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LINCEI CELEBRATIVE ESSAYS

Introduction to the Topical Collection "Lincei Celebrative Essays"

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The value of a piece of scientific research is not limited to the results obtained but increases over time when it opens up new lines of study, which lead to new scientific discoveries and to the development of new applications. It is the aim of this new topical collection, with the title *Lincei Celebrative Essays*, to stress this point.

The celebration referred to is not limited to recalling the value of the results obtained by scientists who were active both in the past and relatively recently, but bears witness, by presenting current scientific results, to the way the celebrated scientists' research has created the context within which these new results were arrived at.

Most of these scientists were, or still are, active members of the Accademia Nazionale dei Lincei, both Italian and foreign, and we refer to them in this topical collection highlighting the importance of the scientific work of the members of the Accademia Nazionale dei Lincei in an international context.

This topical collection is composed of papers that cover several fields of scientific research and which are planned to be published in succession in this and in subsequent issues of the journal. But the idea is not completely without previous antecedents that diachronically could have been inserted within this topical collection. We believe relevant to go back browsing previous issues in search of essays from the past that can serve as models for the present purpose.

A first illuminating example is the article by Giorgio Salvini, dedicated to Enrico Fermi (Fig. 1): after recalling "the progress of human knowledge in the first [part of the] twentieth century", and in particular the fundamental theoretical and experimental contributions made by Fermi in Italy and in the States and his contribution to post-war Italy, Giorgio Salvini (1920–2015), member of the Accademia Nazionale dei Lincei from 1959, President (1990–1994), Vicepresident (1994–1997), interestingly notes an explicit contrast between Fermi's legacy and reality in the days of writing, a dozen years ago; the message is still valid:

> Human curiosity, in all directions, cannot stop. The societies who are able to satisfy it will progress. We must satisfy basic scientific research and the laboratories in which it is done, because that is where our future lies. Enrico Fermi's whole life proves it. I take the freedom of insisting on this point, because I fear that my country's understanding of the need for basic research and its willingness to support it, has waned somewhat in recent years. [...]. Italy is today in a bad position respect to the other major states in Europe regarding the availability of the energy, which is necessary for its existence, bread, eating, electricity etc. This is due to the lack of natural resources in our country, and to the mistake we made in the last twenty years to close our existing plants of nuclear energy, without creating new ones. I hope that this situation will be adjusted in future, with new nuclear plants, and an increased attention in our laboratories and universities to the scientific and technological research, in the field of nuclear solar wind energy. We must intensely participate in the World problem of energy, with all its delicate implications.

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Fig. 1 Enrico Fermi (1901–1954), Linceo Correspondent 1932, National 1935. See Giorgio Salvini (2008) *Enrico Fermi: a guiding light in a troubled century*, Rend Fis Acc Lincei 19: 103–119

Figure 2 portraits the Russian chemist Dmitri Ivanovič Mendeleev, Linceo as a foreign member, introduced by Gian Paolo Chiusoli (1923–2013), Linceo from 1988: a symposium, *140 years from the presentation of the periodic system* was organized on 28–29 May 2009 in Palazzo Corsini (Rome), the headquarter of the Accademia, intended to celebrate one of the major discoveries of modern science:

At that time, it had been established that matter was formed by a certain number of elements, linked to each other by a regular progression of properties. As the science of transformation, Chemistry was expected to work out not only classification systems, but also criteria for passing from an element to another one and anticipating its properties. Fundamental to this aim was the concept of periodicity. Mendeleev noted that by ordering the elements known at that time accord-

