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## 8. Paolo Corradini

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## Personalities in Polymers Science



Paolo Corradini

### Honoring Professor Paolo Corradini on his 70th Birthday

Paolo Corradini was the pioneer in the establishment of the correct structures of stereoregular polymers. He determined the structure of polypropylene, a helical structure, prominently seen in the most important natural polymers, poly ( $\alpha$ -amino acids), and nucleic acids. He also was instrumental in preparing and establishing the structures of many stereoregular polymers and copolymers. He is a renowned International scientist and a leader in polymer science in Europe.

Paolo Corradini was born in Rome, Italy, on October 19, 1930 as the second son (of three) of Corrado Corradini (headmaster and teacher of the local High School) and Bianca Pennacchi (teacher of the Elementary School). Young Paolo grew up in the district of San Giovanni of Laterano in Rome, where he went to Elementary, Middle and High School. He graduated in June 1946, three years earlier than the regular time. During the war, Paolo spent the school year, 1943–1944, away from Rome in a small village, Bellforte del Chienti, in the region Marche.

After graduation, he immediately enrolled in the University of Rome, studied chemistry and received the degree of Doctor of Chemistry in July 1951, *summa cum laude*. His thesis advisor was Professor Giordano Giacomello (who had as his Assistant Alfonso Liquori). The title of his thesis was "The X-Ray Structure of 1,1'-Cyclobutane-dicarboxylate".

In 1952, Liquori recommended Paolo Corradini to Professor Giulio Natta at the Politecnico in Milan. Paolo accepted the invitation and he joined Natta's research group.

The work was sponsored by the "Società Chimica Montecatini", at the Institute of Industrial Chemistry, Politecnico di Milano. Corradini's assignment was to perform X-ray studies on heterogeneous catalysts (ZnO based, for the synthesis of methanol) and solid semicrystalline polymers (free radical low density polyethylenes).

At this same year a collaboration started between Natta and Ziegler on linear ethylene oligomers, which could be obtained with aluminum alkyl catalysts, called the "Aufbaureaktion". The aim was to obtain higher molecular weight ethylene oligomers and the corresponding linear carboxylic acids which were used to produce soaps. High molecular weight polymers were discovered by the group of Ziegler at the end of 1953, through the catalytic combination of aluminum alkyls with titanium tetrachloride.

Soon thereafter, titanium catalysts for propylene polymerization were tried in the laboratories of Professor Natta. This was the start of a research project to produce elastomeric polymers through the copolymerization of ethylene and propylene. On March 11, 1954 Paolo Chini obtained a solid material in an autoclave polymerization trial with propylene alone and brought it upstairs to Paolo Corradini to examine it by X-ray diffraction. This was the starting point of the discovery and structural investigations of an entirely new class of crystalline polymers, stereoregular polymers of which polypropylene is the most important example.

Within a few months from the time this investigation started, Paolo Corradini solved the structure of polypropylene and established the chain conformation of crystalline isotactic polypropylene as a  $M_1$  helix with a repeat unit of 6.50 Å. This was the third major determination of polymer structures, which resulted in a helical structure, after the  $\alpha$ -helix of the poly ( $\alpha$ -amino acids) and the double helix of nucleic acids, and the first of helical synthetic polymer. This foresighted discovery was the basis of the structure evaluation of many synthetic crystalline polymers.

Corradini stayed in Natta's group until 1960 and evaluated the structure of many stereoregular polyolefins and polydiolefins. Natta received the Nobel Prize for polypropylene in 1963, in recognition of the fact that the monopoly of nature, to build macromolecules with ordered steric helical units, had been broken, but Corradini played a decisive part in his work.

In 1958, Corradini was awarded the "Libera Docenza", which is the equivalent of the title of an Associate Professor for his work on Structural Chemistry. In 1960 he

was appointed Full Professor of General and Inorganic Chemistry at the University of Cagliari. The University of Cagliari has been the stepping stone for many important appointments for Professors before they received a call to key Universities. Already in 1961, Corradini was called to the University Federico II of Naples as Professor of General and Inorganic Chemistry. He has been at the University of Naples since that time and now, since 1991, has held the Chair of Industrial Chemistry.

In 1968, Paolo Corradini spent one year abroad as Visiting Professor at the Polytechnic Institute of Brooklyn (Brooklyn Poly). In 1985 he spent half a year in Somalia, cooperating to the Italian effort to start a University in Mogadishu. Over the years, Paolo Corradini served also in key Professional Societies. For many years, from 1968 to 1979, he was a Member of the Macromolecular Division of IUPAC, and from 1989–1990 he was the President of the European Polymer Federation.

The contributions of Corradini were acknowledged in his home country.

