CENTENARY OF PROFESSOR RUDOLF BALLÓ'S BIRTH*

GY. HARDY

Department of Plastics and Rubber,
Technical University, H-1521 Budapest

Received August 2, 1984

Summary

Life and work of the first professor of the Department of Plastics and Rubber, Rudolf Balló (1884–1960) of our University has been dealt in the paper.

Rudolf Balló, the founding professor of the Department of Plastics and Rubber at the Technical University Budapest was born 100 years ago on April 24, 1884 in Borosjenő (Arad county) as the sixth child of a forestry company's cashier. He attended primary and secondary school in Arad, and the excellent chemistry teacher György Telbisz at the secondary school had a decisive influence on Balló's further life course. Telbisz quickly recognized the outstanding ability of the boy and tutored him two or three afternoons a week from the age of 13 to 18 in the laboratory of the school, teaching him the fundamentals of laboratory work. This was of great benefit to Rudolf Balló in his early university years. He started studying chemistry and natural history at the Pázmány Péter (today Eötvös Loránd) University in Budapest in 1902. His chemistry professor Béla Lengyel noticed the young student's much higher than average qualification; finding that he was well acquainted with that usual chemical laboratory excercises and measurements, he let him help the lecture assistant already in his first year, and later charged him with sorting the library of the department and with minor research tasks. Balló's professors at the university included Béla Lengyel and Loránd Eötvös, but he also systematically attended the lectures of Vincze Wartha and Ignác Pfeifer at the Technical University Budapest and it was presumably their influence that formed the chemical-technological approach in Balló which accompanied him all his life.

After passing his primary examinations in 1904, he received a scholarship of 1000 crowns; he started research on equilibria in that year by studying the solubility of mixed crystals on the example of $MnSO_4 \cdot 5H_20$ and

* Read on April 24, 1984 at the session of the Technical University Budapest in memory of Professor Rudolf Balló born 100 years ago.

$MgSO_4 \cdot 7H_2O$ and freezing phenomena of mixtures of saturated fatty acids with water. He published his results in a series of papers in the 1907 volume of Magyar Chemiai Folyóirat and in the 1910 volume of Zeitschrift für physikalische Chemie.

In 1906 he passed his final examinations with excellent marks and graduated as doctor of chemistry, mineralogy and plant physiology. In the academic year 1905–06 he already led the laboratory exercises of pharmacist students as assistant. However, this post taking too much time away from research, he gave it up at the end of the year and instead taught chemistry, chemical technology and photochemistry in various municipal secondary schools. Although his salary was less, he now had more time left for research. He worked as guest researcher in the Chemical Institute II of the University, in an own laboratory, directing the work of students preparing for the doctor's degree. He continued his equilibrium research, which logically led him to the investigation of the factors affecting the formation of minerals. In 1911 he continued research at the Mineralogical Institute of the Vienna University with thermoanalytical and microscopic studies of lithium aluminium silicates and arrived to significant recognitions regarding the formation conditions of silicate minerals. After ending his experiments in Vienna, he continued research in this direction in Budapest and won financial backing of the Hungarian Geological Society for his research program on the theory of dolomite formation. The justness of his research and of his scientific approach was recognized by the Chemical and Mineralogical Section of the Hungarian Scientific Society by charging him in 1916 to write a book on mineral chemistry, summarizing his novel results and methods of investigation.

Besides his successful scientific and teaching work, young Balló also was very active in social and science politics. Still a student at the University, he participated in the endeavours for modernizing university education. He and his companions were dissatisfied with the level of teaching at the universities and with the activities of scientific societies like the Hungarian Scientific Society, the Geological Society etc. To be able to act more efficiently against backwardness and prejudice, they founded, in 1905, the University Union for Sciences, with the aim of making up for the defects of university teaching by surveying recent scientific results, organizing visits to industrial plants and study tours. On the other hand, the University Union for Sciences sharply criticized the scientific policies followed by the scientific societies and their exclusiveness. Therefore they decided to go beyond university limits and organized the Union of Science analogously to the Galilei Circle by drawing into its activities progressive scientists and professors. Balló became president of the Union.

In 1917 Balló was elected recording secretary of the Chemical and Mineralogical Section of the Hungarian Scientific Society and editor of its

journal Magyar Chemiai Folyóirat. Balló was very active in modernizing teaching of chemistry. As president of the chemistry Subsection of the Teachers's Section in the Union of Municipal Employees, he developed the methods and principles of 5-year secondary chemistry teaching based on the heuristic method. As early as in 1908 he organized a training course for workers.

