Obituary

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In Memoriam: Professor Bogdan Baranowski

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With deepest sadness we have to inform the Non-Equilibrium Thermodynamics Community that Professor Bogdan Baranowski passed away on June 29, 2014 at the age of 87.

Born October 27, 1927 in Kępno, he grew up experiencing hardships of war and occupation which formed his strong and brave character. Following his passion for chemistry, he studied his favorite discipline at the University and Technical University of Wrocław (1947–1951) where he started his scientific activity as an assistant to Professor Kazimierz Gumiński, Head of the Department of Physical Chemistry. Then he continued his work with Professor Gumiński at the newly established Department of Theoretical Chemistry at Jagiellonian University in Cracow until 1956 when he was invited by the Institute of Physical Chemistry of the Polish Academy of Sciences in Warsaw. He was nominated professor at the age of 37 in 1964. Professor Baranowski actively contributed to the Institute development as the Head of the Department of Physical Chemistry of Solids founded in 1964 on his initiative. At the same time he collaborated with the Institute of Chemical Synthesis in Tarnow applying Debye’s salt theory to a unique case of aqueous solution of electrolytes and urea. He found several complex compounds in the investigated system [1] and demonstrated the limits of the applicability of Debye's theory and proposed a new modified approach to the related problem.

Professor Baranowski was both a theoretician and an experimentalist; and in both fields his achievements are very significant.

Stimulated by cooperation with Ilya Prigogine, Professor Baranowski turned his research interests to the field of non-equilibrium thermodynamics. His pioneer theoretical and experimental research in linear and non-linear non-equilibrium thermodynamics resulted in explanation of transport processes in salts [2], in metals, in electrolyte solutions [3, 4] and in multicomponent systems [5], influence of chemical reactions on the distribution of components in a non-uniform temperature field [6] and the separation of components in a mixture [7]. Developing the theory of electrothermodiffusion, he showed the effectiveness of this method in the separation of both chemical compounds and isotopes. His discovery of the electrochemical analogue of the Bénard problem [8] improved our understanding of the role of chaos in electrochemical systems. Even such fundamental problems as the origin of life and its evolution were discussed in his work on dissipative structures. He published a large number of original papers related to these topics as well as a significant monograph “Non-Equilibrium Thermodynamics in Physical Chemistry” [9] edited in Polish and translated to other languages.

In 1958, Professor Baranowski made a discovery which dramatically influenced his further scientific activity. In his studies of hydrogen diffusion through the nickel membrane he observed the formation of a novel compound – nickel hydride – at the surface of the investigated nickel foil [10]. Immediately new questions were raised: can nickel hydride be synthesized directly from elements and at which pressure and temperature conditions? His decision to take up this ambitious challenge was a milestone in two research areas: high pressure studies and metal-hydrogen systems investigations. The first synthesis of the nickel hydride was reported in 1966 [11]. The apparatus for compressing gaseous hydrogen initially to 2 GPa (H_2) and then up to 3 GPa (30 kbar) was at these times (years 1966–1972) a very unique piece of equipment used by Baranowski and his group for direct syntheses of other metal hydrides, such as chromium hydride [12], manganese
hydride [13], aluminum hydride [14] as well as various hydrides of nickel based and palladium based crystalline and amorphous alloys [15, 16]. In cooperation with German and British researchers the electronic and magnetic properties of nickel alloyed with other 3d metals were measured (also in situ when it was needed) and interpreted. A surprising and important achievement was Baranowski’s finding that the volumes occupied by hydrogen in several transition metal hydrides have almost the same value which, in contrast to the host metallic lattice, is approximately constant during hydrostatic compression of hydride.

In 1975, systematic investigations of the influence of hydrostatic pressure on properties of hydrides (focused on their compressibility and search for pressure-induced phase transitions) were initiated under the leadership of Professor Baranowski in collaboration with researchers from Japan, Germany and the USA. Valuable new data were published for high pressure behavior of alkaline metal hydrides [17, 18], transition metal hydrides [19], rare earth hydrides [20], Laves phase hydrides and other. Important progress in organic syntheses by application of novel high pressure methods was accomplished in cooperation with Professor Jurczak [16].

His important contribution into thermodynamics of gases under high pressure inspired other researchers in Poland, especially in the Institute of High Pressure Physics PAS Unipress, to use compressed nitrogen for evaluation of thermodynamic properties of gallium nitride (GaN) followed by high pressure synthesis of the highest quality single crystals of GaN – one of the most important semiconducting compound nowadays.