In 1982 he received the recognition of "Benemerito della Scuola, della Cultura e dell'Arte" (*well deserving Citizen in the fields of School, Culture and Arts*) from the Italian "Ministero della Pubblica Istruzione". He also received the important annual Prize for outstanding Italian Scientists of the "Ministero dei Beni Culturali ed Ambientali" (1985), and a number of other prizes and medals from various institutions, among them the Giulio Natta medal of the Italian Chemical Society.

In 1987, he was elected a Corresponding Member of the "Accademia Nazionale dei Lincei" (the most important Italian Academy, of which Galileo Galilei was a founding member) and, since 1993, Corradini is a Full Member.

Paolo Corradini has served as Director of the Chemical Institute in Naples and as President of the Scientific Council of the CNR Laboratory for the Technology of Polymers in Naples for many years.

As mentioned above, the contributions provided by Paolo Corradini to the Science of Macromolecules started with the fundamental studies on the synthesis and structural characterization of stereoregular crystalline polymers of vinyl and diene monomers. Classical is the threefold helix conformation found for the chain of isotactic polypropylene. Numerous polymers have achieved a very large industrial importance, for instance isotactic polypropylene in the field of plastic materials, with a world production in 2000 of more than 30 million tons per year, and *cis*-tactic polybutadiene in the field of elastomers.

The studies on the structure and chain conformation of crystalline polymers have been extended subsequently by Paolo Corradini to the study of the compatibility of various types of statistical disorder (in the constitution, configuration and conformation of the polymeric chains or in the mode of packing of the chains among themselves) with the maintenance of some kind of three dimensional order and, hence, of crystallinity.

They have been extended also in the last fifteen years to a number of new stereoregular polymers which can be obtained with the newly discovered stereoselective homogeneous catalysts. They include syndiotactic and isotactic polymers of olefins, syndiotactic polymers of styrene and styrene derivatives, and tactic copolymers of carbon oxide and styrene both isotactic and syndiotactic.

More recently, a systematic analysis of models for the explanation of the stereoselectivity of Ziegler-Natta polymerizations has been undertaken, based on the evaluation of the energetic interactions between non-bonded atoms at the catalytic sites. General results have been obtained, which explain very well the stereoselectivity of the polymerization reaction on  $TiCl_3$  based and on high yield  $MgCl_2$  supported heterogeneous catalysts as well as on the homogeneous catalysts, based on metallocenes which have become popular.

The extensive scientific research of Paolo Corradini has resulted in more than 400 scientific papers and reviews. He has also written a number of text-books for High School and University students. He has served as a member of various Editorial Boards of Scientific Journals, including *The European Polymer Journal* and *Advances in Polymer Sciences*. He has been invited to give plenary and main lectures at several International Congresses and Symposia and at various institutions in various places around the world. He has also acted as a member of several Organizing Scientific Committees.

Paolo is not only a scientist par excellence but he has several most interesting and satisfying hobbies. Together with his wife Brista, he likes to play cards, in particular bridge on a high level and enters frequently bridge tournaments. He likes to listen to music, especially the opera, but also concerts, and holds season tickets at the "Teatro S. Carlo" in Naples. He collects minerals, and enjoys a walk every day and has to travel to Rome (on the occasion of meetings of the *Accademia dei Lincei*) every month.

In 1956 Paolo Corradini married Brista Griesbeck; they have two daughters, Patrizia

(43) and Maria Grazia (39) and two grandchildren, Simona (21) and Dario (18). Patrizia, together with her husband Mario and their children Simona and Dario, live in Rome. Maria Grazia obtained a doctorate in Chemistry, and lives with her husband Giorgio in Naples. They both are enthusiastic sailors.

This article was prepared by **Otto Vogl**, Herman F. Mark, Professor Emeritus, Department of Polymer Science and Engineering, University of Massachusetts, Amherst, MA, 01003-1350, U. S. A., and **Brigitte Griesbeck Corradini**, the wife of Paolo Corradini, via Caravaggio 70R, 80126 Naples, Italy.

## Photochemical & Biophysical Processes

Book Reviews  
Photochemical and Biophysical Processes  
Edited by R. F. Schuler and R. A. Creswell  
Plenum Press, New York, 1981  
Pp. 300, \$45.00  
This book is a collection of papers presented at the International Symposium on Photochemical and Biophysical Processes, held in Rome, Italy, in 1980. The papers are arranged in two main sections: Photochemical Processes and Biophysical Processes. The Photochemical section includes papers on the photochemistry of nucleic acids, proteins, and other biomolecules, as well as on the photochemistry of synthetic polymers. The Biophysical section includes papers on the photochemistry of photosynthesis, the photochemistry of vision, and the photochemistry of the atmosphere. The book is a valuable reference for researchers in the fields of photochemistry and biophysics.