

IN MEMORIAM

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Academician Ivan Kostov (1913-2004)

Academician Professor Ivan Kostov, the most senior (with H. Strunz) Honorary Fellow of the Mineralogical Society of Great Britain and Ireland, passed away at his home in Sofia, Bulgaria, on March 31, 2004 a few months after his 90th birthday celebrations.

He was born on December 24, 1913 in Plovdiv, the second largest Bulgarian city, not far from the imposing Rhodope Mountains. Even in his youth he showed a wide range of interests and talents. Through his close contact with the mountains he was fascinated by their beauty and they ultimately determine his life's calling as naturalist. In 1936 he graduated in Natural History at Sofia University, devoting himself to the study of the world of minerals and crystals. He began his career as assistant at the University's Institute of Mineralogy and Petrology.

In 1940-1945 he studied at The Royal School of Mines of Imperial College of Science and Technology in London, where in 1941 he received the D.I.C. diploma. The Second World War found him in the UK where he was forced to remain until the end of the military operations. He visited several mineral deposits and published some scientific papers in *Mining Magazine*. In 1945, after returning to Bulgaria, he was appointed Associate Professor at Sofia University where from 1953 he became Professor and Head of the newly established Department of Mineralogy and Crystallography. In 1961 he became a Corresponding Member of the Bulgarian Academy of Sciences, and in 1966, a Full Member. Recently he was made one of three

Honorary Members of the Academy. For a long period in his career he was Head of the Mineralogical Department of the Geological Institute, and from 1977 to 1982 was Director of the Institute. From 1974 he was also Director of the National Museum of Natural History in Sofia, up to his retirement in 1989.

During his long, creative, scientific life, Ivan Kostov wrote more than 280 papers, monographs and textbooks revealing a wide range of interests, which included the following: the characterisation of minerals and their genesis, crystallography, crystal morphology, crystal chemistry, geochemistry, systematics of minerals, mineral deposits and metallogeny. He provided detailed observations on many important minerals of magmatic, pegmatitic and metamorphic origin, on hydrothermal ores and of their alteration products, including sulphosalts and sulphides, zeolites and some of the main rock-forming silicates. He examined and developed original ideas on the paragenetic and crystallo-chemical trends in mineral formation, on epitaxial phenomena, on symmetry of crystals and crystal aggregates, on zoned distribution of important minerals and mineral groups and on the temporal and lateral fractionation of chemical elements in the Earth's crust, etc.

An early monograph by Kostov, *The Minerals of Bulgaria* (1964, in Bulgarian), written with his collaborators (V. Breskovska, J. Mincheva-Stefanova, G. Kirov), gives a significant overview on the accessible information on minerals in Bulgaria and on their deposits, and conditions of formation. In

the book he developed the basis for the mineralogical and metallogenic division of Bulgaria, extended in other publications to the entire Balkan Peninsula and SE Europe, acknowledging the interrelationships with geological development and the migration of tectonic and magmatic processes.

Starting with his first paper in 1939, devoted to crystallography and genesis of fluorite in the Mikhalkovo deposit, the crystal-morphological and crystallogenic analysis of minerals became a central theme of his work developed in numerous papers. He used crystal habits, controlled, on one hand, by the crystal structure (axial, planar or isometric) - genotype, and on the other by growth conditions (supersaturation, admixtures, growth mechanisms, etc.) - phenotype, as sensitive genetic indicators of mineral genesis. Special attention was also devoted to the evolution of crystal morphology and morphological zonality in mineral deposition.

A comprehensive original elaboration on the state of the art on these issues was given in his last monograph *Crystal Habits of Minerals* (1999), published when he was 86, written in co-operation with his son Ruslan I. Kostov. Together with a discussion on modern ideas and concepts, the book presents an exhaustive encyclopaedic overview on the available crystal morphological data for the most widespread minerals.

Ivan Kostov's book *Mineralogy* holds a special place in his works. Published in four consecutively revised and expanded editions in Bulgaria (1950, 1957, 1973, 1993), it was translated and printed in English by Oliver and Boyd, Edinburgh and London (1969), and in Russian by Mir, Moscow, (1971) as part of the Series *Fundamental Works of Foreign Scientists in Geology, Geophysics and Geochemistry*. This classic book on mineralogical science is very popular and can be found in most European university libraries. The mineralogical systematics in the book is based on an original geochemical-crystallochemical classification of minerals, created and developed by Ivan Kostov in the last decades, successively applied to all mineral classes, and

continuously complemented with updated information on newly discovered mineral species. His complex approach takes into account: (1) the geochemical characteristics of minerals, in which the anion composition determines the mineral classes, and the cation composition the associations of geochemically connected metal triads; and (2) the crystallochemical characteristics, in which the anisometricity of crystal structures determines the structure types (axial, planar or isometric), when the specific crystal structures determine the mineral groups. This classification, considering the structural features, is appropriate for the description and study of the real natural mineral parageneses and successions. A similar book by Kostov, *Crystallography*, was also published in four successive editions, Bulgarian (1955 to 1978) and in Russian (1965).