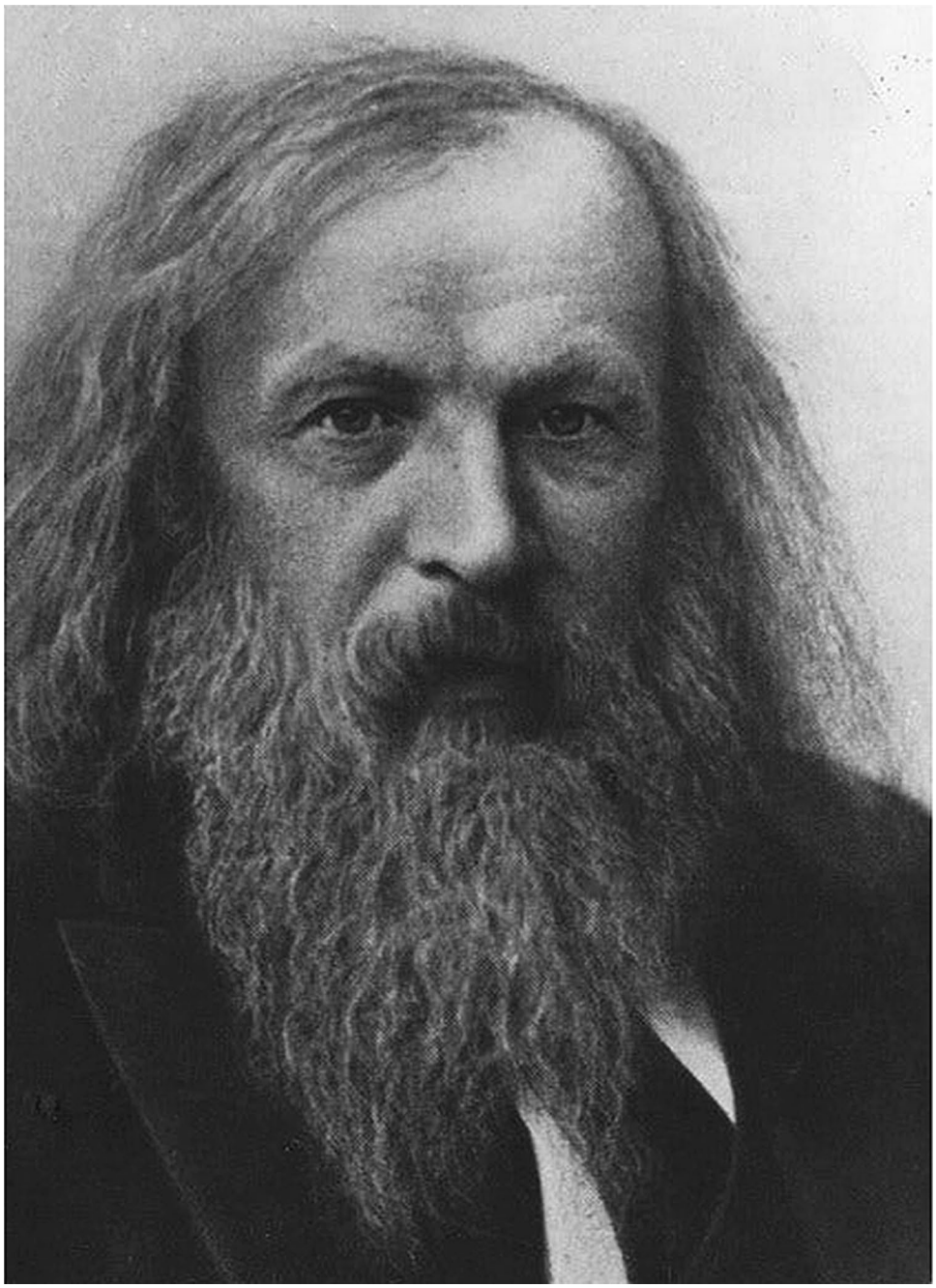

Fig. 2 Dmitry Mendeleev (1834–1907), Linceo, Foreign member 1893. See Gian Paolo Chiusoli (2010), *Dmitry Mendeleev: 140 years from the presentation of the periodic* system, Rend Fis Acc Lincei 21:45–46

ing to their increasing atomic weight certain properties recurred: if elements were placed horizontally along lines corresponding to series (periods), those with similar properties (groups) appeared vertically in columns. It is appropriate to recall at this point that the great Italian chemist Stanislao Cannizzaro offered a fundamental contribution, which was acknowledged by Mendeleev himself. In the following years all the elements […]) were placed into a table where they were ordered no longer according to their atomic weight but according to their atomic number (corresponding to the number of electrons). Two transition series, where elements resemble each other more than in a group, were also included. This systematization, achieved by Mendeleev incompletely when the electronic theory and quantum mechanics were not yet developed, represents one of the wonders of science because it is both an efficient mnemonic system and a predictive tool. It is sufficient to look at the position of an element in the Table for inferring its relevant properties. Already in its initial formulation the system revealed its extraordinary power in that it allowed to foresee the existence of