In 1919 the Scientific Directory was established from the members of the Union for Sciences, and Rudolf Balló became its president. He was appointed professor at the Marx-Engels Workers' University set up by the Educational Commissariat of the Hungarian Soviet Republic, and taught the workers deprived earlier from the possibility of learning with great enthusiasm. He taught general chemistry under the title Material Science and led corresponding laboratory exercises. Simultaneously he lectured at the Technical University. His lectures were entitled "Rare elements" and involved radioactivity and other amazing novel achievements in chemistry.

After the fall of the Hungarian Soviet Republic, Rudolf Balló's promising academic career was wrecked. He was forced to retire, he was deprived of the possibility of teaching and research and expelled from all scientific societies. This was the end of the first period of his creative life.

Balló's interest and activity turned towards plastics in the period between 1919 and 1945. To make a living, he accepted employment in a chemical factory called Derma, but quitted in 1921, because his salary was retained. Later it was refunded in one sum, and with that money he founded, in 1922, an essentially family enterprise called Isola Works Ltd. for research and development and pilot-plant production of electric insulators. Operation was started in February 1922; Balló shared his time between the research laboratory, the pilot plant and the workshop where tools, equipment for resin production and control instrument were made. All members of his family worked in the enterprise, but the workers also participated as family members. Even when the enterprise became profitable, no dividends were paid; profit was assigned to the development of the enterprise and to social purposes. The size of the enterprise, the personal participation of Balló and his family in work created a patriarchal atmosphere, in which not only Balló himself, but every worker participated in the joy of creative action. Balló did everything to teach the workers the essence of the process they were charged with, so that in the possession of this knowledge they were able to add to the understanding of the process by their direct observations. This atmosphere was entirely different from the conditions ruling in the industrial enterprises of antirevolutionary Hungary and quickly led to appreciable results. Not only did the Hungarian electrical industry reach an internationally competitive level in synthetic resin-based insulators; Balló largely assisted the development of Yougoslavian and Roumanian resin

industry, his patents were utilized in the highly developed German, British and Italian industry, and Hungarian insulators were exported into these countries.

Balló travelled much, not only to amplify the commercial relations of Isola Ltd, but also to acquire informations on recent research results.

His industrial R + D activities were characterized by their high scientific level and by their novelty. His patents from that period reflect his comprehensive interests and successfull activities. Some examples: Process for manufacturing synthetic adhesive, No. 79,380 (April 25, 1921); Manufacture of water-tight ledge (1926); Process to manufacture coating materials protecting against rust, rot and putrefaction (bauxite—red lead) No. 991,383 (June 8, 1929); Shaving brush, No. 933,935 (January 14, 1935); Plastic box, No. 20,072/934, January 15, 1935; Brake shoe and brake lining, and process for their manufacture, No. B 12,489, February 15, 1935 (this became a world patent later); Crank press particularly for moulding plastics, No. 127,404, April 26, 1940; Bearing and bushing of plastic and process for their manufacture, No. 155,560, August 28 1942; Attachment process of sheet-like moulded plastic inserts, No. 10,0003, May 24 1944.

Upon the request of the Hungarian Electrotechnical Society he elaborated the first Hungarian standard for plastics, and—as second volume of the recommending bibliographies of the Central Technological Library—he prepared the bibliography of literature on plastics accessible in Hungary.

In addition to developing plastics systems satisfying exacting technological functions, Balló also wrote various papers on other subjects, for instance on aesthetics in the plastics industry for the journal Műanyag in 1939, which was published in full in British Plastics in the same year. Preceding the literature of the age, he wrote papers in 1939 on the economic significance of plastics, on the obligatory training of skilled workers and foremen in the plastics industry, in which he expressed views adopted only much later, in the mid-sixties, in countries with highly developed plastics industries.

Balló's experiences from the first stage of his scientific activities regarding the formation of minerals were also utilized at this period. He successfully solved the problem of optimum drying of bauxite, developed bauxite-asphalt road-surfacing systems and tube-moulding technology termed calorite.

The great moral teaching of this second stage of Rudolf Balló's life is that deprived of the possibility of an academic career he none the less found his way to creative activity by industrial research and development work and by developing a particular form of enterprise, and as the pioneer of the Hungarian plastics industry he left an indelible trace in the industrial development of the country.

The third period of Rudolf Balló's activities began in 1945 with the liberation of Hungary. He was rehabilitated in October 1945 and invited in October 1946 to lecture on chemical technology at the economic faculty of the

Technical University Budapest. In July 1947 he was honoured with the gold medal of the National Industrial Society for developing the plastics industry. In June 1948 the title of university professor was awarded to him for his merits in scientific literature and higher education. On March 23, 1949 he was elected honorary member of the Hungarian Scientific Society. From September 1949 he lectured on chemistry and technology of plastics at the Eötvös Loránd University and was appointed associate professor on May 4, 1950. In February 1952 he lectured at the Faculty of Chemical Engineering of the Technical University of the technology of plastics. In May 1952 he was elected president of the Plastics, paints and Rubber Section of the Society of Hungarian Chemists. On September 27, 1952, he was charged with organizing the Plastics and Rubber Department at the Faculty of Chemical Engineering of the Technical University Budapest, and on July 15, 1953, he was appointed full professor and head of department.

