site for private citizens in order to disseminate the Academic Heritage to the entire community. Besides private visits, the Collection can be admired within specific occasions. As example, the visit to the Collection was included in the programs of "Il Genio di Palermo 2025" and "Il Festival 2025", which are social events yearly organized by "La Fondazione Le Vie dei Tesori" with the support of University of Palermo.

OC-2

THE DONATION OF STANISLAO CANNIZZARO PORTRAIT TO THE UNIVERSITY OF PALERMO: CHARACTERIZATION AND CONSERVATION OF THE PAINTING

Giulia D'Agostino[1,2], Federica Palumbo[3], Giuseppe Lazzara[2,4], Giuseppe Cavallaro[2,4], Maria Luisa Saladino[5]

[1]Dipartimento di Scienze dell'Antichità, Università degli Studi di Roma "La Sapienza", P.le Aldo Moro 5, 00185, Roma, Italy
[2]Dipartimento di Fisica e Chimica, Università degli Studi di Palermo, Viale delle Scienze, pad. 17, 90128 Palermo, Italy
[3]Dipartimento di Culture e Società, Università degli Studi di Palermo, Viale delle Scienze, pad. 15, 90128 Palermo, Italy
[4]Consorzio Interuniversitario Nazionale per la Scienza e Tecnologia dei Materiali, INSTM, Via G. Giusti, 9, I-50121 Firenze, Italy
[5]Dipartimento di Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche, Università degli Studi di Palermo, Viale delle Scienze, pad. 17, 90128 Palermo, Italy

This contribution presents the conservation process of an oil on canvas painting depicting Stanislao Cannizzaro, dated 1901 and signed by Raja Ciccarelli. The portrait was donated in 1936 to the Regia Università di Palermo by the artist's son and represents an important element of the visual legacy associated with Cannizzaro within the Italian academic and scientific context.

Although Cannizzaro was still alive at the time of execution, the portrait was not painted from life but was most likely copied from a photograph or a related engraving, as evidenced by the presence of a preparatory grid revealed during IR examination (Figure 1). The overall conservation state of the painting was generally good; however, several issues primarily affected the canvas support, with consequent repercussions on the preparatory and pictorial layers. A patch applied on the reverse suggested the presence of a major tear, later confirmed during restoration. Moreover, the canvas showed deformations caused by the stretcher, and by the patch added during the previous intervention. The ground and paint layers exhibited minor abrasions. A yellowed varnish layer, and a light deposit of atmospheric particulate matter were also observed.

The restoration treatment firstly focused on the support stabilization and on the cleaning process of the altered varnish. The patch was mechanically removed and the gap has been sealed. The canvas was subsequently flattened through controlled humidification and weighted relaxation, followed by peripheral strip-lining and re-stretching. Finally, the conservation treatment ended with the pictorial reintegration, improving the visual readability of the portrait, and enhancing its documentary and symbolic value within the context of Cannizzaro-focused historical and scientific studies.

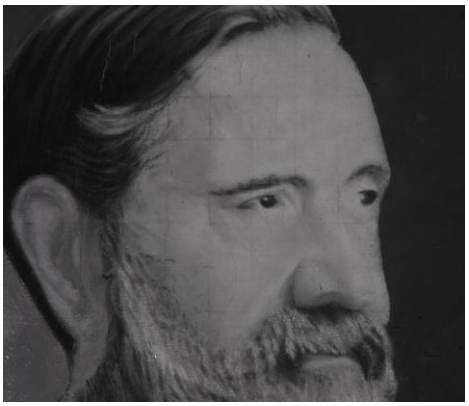

Figure 1. The preparation grid present on the surface as a drawing guide for the painter, detected through infrared observation.

PL-2

«THE CHEMICAL BROTHERS». STANISLAO CANNIZZARO AND THE NETWORKS OF ITALIAN SCIENTISTS IN THE NATION-BUILDING PROCESS (1848-1871)

Alessia Facineroso

Università di Catania, Dipartimento di Scienze Politiche e Sociali

By reconstructing Stanislao Cannizzaro's biography, this contribution will analyze the role of scientists in the process of Italian State and Nation Building.
While Cannizzaro, since the early 1840s, was an integral part of a circle of scholars determined to change the peninsula's institutional structure – and capable of creating a scientific "canon" that paved the way for Italian unification – from the 1848 revolution onward, he took an active role in the violent protests against the Bourbon monarchy, participating in the revolution and subsequently suffering exile in France and Piedmont.
During this period of "preparation" for Unification, as well as in the aftermath of its completion, study and activism went hand in hand, strengthening Cannizzaro's scientific and political ties and his role as a well-rounded intellectual. In the summer of 1860, after Garibaldi's entry into Palermo, Stanislao returned to his hometown and became a member of the Higher Council of Public Education; in 1865 he became a member of the National Academy of Sciences; subsequently, he served as Rector and Vice President of the Senate (from 1886 to 1897 and from 1898 to 1904), once again expressing his scientific vocation as a service to the nation.