Fig. 3 Ardito Desio (1897–2001) standing in the center of the photo with the white shirt, K2 expedition 1954, Linceo Correspondent 1948, National 1963. See Maria Bianca Cita (2016), *The legacy of Ardito Desio concerning the geological exploration of Karakorum*, Rend Fis Acc Lincei 27:145–156

not yet known elements, which corresponded to empty boxes in the Periodic Table. The predictive power of the system still was at its beginnings, however, and would allow later to foresee essential properties such as electronegativity (which is fundamental to account for the formation or cleavage of chemical bonds), magnetism and many other properties. A spectacular advancement occurred when electrons were associated with electromagnetic waves and a breakthrough was achieved by quantum mechanics (1927). A series of important theoretical developments, which cannot be analysed here, followed. To make a long story short, we can state that the periodic system of the elements more and more revealed itself as a precious guide to chemical properties and reactivity as well as a fundamental support for scientific elaborations. The concept that inspires it is quite general and exerts a profound influence not only on chemical but also on the other disciplines. Thus, biologists are interested in predictive systems of biological properties such as protein ability to fold in a variety of ways, which are very important for life processes. Physicists too are attempting to

Fig. 4 Rita Levi-Montalcini (1909–2012), Linceo Correspondent 1977, National 1990. See Piergiorgio Strata (2018), *Rita Levi-Montalcini and her major contribution to neurobiology*, Rend Fis Acc Lincei 29:737–753

order the properties of the large number of subnuclear particles that have been found until recently.

In her essay on the legacy of Ardito Desio (Fig. 3), Maria Bianca Cita Sironi, born in 1924, Lincea since 1985, traces the history of her mentor Desio's geographical and geological explorations of Karakorum, that remote, a most glaciated and difficult to access mountain chain, from his first expedition in 1929 to 1975. In 1954 Desio was the leader of the conquest of K2 – the second highest peak in the world (8611 m) and for additional three months explored the geology of the Baltoro and Biafo-Hispar valley. In the following twenty years he came back to those mountains and glaciers many times with young colleagues of the University of Milan, arousing interest on Karakorum and passing the baton to the next generation. Since the '80 s of the past century a growing group of Italian geologists devoted itself to the study of the Karakorum-Himalayas, contributing intensively