Nonwithstanding his age (Rudolf Balló was 69 at the time) he organized the department with great energy and mobility and created the conditions for successful work. Since the Technical University was unable to assign suitable rooms to the new department, Balló made an agreement with the Budapest Cable and Plastics Factory (today Electric Insulators and Plastics Factory), according to which the factory put laboratories and industrial equipment at the disposal of the department; in return, the department worked on the research and development problems of the factory and placed the results at its disposal. This type of teaching and research work, established much earlier than the university reform, was based on up-to-date principles. It was Balló's conviction that to prepare students successfully for life can be attained only by close cooperation with industrial plants. He felt that research without a background of industrial applicability was meaningless, while on the other hand, he considered applied research satisfactory only if it was performed with highest scientific exaction and circumspection. This is how he formulated the advantages of the department's and the factory's interpenetration in 1958: "Our agreement allowed to implement true practical training in technology. The students start in the laboratory at a flask scale, then continue on a model scale and finally manufacture, process and test plastics on the industrial scale. In this manner we educate engineers incorporated into industry and not estranged from it; their thesises for the final examination prove the correctness of their problem perception, their independent resoluteness and their sense of reality." As to the objective of research at the department, he wrote: "The technological department within the factory allowed an important research area: strength studies of composite plastics. This is a highly complex, novel research area, of interest not only for theory, but also for practice, since the knowledge of the factors defining mechanical strength properties will allow to raise the present strength level. This is of importance not only from the aspect of

economy with materials, but an efficient path towards modern light structures."

Balló's research program is timely at this stage too, because he perceived numerous problems much earlier than his contemporaries and urged their solution. He started a systematic study of the factors influencing the properties of heterogeneous plastic composites. By the systematic study of resin-yarn, resin-sheet and resin-multiple layer systems he laid the foundation of investigating the behaviour of one-, two- and three-dimensional reinforced systems. He systematically studied the breakdown mechanism of these composite systems, the interaction between resin and reinforcement and its importance on the mechanical properties of the system. He also investigated the properties of resins reinforced with spherical powders and milling products. He was the first to recognize that not only mechanical properties, but other, e.g. thermal properties of these systems can be optimized by deliberate planning of grain size distribution on the basis of the Fuller formula. His experimental techniques were characterized by simplicity and ingenuity. For light microscopy he developed a superb technique of preparing microsections, to be able to observe the true physical structure of multicomponent heterogeneous systems. He was a master of dyeing the different components, so that he could follow their position in the system. These experiences were implement in practice in the development of bushings for locomotives, of plastic pads to apply between the rails and prestressed concrete sleepers, of optimum composition for brake linings. On the initiative of the orthopaedic surgeon Professor Zinner he started work on plastic prostheses of neck of femur and other osteoplastic applications yielding X-ray contrast. Such plastic applications are at the present stage in the frontline of international interest.

Professor Balló recruited enthusiastic co-workers for organizing teaching and research at the department. Above all I wish to emphasize János Oravecz, a former co-worker at the Isola Ltd., who was leader of laboratory exercises and of the workshop at the department. From the Department of Organic Chemical Technology headed by Professor Zoltán Csűrös numerous co-workers came over to the new department: Dr. István Géczi, dr. Kálmán Juhász and dr. József Makádi. From the first generation of students at the department dr. Sándor Doszlop, dr. Ottó Kelemen, Mrs. F. Kőmüves, dr. Imre Molnár, dr. Imre Mondvai and dr. István Szőllősi stayed on at the department. Later, plastics specialists having studied at the Soviet Union complemented the teaching staff of the department (dr. Mária Azori, Mrs. F. Biró, dr. Gyula Hardy, Mrs. S. Molnár and dr. József Varga).

One of the important tasks of the department has always been to educate well-trained technological and economic leaders for the Hungarian Plastics industry. Hundreds of Professor Balló's pupils are at work in management and as scientists and technologists in the enterprises and utilize the knowledge and attitude learned from him.

Professor Balló retired from heading the department in 1960, but continued to remain the active guider of research at the department, notwithstanding his serious illness and confinement to bed, till his death (November 6, 1969).

His many hundreds of pupils and direct co-workers will never let his memory fade and will always remember their master with deep gratitude for the assistance and human kindness which they so frequently received from him. His career is an example for future generations. Further development of his life-work is our honourable, but far from easy duty.

Prof. Dr. Gyula HARDY H-1521 Budapest