OC-3

THE HYPOTHSES OF AMEDEO

Oliviero Carugo

Department of Chemistry, University of Pavia, viale Taramelli 12, I-27100 Pavia (Italy), olivieroitalo.carugo@unipv.it

Amedeo Avogadro's hypotheses, published in 1811[1], form the basis of the theories later developed by Stanislao Cannizzaro. This communication describes, in terms accessible to non-specialists, Avogadro's two hypotheses and the development of his scientific personality in Italy at the turn of the eighteenth and nineteenth centuries[2].

Destined for a legal career – Avogadro derives from *avvocato*, "lawyer" – Amedeo left his native Turin in 1796, during Napoleon's first Italian campaign, to take refuge at the family estate in the countryside. There, to combat boredom, he developed an interest in the natural sciences, which he studied in a manner we would now call *remote learning*. He soon abandoned the practice of law to become a professor of physics at the Royal College of Vercelli, where he could devote himself fully to teaching and scientific research. It was in Vercelli that Avogadro published his most important work, before becoming Professor of Sublime Physics at the University of Turin in 1821 – a position revoked in 1824 and reinstated ten years later.

Avogadro's first and most famous hypothesis states that, at equal pressure and temperatur e, equal volumes contain the same quantity of any type of gas, regardless of the chemical nature of the gases. What now seems obvious – an embryonic definition of the ideal gas equation – was, in fact, a revolutionary strategy to establish a relative scale of molecular masses.

Avogadro's second hypothesis, less well known but equally important, suggests that certain elements – for example hydrogen and oxygen – may not be monoatomic gases but diatomic ones. This idea, which today seems obvious, was at the time astonishing, yet essential to reconcile Dalton's atomic theory with Gay-Lussac's highly accurate experimental results.

However, the scientific community initially dismissed Avogadro's work, and it was thanks to Stanislao Cannizzaro, at the Karlsruhe congress of 1860, that these seemingly abstruse hypotheses spread throughout the world, becoming the foundation of chemistry in the second half of the nineteenth century – and, ever since, of modern science itself.

Amedeo Avogadro passed away on July 9, 1856. At the time, Stanislao Cannizzaro was thirty-one years old and had just been appointed professor of chemistry at the University of Genoa — it seems almost like a passing of the baton. Yet, it appears that the two never met in person. After the "remote learning" that first drew Avogadro to science, the relationship between Avogadro and Cannizzaro can thus be seen as a kind of *telematic connection avant la lettre*.

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OC-4

DOES THE TOOL DEFINE THE CHEMIST? EVIDENCE FROM NINETEENTH-CENTURY CHEMICAL LABORATORIES IN PISA

Luca Rocca[1]; Valentina Domenici[2].

[1.] *Dipartimento di Chimica e Chimica Industriale, Università di Pisa, Via Giuseppe Moruzzi 13, 56124 Pisa, Italia.* luca.rocca@dcci.unipi.it
[2.] Dipartimento di Chimica e Chimica Industriale, Università di Pisa, Via Giuseppe Moruzzi 13, 56124 Pisa, Italia. valentina.domenici@unipi.it

This contribution examines the role of scientific instrumentation in nineteenth-century chemical practice and university teaching through the figure of Stanislao Cannizzaro (1826–1910), with particular attention to the instrumentation used by Raffaele Piria (1814-1865) and the following tradition of chemical studies in the University of Pisa. The aim is to show how Cannizzaro's sustained attention to laboratory equipment and experimental spaces constituted a central element of his conception of chemistry, and how this material dimension of science today provides a privileged interpretative key for the study of historical collections and for contemporary chemical education.

During the nineteenth century, chemistry underwent a profound transformation, evolving from a largely theoretical and descriptive discipline into an experimental science grounded in measurement, reproducibility, and the systematic use of precision instruments. Within this process, Cannizzaro stands out not only for his theoretical contributions—culminating in the reformulation of atomic and molecular weights—but also for his active role in shaping the material infrastructure of chemical research and teaching. Archival and epistolary sources relating to his academic activity, particularly during his years in Genoa, Pisa, and later Palermo, clearly show that Cannizzaro regarded laboratory instrumentation as an indispensable condition for modern instruction and rigorous scientific inquiry, a view explicitly articulated in his celebrated *Sunto di un corso di filosofia chimica*.[1] Although Cannizzaro's stay in Pisa (1845–1847) was relatively brief, he later described those years as decisive for his chemical education.[2] He entered an environment already structured by the work of Raffaele Piria, whose laboratory represented a major centre for experimental chemistry in Italy. Cannizzaro's presence contributed to reinforcing a generational continuity that would later find its fullest expression in the figure of Raffaello Nasini (1854-1931) and in the subsequent development of the Pisan chemical tradition. Research conducted within the Va3SCoDi project (Valorizzazione degli Strumenti Scientifici Storici per la Conoscenza e la Didattica)[3] has made it possible to identify historical inventories of the chemical laboratory managed by Piria, allowing a partial reconstruction of its instrumental equipment. These documents reveal acquisitions consistent with the needs of a quantitative, analytical, and experimental chemistry aligned with contemporary European standards. Cannizzaro was directly involved in the organisation of laboratory spaces, the selection of instruments, and their suitability for advanced experimental practices. In this sense, scientific instruments become primary historical sources, capable of illuminating not only analytical techniques

but also teaching models, epistemological priorities, and networks of knowledge circulation in nineteenth-century chemistry.