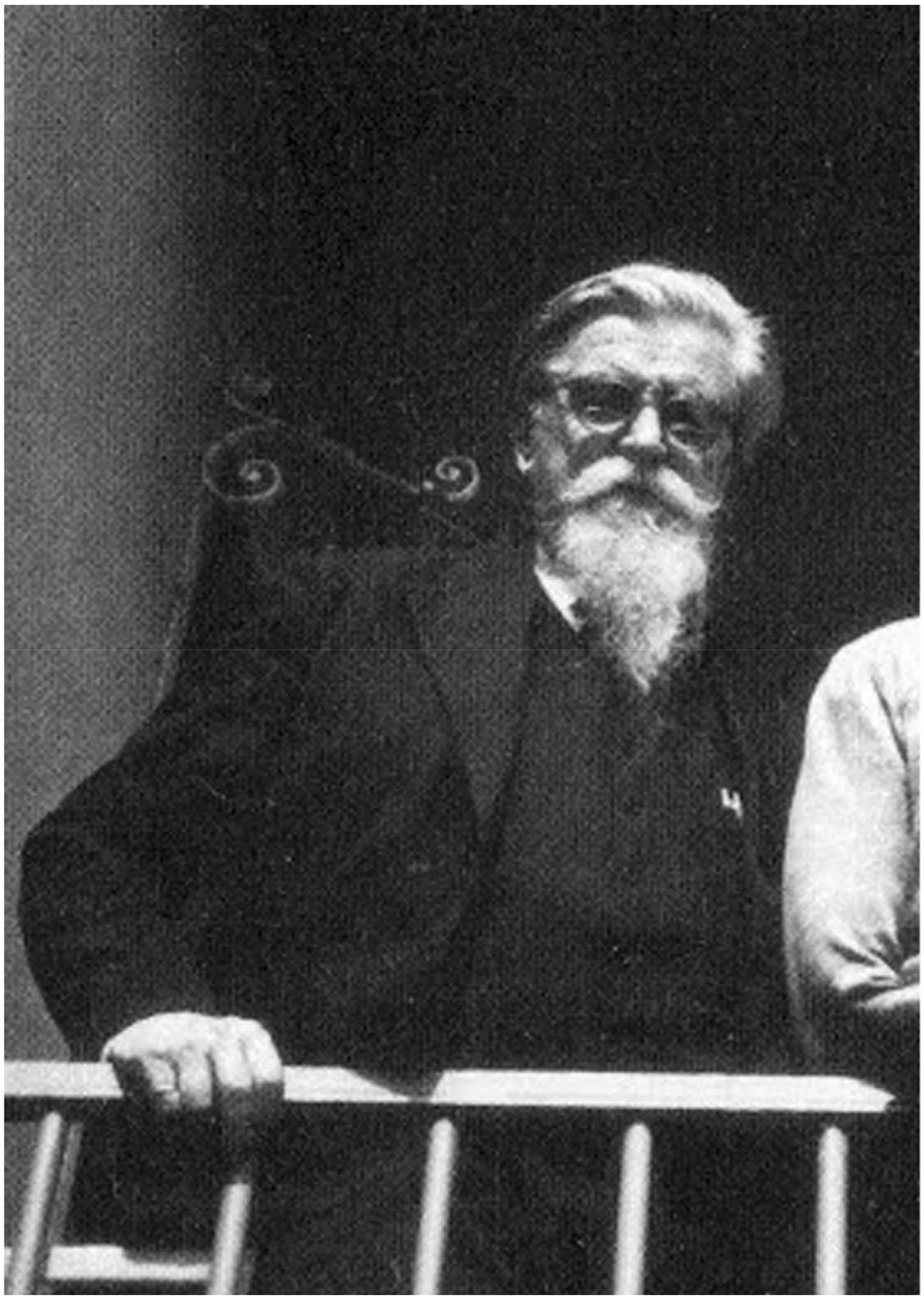

Fig. 5 Gustavo Colonnetti (1886–1968), Linceo Correspondent 1947, National 1948. See Diederik S. Wiersma and Giovanni Mana (2021), *The fundamental constants of physics and the International System of Units,* Rend Fis Acc Lincei, 32: this issue

to the international studies on this complex, highest, and tectonically active mountain system, for several reasons one of the key areas for the geosciences in the world.

As a more recent example, see Piergiorgio Strata's celebration of Rita Levi-Montalcini, the 1986 Nobel Laureate (Fig. 4), He illustrates her personality, highlighting how she first emerged within a prestigious school, while under the direction of Giuseppe Levi (1872–1965), Linceo from 1922, a most inspiring and stimulating figure. Between 1919 and 1938, he created a rich environment capable of influencing the minds of innumerable students; among them, three future Nobel Prize winners, Renato Dulbecco, Salvador Luria, and Rita Levi-Montalcini, who were companions in the same classroom. In 1938, due to the infamous laws for the defence of the race, they were banned from entering the university premises. In a small working space in her bedroom–"a minuscule laboratory not unlike a convent cell"–Levi-Montalcini, supported by Levi (suspended from the Accademia from 1938 to 1945), made a most outstanding discovery that opened a new chapter in neurobiology.