Collaborating with research groups all over the world, he received many invitations from universities and scientific institutions. He was visiting professor at Mining Academy in Freiberg, where he lectured on irreversible thermodynamics (1971–1972), the University of Hannover, and the Solid State Physics Institute of the Max Planck Society in Stuttgart. He was also awarded a research grant by the Royal Society. On a sabbatical at the Technical University in Göteborg, he investigated the pressure-induced phase transitions in ionic crystals by using the scanning calorimetry under high pressure as well as x-ray diffraction on single crystals as a function of temperature. Results were published with his Swedish partners. This long and fruitful collaboration has been much appreciated and in 1983 Professor Baranowski received nomination of Honoris Causa Doctorate of Technical University in Göteborg.

While non-equilibrium thermodynamics was his favorite area of exploration, Professor Baranowski for a long time was strongly involved in other fields of study such as electrochemistry, metal-hydrogen systems, high pressure research, organic materials and ionic crystals. However, non-equilibrium thermodynamics was always close to his heart [21, 22]. In [21], extending his early results obtained in [9], Baranowski applied non-equilibrium thermodynamics to membrane transport and diffusion in elastic media with stress fields. He characterized the framework of linear non-equilibrium thermodynamics (LNET) by tracing the way of derivation of the phenomenological equations and presenting applications to membrane transport. He gave a theory of the active transport in terms of linear NET. He showed the importance of individual balance equations for the coupling of diffusion and viscous phenomena. Importantly, he illustrated the efficiency of his approach by the generalization of Prigogine’s theorem for the invariance of diffusional entropy production. The approach
indicated possible non-local phenomena due to stress fields. Moreover, by applying extended irreversible thermodynamics, he outlined a more general approach to membrane transport. Next, [23], he explored the influence of stress fields on diffusion in isotropic elastic media, i.e. developed thermodynamics of solids with stress fields. He gave an extension of the chemical potential to stress fields under the (experimentally proved) assumption neglecting the role of off-diagonal elements in the stress tensor. His attention was directed to stresses in the solid developed by a diffusing component, and non-local diffusion effects were verified by an original experiment. Effects of stresses on the entropy production were discussed with the conclusion that a stress-free steady-state obeys the minimum entropy production principle.

Professor Baranowski was the author or co-author of about 350 original publications including several monographs. More than 20 people got the PhD degree under his supervision. Some of them became professors and group leaders. They will never forget the encouragement, advice and inspiration received from Professor Baranowski during their research work.

Since 1991 Professor Baranowski was the Chief Editor of the “Polish Journal of Chemistry”. He also was a member of Editorial Boards of “Journal of Non-Equilibrium Thermodynamics”, “Journal of Alloys and Compounds” and “High Pressure Research”. He was devoted Editor and Board Member actively engaged in developing these journals and promoting them all over the world. At his 80th birthday Professor Baranowski was the Editor of ICHMS Conference Proceedings [24].

Baranowski’s outstanding achievements in various disciplines of science were highly valued by the international scientific communities. He was granted membership of the Polish Academy of Sciences, the German Academy Leopoldina and the Ukrainian Academy of Sciences. He significantly contributed to the activities of the Polish Chemical Society (President 1974–1979; Honorary President since 1997), German Chemical Society, Federation of European Chemical Societies, European High Pressure Research Group (EHPRG) and International Association for the Advancement of High Pressure Science and Technology (AIRAPT) as Vice President (1981–1985) and President (1989–1993). He was also Member of Warsaw Learned Society (since 1981, the year of renaissance of the Society), International Academy of Sciences (from 1986) and Deutsche Bunsen Gesellschaft für Physikalische Chemie (since 1989). For a long time he was also a dedicated Member of the International Steering Committee of International Symposia on Metal-Hydrogen Systems and then Honorary Member of this organization.

The novel ideas implemented by Professor Baranowski into several scientific areas and his impressive achievements were recognized by numerous honors of which the most prestigious are Marie Curie-Skłodowska Award (1973), Bourke Medal and Bourke Lecture by the Faraday Society (1973), Medal of Jędrzej Śniadecki by the Polish Chemical Society (1984), “August Wilhelm von Hofmann” Lecture by the German Chemical Society, Award of the Prime Minister of Poland (1994) and Bridgman Medal of AIRAPT (1995), the highest award of the international high pressure community.

Professor Baranowski’s unceasing curiosity in physical chemistry and phenomena occurring in extreme thermodynamic conditions kept him active in research during his whole life. He will remain forever in our memory as a great scientist, a strong character, sharp and critical brain, a bright and hard-working inspiring leader, a charming person and a true friend.

References