This historical perspective finds a natural continuation today in the study and valorisation of scientific instrument collections, such as that preserved at the Department of Chemistry and Industrial Chemistry of the University of Pisa. Historical instruments thus cease to be merely objects of preservation and instead become tools for understanding science as a concrete, historically and culturally situated practice. Cannizzaro's legacy therefore emerges not only as a theoretical achievement, but as the expression of a scientific culture deeply rooted in laboratory work and instrumentation. Analysing this material dimension enriches our understanding of nineteenth-century chemistry and offers new perspectives for both te[4]aching and the valorisation of scientific heritage today.

References

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PL-3

STANISLAO CANNIZZARO IN PARIS (1849-1851)

Danielle M. E. Fauque

UR Études sur les Sciences et les Techniques (UR EST), Université Paris Saclay, France
fauquedme@gmail.fr

Stanislao Cannizzaro arrived in France in May 1849 and left in November 1851 to go to Alessandria (Piedmont), where he had just been appointed professor at the Collegio Nazionale. There are few traces of his time in Paris, apart from the testimony he gives of it himself. France had just embarked on the Second Republic (1848-1851), and Cannizzaro was certainly not indifferent to the political climate he encountered.

The young man – he was 23 years old – had been diverted from his original path, chemistry, by politics, and he now sought to resume his scientific training. A recommendation from R. Piria to Dumas and a crucial meeting with A. Cahours allowed him to enter the laboratory of M.E. Chevreul, at the Muséum d'histoire naturelle, one of the best places in Paris at that time.

Together with S. Cloëz, Chevreul's assistant, he published on substances of the cyanic series in the prestigious *Comptes rendus de l'Académie des sciences*. He also observed the experiments of E. Fremy, in the laboratory close to Chevreul's, and had a friendly relationship with E. Péligot, Dumas's assistant.

But it was probably with Cahours, a teaching assistant at the École Polytechnique and assistant professor at the École centrale des arts et manufactures, that he had the strongest links. The evidence for this is in the correspondence between the two men, resumed after the Karlsruhe Congress, which saw the triumph of Cannizzaro's ideas in 1860, and published on the occasion of the centenary of his birth (1926).

But did he meet A. Laurent, who was then working at the Hôtel de la Monnaie in Paris, or Ch. Gerhardt, who had opened a school of practical chemistry in Paris and whose proposals he would follow and defend brilliantly in Karlsruhe in 1860? Did he actually meet Ch. A. Wurtz, then in the orbit of J.B. Dumas, whose method of studying compound ammonia (amines) he applied with Cloëz? Or S. Malaguti, an Italian exile like him, but who was pursuing a brilliant career in Rennes, and for whose Italian version of his magisterial work on agricultural chemistry Cannizzaro wrote the preface? What too might he have learned from V. Régnault's lectures at the Collège de France?

My paper aims to throw light on the intellectual and social climate in which the young Cannizzaro matured during his stay in Paris. It was a framework that undoubtedly contributed to his subsequent evolution towards new ideas in chemistry, even though several of the chemists he frequented remained in relatively traditional positions.

PL-4

CANNIZZARO IN KARLSRUHE

Alan J. Rocke

Case Western Reserve University 10900 Euclid Ave. Cleveland, Ohio 44106

ajr@case.edu

Stanislao Cannizzaro is traditionally and correctly viewed as the hero of the Karlsruhe Congress, but it is not easy to find clear and correct summaries of what he accomplished. The speaker will describe what happened at the Congress, focusing on Cannizzaro's performance there. International chemical science was a mess in the 1850s, for several incompatible systems of atomic weights and molecular formulas were being used by various squabbling chemical factions, creating widespread confusion. It was for this reason that two leading younger chemists, a Frenchman and a German, organized this international conference, in hopes of achieving unity among the schools of thought. It proved to be the Italian chemist Cannizzaro who showed the way to a principled methodological pluralism, a science of chemistry in which all evidence, physical and chemical, was to be holistically considered in building a single "most probable" picture of atomic-molecular reality. In doing so, he resolved the contradictions and created the basis for the chemical atomic theory that we know today.