The important mineral class of the sulphides is thoroughly analysed in the monograph of I. Kostov and J. Minčeva-Stefanova: *Sulphide Minerals. Crystal Chemistry, Parageneses and Systematics* (1981), printed in Sofia, and later (1984) in Moscow in a Russian translation. Similar is his book on *Phosphate, Arsenate and Vanadate Minerals. Crystal Chemistry and Classification* (I. Kostov, V. Breskovska, 1989, Sofia).

Through his fascinating university lectures, his books and numerous publications, as well as by direct contacts with his students in the auditoria and in the field, Professor Ivan Kostov created generations of qualified and enthusiastic specialists in mineralogy, crystallography and geology. He was also invited to present lectures at many universities in different parts of the world. Also valuable are his contributions in popularizing scientific knowledge.

Ivan Kostov actively promoted the introduction of the modern X-ray, electron microscopic and microprobe methods in mineralogical research institutions in Bulgaria. He also made a considerable contribution to geological practice for the discovery, prospecting and evaluation of the mineral resources of manganese, copper, kyanite,

fluorite, etc. He was responsible, in particular, for systematizing the mineralogical collection of the National Museum of Natural History in Sofia and its expansion and enrichment with unique and valuable mineral specimens. Ivan Kostov was founder and first President of the Bulgarian Mineralogical Society (1990-1995) and then became its Honorary Life President.

With his erudition, activity and contributions Ivan Kostov enjoyed the widespread confidence and respect of the mineralogical community. He kept personal contacts with a number of eminent scientists of the 20th century, as a participant in numerous international scientific forums, in commissions, councils and excursions, as well as in extensive correspondence. Not being involved in any political activity, he was able to be very active in establishing and promoting scientific relationships between scientists of the East and West during the years of the Cold War. Ivan Kostov was among the founders of the International Association on the Genesis of Ore Deposits (IAGOD) in 1963, Vice-President (1972-1976), and the main organiser of the 4th IAGOD Symposium in Varna (1974). Particularly remarkable is his service rendered to the International Mineralogical Association (IMA). He was a permanent and active member of the Commission on New Minerals and Mineral Names (CNMMN) and national representative of Bulgaria in the Association. He was Chairman of the Organising Committee of the 13th IMA General Meeting in Varna (1982), First Vice-President (1978-1982), and President of IMA in 1982-1986.

Ivan Kostov joined the Mineralogical Society in 1944 and since 1973 was an Honorary Fellow. He was also an Honorary Fellow of the Geological Society (since 1966), and of the Geologists' Association of the United Kingdom (since 1978). He was a member of the Academy of Natural Scientists 'Leopoldina', Germany (1974), foreign member of the Russian Academy of Sciences (1982), and honorary member of the Indian, Czech, All-Russian and Ukrainian mineralogical societies.

Ivan Kostov was an authoritative member of the editorial boards of scientific journals, including *Mineralogical Abstracts* (since 1962), *Tschermaks Mineralogische und Petrographische Mitteilungen* (1969-1977), *Kristall und Technik - Crystal Research and Technology* (1964-1992), *Comptes Rendus d'Académie Bulgare des Sciences* (since 1978) and the key Bulgarian geological journals of which he was founder and Chief Editor of the *Geochemistry, Mineralogy and Petrology* Series (Sofia, 1975-1990).

A devout naturalist, active up to his last days, Ivan Kostov preserved throughout all his life his love and keen interests in plants, in animals and the whole natural world. He also had a liking for art, poetry, and philosophy. In his lectures and publications he often used vivid verses and quotations by classical and modern authors. He liked painting and in his free time created a gallery with lively portraits of the first Bulgarian mineralogists which he later donated to Sofia University. He was interested in the problems of human relations, the role of science and scientists in society and human progress. In his last years he was especially fascinated by the problems of the origin of life, by the possible mechanisms of creation of organic matter and simple living forms within thermal waters through crystallo-chemical interactions with mineral surfaces, especially of some porous minerals. His presented these insights in his last lecture, during the session *Minerogenesis-2004* held in January at the Bulgarian Academy of Sciences in Sofia and dedicated to his 90th Birthday celebrations.

The mineral kostovite, is named in honour of Ivan Kostov. The gold-telluride AuCuTe₄, was discovered by G. Terziev in 1966 in the famous Bulgarian Au-Cu deposit Chelopech, and then found in several other deposits. One of the few minerals of the noble metal, this is an unusual but well-earned reward.

The life of Ivan Kostov is an example of purposeful and dedicated service to science and society.

Ivan K. Bonev