Obituary

# Otto Wichterle (1913–98)

## Pioneer of biomedical polymers

**Otto Wichterle, who died on 18 August at the age of 84, was one of the driving forces behind the emergence of biomedical polymers as a distinct and thriving field of research. Over 40 years ago, Wichterle recognized that polymers to be used in medicine have to be designed and synthesized based on a sound biological rationale; and long before it became well accepted, he took an interdisciplinary approach to hypothesis formulation and problem solving. He will be remembered mainly as the inventor of the soft contact lens, an idea that blossomed into a billion-dollar industry. But his influence is felt on a much broader scale. Research on biomedical polymers has expanded in new directions, and among the results are 'smart' biomaterials, biorecognizable polymers and polymeric carriers of biologically active compounds.**

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**Wichterle was born in Prostějov, in part of the Austro-Hungarian empire that was to become Czechoslovakia, on 17 October 1913. He studied at the Technical University in Prague and obtained his PhD in organic chemistry under Emil Votoček in 1936. After graduation he became an assistant lecturer to Votoček while also studying medicine at Charles University. He was expelled when the German occupation forces closed all Czech universities in 1939. Fortunately, he was able to work in the research institute of the Bata Company in Zlín, where he developed the techniques for the polymerization of lactams. These techniques became the foundation for the Czech polymer industry after the Second World War.**

**Wichterle returned to the Technical University when the war ended, and in 1949 was appointed professor of macromolecular chemistry and technology. In the late 1950s he created a first-class basic research facility, the Institute of Macromolecular Chemistry of the Czechoslovak Academy of Sciences. Thanks to his leadership, many young scientists (including myself) received an excellent education. Wichterle worked hard and demanded the same from others. I recall his meeting with me and other first-year graduate students in the autumn of 1961, when, among other things, he told us: "Those of you who do not know more about your project than your supervisor within one year should leave at that time". Asked how we could achieve that, he replied: "Your supervisor has about ten graduate students and many other duties. You would not like to admit that you are ten times less efficient".**

**His career was interrupted again after the Soviet tanks crushed the 'Prague spring', a short period of liberalization in 1968. He was forced to work alone; nevertheless his patents generated more income than those of all the rest of the institute put together (the staff included more than a hundred holders of PhDs). After the 'velvet revolution' in 1989, which restored democracy in Czechoslovakia, he was elected president of the Academy of Sciences. When he resigned three years later, he was named honorary president.**

**Wichterle's scientific career started in synthetic organic chemistry. The laboratories of Votoček and Rudolf Lukeš where he studied produced many excellent chemists, including Vladimir Prelog, the Nobel laureate. Wichterle's contributions in this area cover monosaccharide chemistry, the chemistry of alkoxy-butadienes and dichlorbutadiene, diene additions, and polymerization of cyclic amides. His main achievement, however, was to open up the field of biomedical polymers to systematic research.**

**At the beginning of the 1950s, commodity polymers such as poly(methyl methacrylate) and Vinion 'N' (a copolymer of vinyl chloride and acrylonitrile) were beginning to be used for hard contact lenses and vascular grafts, respectively. At that time, Wichterle hypothesized that a polymer with properties close to those of living tissues would be compatible with such tissues, and suitable for use as contact lenses and other implants. Within a year, the first samples of hydrogels were synthesized by cross-linking copolymerization of 2-hydroxyethyl methacrylate and ethylene dimethacrylate. This work (*Nature* 185, 117–118; 1960) attracted the attention of scientists worldwide.**

**Wichterle also discovered the so-called spin-casting process for lenses using a children's construction set. In this method, a solution of monomers is converted into a hydrogel lens during a rotation of the polymerization mould. The optical properties of the lens depend on the shape of the rotating form and on the speed of rotation. Numerous modifications of the original hydrogel composition and soft-lens production process were made later, many of them by Wichterle himself. One such development was the technology of preparing soft contact lenses from a dry 'xerogel' by a lathing process, followed by swelling in water.**

**The transfer of the soft-contact-lens technology to the United States initiated intense interest in hydrophilic materials in general, and hydrogels in particular, to the extent that hydrogel studies were transformed into a whole new field. Among the fruits have been stimuli-sensitive hydrogels, which abruptly change their properties upon the application of an external stimulus, for instance pH, temperature, solvent or electrical field; such changes can be continuous or discontinuous (that is, involve phase transitions). These features give hydrogels potential as actuators or artificial muscles that can convert chemical into mechanical energy.**

**Hydrogels are also used as carriers for the delivery of drugs, proteins, or as matrices for enzyme or other protein conjugates. Hybrid hydrogels synthesized from synthetic macromolecules and engineered protein domains can be tailor-made for properties imposed by the structure of the particular domain. Moreover, the field is not restricted to crosslinked polymers. Hydrophilic water-soluble polymers are used for the targeted delivery of anticancer drugs, antisense oligonucleotides and genes.**

**Wichterle's devotion to science, his energy, creativity and courageous spirit, and his uncompromising stand against oppression of any sort, set an example which formed both the scientific careers and the character of his students and co-workers. All who had the privilege of knowing him will remember him as one of the remarkable scientists of the twentieth century. He was a great teacher, a great scientist and a great man.**

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