OC-5

THE IDEA OF SCIENCE AND THE VALUE OF THE HISTORY OF SCIENCE IN THE THOUGHT OF STANISLAO CANNIZZARO

Giovanni Villani

già Consiglio Nazionale delle Ricerche, giovanni.villani@cnr.it
Coordinator of Gruppo Tematico della Società Chimica Italiana Epistemologia e Storia della Chimica

The figure of Stanislao Cannizzaro is multifaceted, as the Cannizzaro Congress 2026 aims to highlight. He was undoubtedly a distinguished experimental chemist; even today, an important reaction in organic chemistry is known as the Cannizzaro reaction, namely the disproportionation of aldehydes lacking α-hydrogen atoms.

Cannizzaro was also a highly influential scientific figure in his time. His participation in the Karlsruhe Congress, for example, played a crucial role: numerous testimonies show that in the years that followed, many chemists referred to the indications he provided on that occasion, using them as a guide for their own research.

A significant example of this influence is the role his ideas played in the development of the Periodic Table of Elements, which within a decade contributed to the rationalization of chemistry in the second half of the nineteenth century. Dmitri Mendeleev himself explicitly acknowledged his intellectual debt to Cannizzaro and the importance of Cannizzaro's ideas in guiding the subsequent research that would lead to the formulation of the periodic table.

The figure of Cannizzaro can, in this sense, take on an emblematic value once the full scope of his contributions is properly recognized. Such recognition should come first from the community of Italian chemists, which has not infrequently overlooked the broader cultural legacy of its leading figures, and subsequently from the international scientific community.

Cannizzaro represents a significant example of a modern scientist who, even while working in highly specialized fields, succeeded in combining the technical aspects of research with a broader, more general reflection. This cultural reinterpretation of his figure allows not only a deeper understanding of Cannizzaro's scientific "style" and his role as a professor, but also a renewed appreciation of the contemporary relevance of his work.

In this presentation, we will address two broad aspects of Cannizzaro's thought. First, we will examine his conception of science. Although this topic may seem secondary today, we believe it is in fact fundamental for fully understanding Cannizzaro's figure and work.

We propose the hypothesis that Cannizzaro, like other great scientists of the past, can be interpreted from a perspective broader than the strictly disciplinary one—that is, from a perspective closely aligned with the philosophy of science. In nineteenth-century

scientists, a solid cultural and philosophical education often constituted the foundation and unifying framework of their scientific activity. It is precisely this dimension that we aim to highlight, drawing on several explicit statements made by Cannizzaro himself.

The second theme, also reflected in the title of this presentation, concerns Cannizzaro's reflection on the role that the history of science can play both in the development of scientific research and in the teaching of scientific disciplines. In our view, this aspect of Cannizzaro's thought—innovative in many respects—has so far received limited attention in studies dedicated to his work.

Drawing on some of his explicit statements, we will show how Cannizzaro attributed a fundamental role to the historical analysis of science, not only as a guide for research but also as a means to clarify and strengthen the teaching of chemistry.

In a contemporary science increasingly characterized by a high degree of specialization, we believe it is important to revisit—through the study of great scientists of the past, such as Cannizzaro—the general, historical, and cultural dimensions of scientific activity. We will show how, from this cultural and philosophical perspective, the analysis of Cannizzaro's scientific approach and the role he attributed to the history of science remains highly relevant today. Its significance extends beyond purely historical or academic interest.

In an era marked by the growing fragmentation of scientific knowledge and widespread uncertainty regarding the cultural role of science—and chemistry in particular—it becomes essential to ask what knowledge should be transmitted to future generations and how. In this context, Cannizzaro's figure can represent more than a scientist of the past: he can serve as a meaningful point of reference, both in terms of scientific reflection and in the teaching of science.

OC-6

FROM PLAY TO DISCOVERY: HOW THE CANNIZZARO GAMES SPARK EARLY SCIENTIFIC THINKING

Alessandro Abbotto[1], Ottavia Bettucci[1], Sabrina Donghi[2], Luigi Falciola[3], Marcolina Ruggiata[4], Alice Severi[5], Margherita Venturi[6]

[1]*Università degli Studi di Milano Bicocca, via Cozzi 55, Milano,* alessandro.abbotto@unimib.it *and* ottavia.bettucci@unimib.it
[2]*Istituto Comprensivo Luigi Galvani, via Galvani 7, Milano,* sabrina.donghi1@gmail.com
[3]*Università degli Studi di Milano, via Golgi 19, Milano,* luigi.falciola@unimi.it
[4]*Istituto Comprensivo Don Pino Puglisi - Scuola Primaria Papa Giovanni XXIII, Bresso (MI),* mruggiata@gmail.com
[5]*Scuola secondaria di II grado "ISIS Follonica", Follonica (GR),* alice.severi@gmail.com
[6]*Divisione di Didattica della Società Chimica Italiana,* margherita.venturi@unibo.it

Cannizzaro Games (Giochi di Cannizzaro[1]) represent an innovative national initiative designed by the Italian Chemical Society (Società Chimica Italiana, SCI) to spark scientific curiosity among primary school students and to build a coherent vertical pathway in chemistry education from early childhood to the International Chemistry Olympiads. Launched in the 2024/2025 school year with the patronage of the Italian Ministry of Education, the Games target 9–10-year-old students in fourth and fifth grade, offering them an inclusive, motivating, and playful approach to science learning.