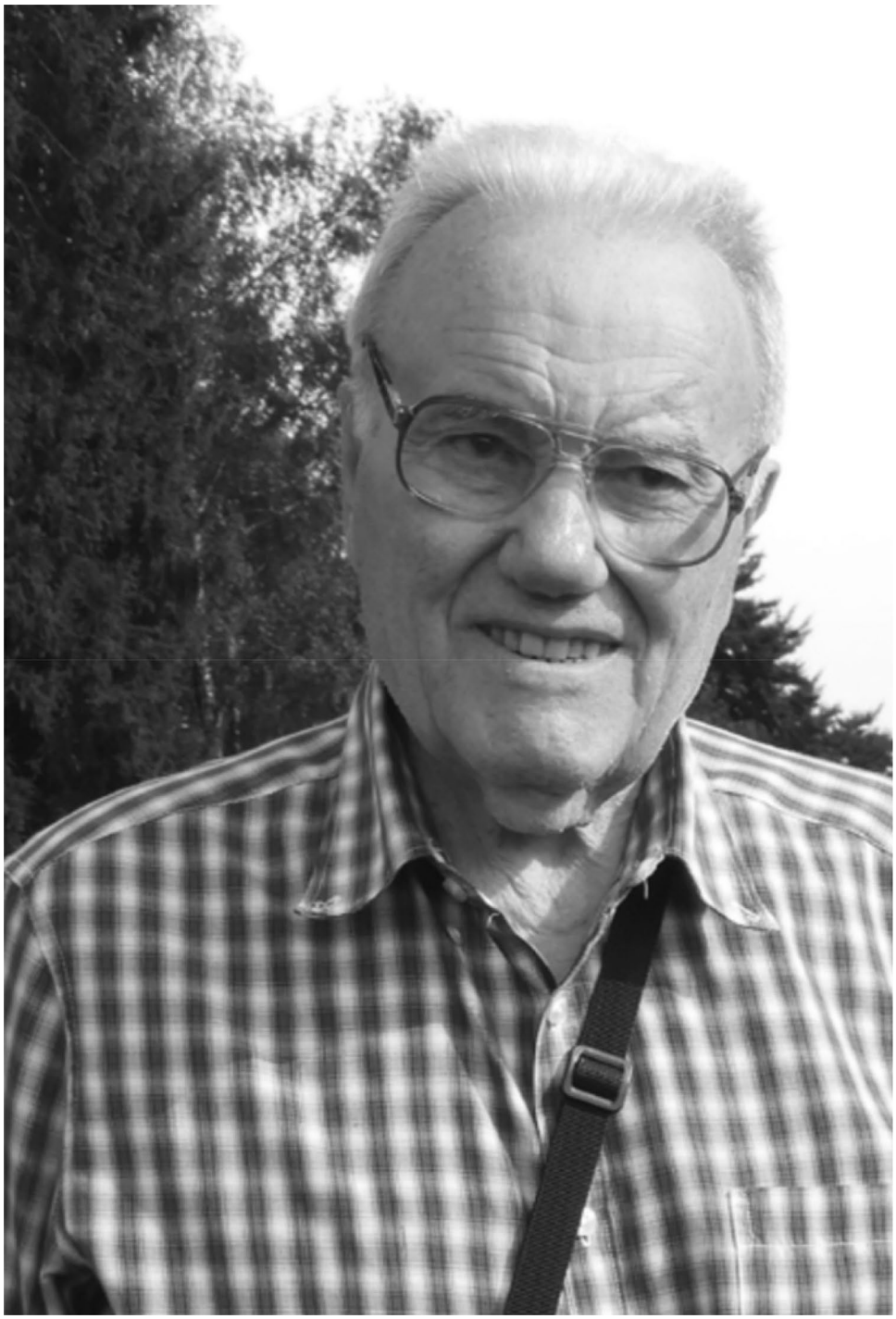

Fig. 6 Giorgio Forti. (1931–2021), Linceo Correspondent 1985, National 1991, See Giuseppe Zucchelli and Robert C. Jennings (2022),*The thermodynamics of light absorption for a two- level system*, Rend Fis Acc Lincei 33: next issue

Subsequent collaborations with Viktor Hamburger and Stanley Cohen led Levi-Montalcini to the discovery of the nerve growth factor (NGF): a remarkable accomplishment which turned out to represent a milestone in the development of modern cell biology.

The first essay of the Topical Collection appears in the present December issue: it was prepared by Diederik S. Wiersma and Giovanni Mana, who tackle the subject of the definition of units of measure in physics. They remark: "Since recently, we have a truly universal and stable system that uses physics's natural constants and laws to define the base units of measurement. This paper explains how this new concept works and how it is implemented in practice". To quote from the dedication note "This article celebrates Professor Gustavo Colonnetti (Fig. 5), who "triggered the development of Italian metrology through the foundation of

the Istituto Dinamometrico and Istituto Termometrico that, in 1968, merged in the Istituto di Metrologia "G Colonnetti", now Istituto Nazionale di Ricerca Metrologica". Engineer and mathematician, Colonnetti was influential promoting science as president and president emeritus of CNR, the Italian National Research Center, since 1956.

A further article is available online and will appear in print in the next year's first issue. It reports basic issues of the thermodynamics of light absorption, with specific reference to biological matter. It is authored by Giuseppe Zucchelli and Robert C. Jennings (born in 1945, Linceo since 2003), and dedicated by them to Giorgio Forti (Fig. 6).

> […] the father of modern photosynthetic research in Italy. His contribution to photosynthesis studies for over 50 years is respected and acknowledged internationally. The basic scientific interests of Giorgio Forti were in the field of biochemistry and physiology of photosynthetic electron transport. His pioneering research on ATP synthesis generated by the Mehler reaction and the cyclic electron transport around photosystem I gained him international recognition, as did the biochemical studies on the key enzyme ferredoxin NADP+ oxido reductase, pivotal in both the above-mentioned processes. This enzyme was shown to be localised mostly in the partition zones between the thylakoids which excluded its postulated role of connecting the two spatially separated photosystems. Interest in the Mehler reaction, as a parallel electron transport and ATP generating process to NADP reduction, remained with Forti, as well as the cyclic electron transport process and its regulation during state I/state II transitions. Over the years he taught the thoughts, skills and the enthusiasm for photosynthetic research to his many students, a large number of whom remained in the field, working both in Italy and overseas, and who in turn carried on, with success, the enthusiastic Forti tradition.

We are confident that Lincei and colleagues from an ample spectrum of disciplines accept our invitation to contribute through their essays to the celebration of past and present members of the Accademia.