The competition is structured in two main phases: a preparatory phase, in which teachers and students access narrative-based educational materials introducing major figures of Italian chemistry (starting right with Stanislao Cannizzaro) and fundamental scientific concepts; and a National Competition, a synchronous, digital "escape-room style" challenge carried out directly in classrooms across the country. This format invites entire classes (not individual students) to decode clues, solve logic–scientific mini-problems, and collaboratively navigate a timed sequence of challenges. The game mechanics leverage principles of gamification, promoting intrinsic motivation, creativity, teamwork, and critical thinking while transforming chemistry into an accessible and engaging discipline.

The educational value of the Cannizzaro Games lies not only in their alignment with the STEM curriculum and civic education guidelines, but also in their proven capacity to foster cooperation, strengthen observation and problem-solving skills, and support inclusivity through diverse learning modalities. Early impact data confirm the initiative's strong potential: from its debut edition involving 8 schools, 24 classes, 50 teachers and 377 students, participation has already doubled, with growing representation across Italy.

By cultivating enthusiasm for science at a young age, the Cannizzaro Games establishes the foundational step of a long-term educational continuum that progresses toward the Avogadro Games and the national Chemistry Games. As such, they stand as a pioneering example of how gamified learning can transform STEM education, empower young learners, and create a vibrant cultural environment in which chemistry becomes a journey of discovery: accessible, collaborative, and inspiring for all.

At the heart of this project stands the inspiring legacy of Stanislao Cannizzaro, one of the founding figures of modern chemistry. His revolutionary clarity in defining atomic and molecular masses, his pedagogical brilliance, and his lifelong commitment to making science accessible resonate deeply with the spirit of the Games. By bearing his name, the initiative not only honors a towering scientific mind, but symbolically invites children to follow in his footsteps, embracing curiosity, reasoning rigorously, and discovering the joy of scientific understanding. The Cannizzaro Games thus become more than a competition: they are a living tribute to a scientist who transformed complexity into comprehension, and who continues to guide new generations toward a future where chemistry is a gateway to imagination, empowerment, and discovery.

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PL-5

CANNIZZARO A ROMA, TRA POLITICA E ACCADEMIE

Giovanni Paoloni

Accademia Nazionale delle Scienze detta dei XL, già Sapienza Università di Roma

Oltre Roma: Cannizzaro linceo e XL

Cannizzaro fu socio di molte accademie, italiane e non solo. Due di queste, la Reale Accademia Nazionale dei Lincei e la Società Italiana delle Scienze detta dei XL, avevano sede a Roma e portata nazionale. Alla loro vita partecipò attivamente, mettendo anche a frutto le esperienze fatte nel periodo dell'esilio, peregrinando da un luogo all'altro. La politica delle istituzioni di alta cultura è normalmente considerata dalla storiografia come un aspetto marginale della politica universitaria, una confusione favorita dall'ambiguità dell'aggettivo 'accademico'. In realtà nel Regno d'Italia la questione dell'accademia nazionale coinvolse sia i XL che – dopo il 1870 – i Lincei. Nei dibattiti e nei conflitti che ne seguirono Cannizzaro svolse un ruolo tutt'altro che secondario, in particolare nei rapporti non semplici che ebbe con Sella, Brioschi, Blaserna e altri colleghi e consoci, nel dibattito sulle sedi e sulla funzione sociale dei sodalizi. Questo contributo intende ripercorrere alcuni momenti dell'attività del Cannizzaro 'socio'.

OC-7

STANISLAO CANNIZZARO AND THE "LABORATORIO DELLE GABELLE": AN EARLY EXAMPLE OF SCIENTIFIC APPROACH WITHIN THE PUBLIC ADMINISTRATION

Vincenzo Gambino; Sergio Giuffrida

Laboratory of Palermo, Agenzia delle Dogane e dei Monopoli, Largo Pietro Barbaro 8, Palermo, dt.sicilia.laboratorio.palermo@adm.gov.it

Stanislao Cannizzaro played a fundamental role in the foundation (1886) and development of the "Laboratorio Chimico delle Gabelle" (Chemical Laboratory of the Duties) in the post-unitary Italian Kingdom, when the young state administration needed reliable scientific support to control the exchanged commodities, both from fiscal and sanitary point of views. Placed in a socio-political context marked by national unification and the resulting reorganization of the state administration structure, this Laboratory was a meeting point between science and state administration, and it contributed to modernizing the tax imposition system and improving the protection of public health.

Stanislao Cannizzaro, already well known for his fundamental theoretical contributions in chemistry and for his role in the diffusion of atomic-molecular theory, was summoned to organize an efficient and thorough chemical service. He promoted the use of standardized analytical methods and the training of qualified personnel, by relying on of young collaborators, destined to become prominent chemists in the Italian scientific scene. Included among them, Raffaele Nasini e Girolamo Villavecchia contributed to the development of analytical techniques and in systematising the laboratory procedures. In particular, Villavecchia will succeed as head of the Laboratory after Cannizzaro renunciation in 1896.

Initially, the lack of shared protocols and suitable instruments made necessary a hard work on method standardisation, as well as the elaboration of reliable criteria to identify frauds. Among the first challenges the Laboratory faced, there was the correct fiscal classification of sugars. In this context the Laboratory played both a technical and a political role, contributing to building a scientific authority for the State and reinforcing the bond between chemical research and public administration.

The work of Cannizzaro within the Laboratorio delle Gabelle was a part of a wider process of institutionalization of science in united Italy, marking a crucial passage toward a systematic use of scientific knowledge in the management of commodities and, more in general, fiscal politics.

OC-8

TEACHING THE HISTORY OF CHEMISTRY AT THE UNDERGRADUATE LEVEL THROUGH ACTIVITIES WITH BOOKS, HISTORICAL INSTRUMENTS AND PRIMARY SOURCES

Valentina Domenici

Dipartimento di Chimica e Chimica Industriale, via Moruzzi 13, 56124 PISA, Italy, valentina.domenici@unipi.it

The role of history of chemistry in the training of future chemists has been identified as fundamental by several thinkers and experts in chemistry education[1-3]. As Schummer[1] suggests, one reason chemists should be trained in philosophy, history, and ethics is that they must address increasingly interdisciplinary problems, developing transferable skills and a deeper understanding of the complex relationships between chemistry and other disciplines, as well as between chemistry and society. Taken together, these considerations suggest that teaching the history of chemistry at the undergraduate level can be challenging. The experiences carried out within the course *History of Chemistry and Elements of Chemistry Education* at the University of Pisa[4] are presented and discussed here, with the primary aim of sharing educational strategies and demonstrating their beneficial effects on first-year undergraduate students. These experiences include cooperative activities using books on the history and philosophy of chemistry[5], reading primary sources in class and discussing their social and cultural context,[4] as well as exploring the evolution of chemistry through the historical scientific instruments present in science museums[6,7] (**Figure 1**).

Figure 1. Some pictures showing from the top left to the bottom right: The collection of historical scientific instruments at DCCI – UNIPI; three books used for didactic activities with students: 'A tale of 7 elements' (E. Scerri), 'Il Chimico e l'alchimista' (A. De Meo), 'L'interpretazione chimica del vivente' (G. Villani); photo of an activity with historical instruments with undergraduate students in 2025.

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OC-9

THE THEORY THAT ILLUMINATES THE DATA

The Educational and Formative Value of Cannizzaro's Contribution

Testoni Antonio,[1] Aquilini Eleonora,[2] Andreini Claudia[3]

[1] *Teaching Division of the Italian Chemical Society, e-mail: antonio.testoni55@gmail.com*
[2] *Past President of the Teaching Division of the Italian Chemical Society, e-mail: ele.aquilini6@gmail.com*
[3] *Associate Professor at the University of Florence, e-mail: claudia.andreini@unifi.it*

Learning science means more than simply acquiring a body of established knowledge; it also involves adopting ways of thinking, arguing and interpreting the world that are rooted in a long historical and cultural tradition. From this perspective, science teaching cannot be limited to transmitting the 'products' of science — that is, stabilised results — but must also reveal the processes through which those results were constructed, debated, revised and, at times, superseded. Restoring science's historical dimension, comprising conjectures, errors, revisions and conceptual redefinitions, is essential for fostering an authentic scientific mindset and for contributing, together with the humanities, to the critical education of citizens.[1,2]

Within this theoretical framework, the paper reflects on the formative value of nineteenth-century chemical atomism, with particular attention to Stanislao Cannizzaro's role in clarifying the conceptual distinction between atoms and molecules and in determining atomic weights. The underlying hypothesis is that atomic theory, in its original formulation by John Dalton, far from being merely a chapter in the history of chemistry, still represents an extraordinarily effective pedagogical device for introducing chemical thinking in a rigorous yet accessible way[3,4]. It offers a relatively simple conceptual structure, strong internal coherence, and the ability to give meaning to experimental data.

At this point, a significant convergence emerges between Cannizzaro's and Thomas S. Kuhn's reflections[4]: measurement does not precede theory; rather, theory makes measurement intelligible by orienting questions, selecting what is relevant, and providing the language through which laws are expressed. Without a conceptual framework, data remains fragmented and meaningless; in light of a theory, however, it acquires coherence and explanatory power. This aspect, crucial from an epistemological standpoint, also assumes decisive importance in educational terms: showing students that science is an interpretative enterprise, guided by models and hypotheses, means educating them to a critical and conscious use of concepts.

This paper presents an excerpt from a teaching sequence designed for the first two years of upper secondary school. The sequence begins with Dalton's theory, it moves through Amedeo Avogadro's hypothesis[6], and reaches the systematic clarification proposed by Cannizzaro eventually situating these developments within the broader context that led to the construction of the periodic table. The intentionally long pathway is designed to encourage the progressive re-elaboration of concepts and highlight the connection between theoretical problems, experimental practices and interpretative choices.

From this perspective, historical reflection is not viewed as an end in itself, or as mere cultural enrichment, but rather as a methodological tool for shedding light on the foundations of the discipline. Following Cannizzaro's advice, the objective is to "put students on the same path"[7], that led to the development of concepts, by selecting events and theoretical turning points that reveal the origin of ideas and their gradual refinement.

Ultimately, the fundamental goal of teaching is the deep and meaningful assimilation of the content to be covered, rather than its quantity. Only an approach that prioritises gradual progression, the careful selection of foundational concepts and the critical re-examination of ideas can transform knowledge into genuine instruments of thought. In this sense, the case of nineteenth-century atomism and Cannizzaro's clarifying work are paradigmatic examples of how the history of science can be a valuable resource for a form of teaching that combines conceptual rigor, epistemological awareness, and critical thinking at school and university level.

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PL-6

CANNIZZARO, ATOMIC WEIGHTS, PHILOSOPHY OF CHEMISTRY, AND ATTEMPTS TO CAPTURE THE ESSENCE OF ELEMENTS.

Eric R. Scerri,

Department of Chemistry & Biochemistry,
University of California Los Angeles
Los Angeles
USA
scerri@g.chem.ucla

The lecture will present a view of the work of Cannizzaro from the perspective of contemporary philosophy of chemistry. I will argue that, like many other scientists of the period, Cannizzaro operated as much as a philosopher as he did as a chemist, especially in his arriving at a definitive set of atomic weights of the then-known elements.
Moreover, I will propose that Cannizzaro's scientific approach to obtaining accurate and consistent atomic weights is an example of a type of scientific reasoning that has been largely ignored by the better-known philosophers of science, from the logical positivists to their critics, such as Popper, Kuhn, Lakatos, and others. Examples will be provided of some more recent philosophers of science who have paid close attention to Cannizzaro's style of reasoning.
I will also examine the extent to which Cannizzaro's atomic weights opened the door to the discovery of the periodic system, by many independent scientists, as has been previously claimed by many authors, including myself.[1]
The second part of the presentation will consider a central question that is being debated by contemporary philosophers of chemistry, namely the dual nature of the chemical elements, which hinges very much on atomic number, which is itself the modern counterpart to atomic weight, that Cannizaro did so much to clarify.[2]

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OC-10

STORIE DI UOMINI, DI LUOGHI E DI IDEE. L'UNIVERSITÀ DEGLI STUDI DI PALERMO TRA XIX E XX SECOLO

Valentina Favaró

Dipartimento Culture e Società, Università degli Studi di Palermo
valentina.favaro@unipa.it

Capitale "senza studium": così è stata efficacemente definita la città di Palermo per i secoli dell'età moderna. La fondazione dell'Università arrivò, infatti, tardivamente e risentì di dinamiche politiche locali e internazionali che si intrecciarono nel delineare il ruolo che la nuova istituzione assunse negli anni della presenza della corte regia prima, e del nuovo regno delle Due Sicilie poi. Come in un gioco di specchi, la relazione metterà in evidenza, usando quali punto d'osservazione privilegiato alcune figure di particole rilievo, le connessioni fra dimensione culturale, politica e sociale. La storia dell'Università, lungi dall'essere una lineare storia dell'Istituzione, consente di tracciare alcuni fili rossi che legarono spazi - cittadini, regnicoli e poi nazionali - e saperi, alimentati da una mobilità e circolazione di docenti e studenti che posero col tempo l'Università al centro dell'area mediterranea.

OC-11

L'UNIVERSITA' DI PALERMO OGGI

Cinzia Cerroni

Dipartimento di Matematica e Informatica,
Università di Palermo, cinzia.cerroni@unipa.it

Si descriverà l'Università di Palermo da un punto di vista dell'offerta formativa, dei servizi erogati e delle aree di ricerca presenti. In particolare, si evidenzierà come lo studente è centrale nell'organizzazione e nella destinazione dei servizi. La visione dell'orientamento dell'Ateneo di Palermo accorda ai futuri studenti la possibilità di accedere a percorsi di orientamento e a consulenze individuali che favoriscono la scelta. Inoltre, la configurazione generalista dell'Ateneo, nella sua articolazione in sedici dipartimenti, consente la possibilità di scegliere gli studi secondo le proprie attitudini e di optare per la prosecuzione degli stessi, fino anche al dottorato di ricerca.

OC-12

CONTAMINAZIONI TRA SAPERI E NUOVI PERCORSI TRA RICERCA E INNOVAZIONE

Clelia Dispenza

Dipartimento di Ingegneria - Università degli Studi di Palermo

Viale delle Scienze 6 – 90128 Palermo e-mail: clelia.dispenza@unipa.it

L'intervento propone una riflessione sul valore delle "contaminazioni" tra saperi come motore di avanzamento scientifico, prendendo ispirazione dalla figura di Stanislao Cannizzaro, la cui attività scientifica e didattica ha contribuito in modo decisivo a ridefinire i fondamenti della chimica moderna attraverso un approccio rigoroso ma aperto al dialogo tra discipline.

A partire da questo esempio storico, il contributo intende mostrare come il progresso della ricerca sia sempre più legato alla capacità di integrare competenze diverse, superando i confini tradizionali tra ambiti disciplinari. In particolare, nel campo biomedico, le sfide contemporanee — dalla medicina rigenerativa allo sviluppo di nuovi materiali per applicazioni cliniche — richiedono una convergenza tra chimica, ingegneria, biologia, fisica e scienze dei dati.

L'intervento discuterà come tali "nuovi percorsi" non rappresentino soltanto una necessità tecnica, ma anche un cambiamento culturale nel modo di concepire la ricerca: dalla specializzazione verticale a modelli collaborativi e interdisciplinari, capaci di generare innovazione sostenibile e trasferibile. In questa prospettiva, si evidenzierà il ruolo cruciale della formazione, delle infrastrutture condivise e delle reti di collaborazione nel favorire l'incontro tra saperi.

Riprendendo idealmente l'eredità di Cannizzaro, si propone quindi una visione della ricerca come spazio dinamico di contaminazione, in cui l'integrazione delle conoscenze diventa la chiave per affrontare le sfide scientifiche e sociali del presente.

OC-13

THE LABORATORIES OF THE AGENCY OF CUSTOMS AND MONOPOLIES: A SCIENTIFIC APPROACH TOWARD TRADE, SAFETY AND CONTROL OF COMMODITIES

Sergio Giuffrida; Vincenzo Gambino

Laboratory of Palermo, Agenzia delle Dogane e dei Monopoli, Largo Pietro Barbaro 8, Palermo, dt.sicilia.laboratorio.palermo@adm.gov.it

The Agency of Customs and Monopolies (ADM) is an Italian government Agency with regulatory, supervisory, and control authority in the fields of energy, alcohol, tobacco products, agri-food, customs, and public gaming. In these areas, the objectives of the Agency are supporting and promoting economic growth, protecting the financial interests of Italy and Europe, and ensuring the legality of trade.
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- verifying the compliance of goods with current national and European regulations and quality standards;
- supporting the law enforcement agencies and the judicial authorities in the controls and repression of frauds and drug trafficking;
- providing product certification services for the market in the field of regulated quality agri-food production;
- performing analyses for private entities under market conditions and in collaboration with other government agencies;
- conducting technical and scientific research to identify and, if possible, anticipate future commercial fraud, with the aim of protecting the market and consumers.

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LIST OF PARTICIPANTS

Anna Maria	***ALMERICO***
Giuseppe	***ANGELLOTTI***
Eleonora	***AQUILINI***
Giampaolo	***BARONE***
Marco	***BELLINI***
Floriana	***BILLECI***
Gabriella	***BUSCEMI***
Franco	***CALASCIBETTA***
Antonio	***CAPOLONGO***
Oliviero	***CARUGO***
Giuseppe	***CAVALLARO***
Sandra	***CECCATELLI***
Delia Francesca	***CHILLURA***
Giulia	***D'AGOSTINO***
Valentina	***DOMENICI***
Alessia	***FACINEROSO***
Danielle M. E.	***FAUQUE***
Jonathan	***FILIPPI***
Vincenzo	***GAMBINO***
Elena Maria	***GHIBAUDI***
Luisa	***GIANSANTI***
Sergio	***GIUFFRIDA***
Giuseppe	***LAZZARA***
Giovanna	***LI PETRI***
Lorenzo	***LISUZZO***
Fabrizio	***LO CELSO***
Annette	***LYKKNES***
Annamaria	***MARTORANA***
Stefana	***MILIOTO***
Luigi	***MONDELLO***
Vincenzo	***NICOLI'***
Giovanni	***PAOLONI***
Rinaldo	***POLI***
Davide	***PROSERPIO***
Luca	***ROCCA***
Alan J.	***ROCKE***
Eric R.	***SCERRI***
Sergio	***STOCCORO***
Alessio	***TERENZI***
Fabiana	***TESCIONE***
Antonio	***TESTONI***
Fulvia	***TRAPANI***
Margherita	***VENTURI***
Giovanni	***VILLANI***
Francesco	***VIZZA***
Roberto	***ZINGALES***