

ANNIVERSARIES AND DATES



MIKHAIL GRIGORIEVICH VORONKOV

(On his 80th birthday)

Mikhail Grigorievich Voronkov – distinguished scientist and specialist in the chemistry of heteroorganic compounds and organic and physical organic chemistry – was born in Orel on December 6, 1921. In 1938 he entered the chemical department of Leningrad State University. In July, 1941, Voronkov joined the ranks of the defenders of the Fatherland as a volunteer, but in December of the same year he was demobilized after shell-shock. In 1942 Voronkov was evacuated from blockaded Leningrad to Sverdlovsk, where he graduated from the local university early. He then became a post-graduate at the Institute of Organic Chemistry, Academy of Sciences of the USSR (Kazan-Moscow); he returned to his home university at Leningrad, first as assistant and then as a senior researcher in the Department of Organic Chemistry (1944-1954), head of the Laboratory of Inorganic Polymers at the Institute of the Chemistry of Silicates, Academy of Sciences of the USSR (1954-1961), and head of the Laboratory of Heteroorganic Compounds at the Institute of Organic Synthesis, Academy of Sciences of the Latvian SSR in Riga (1961-1970). From 1970 to 1994 Voronkov headed the Irkutsk Institute of Organic Chemistry, Siberian Branch, Academy of Sciences of the USSR. In 1995 he became advisor at the Russian Academy of Sciences and headed the Laboratory of Heteroorganic Compounds at the same institute.

Voronkov's scientific life proved very successful. He was pupil of three celebrated chemical schools, headed by Academicians A. E. Favorsky, N. D. Zelinsky, and V. N. Ipatieff. While still a student, he was involved in the scientific investigations of Prof. S. A. Shchukarev and Assistant Professor V. I. Egorov, a close collaborator of A. E. Favorsky. Subsequently Mikhail Grigorievich was lucky enough to work under the leadership of Profs. Yu. K. Yur'ev and R. Ya. Levina at Moscow State University (collaborators of N. D. Zelinsky) and also B. N. Dolgov, who was pupil of V. N. Ipatiev (Professor at Leningrad State University). Having become a graduate student of Academician A. E. Favorsky and of M. F. Shostakovskii, future

Corresponding Member of the Academy of Sciences of the USSR, from 1942 Voronkov carried out research in the chemistry of alkyl vinyl ethers; from 1970 he continued this research at the Irkutsk Institute of Organic Chemistry, Siberian Branch, Academy of Sciences of the USSR.

At Leningrad between 1944 and 1948 Voronkov studied the reactions of sulfur with organic compounds. Research into the reaction of sulfur with phenylalkenes and phenylalkadienes became the subject of his thesis for his Candidate of Science degree (1947). These investigations, continued in 1962-1970 at the Institute of Organic Synthesis, Academy of Sciences of the Latvian SSR, led to the discovery of previously unknown classes of organosulfur compounds and many new reactions, one of which (the reaction of sulfur with arylchloroalkanes and arylchloroalkenes) was named after him. The results of these investigations are summarized in the monograph "Reactions of Sulfur with Organic Compounds."

From 1948 Voronkov's main scientific interests were concentrated on the chemistry of the organic compounds of sulfur. His first treatise in this region of chemical science went to press after only four years. He was the first in the world to undertake a systematic study of the heterolytic reactions involved in the cleavage of the S–O–Si group. These data formed the subject of his doctoral thesis (1961). Having started research into the biologically active compounds of silicon, he created a new region of silicon chemistry – bioorganosilicon chemistry. The treatises "Silicon and Life" (translated in the GDR and in Rumania), "Silicon in Living Nature" (translated in Japan), and "A Wonderful Element of Life" were devoted to this field.

His fundamental investigations in the chemistry, physical chemistry, biology, and pharmacology of silatranes and other compounds of hypervalent silicon (dragonoids, derivatives of lactams, amides, azoles, carboxylic acid hydrazides, etc.) have been widely recognized. Silatranes were a new class of physiologically active substances and have found widespread use in agriculture and medicine. For the creation and development of the chemistry of pentacoordinated silicon in 1997 Voronkov was awarded the State Prize of the Russian Federation.

Voronkov was the first to begin a study of organosilicon compounds containing a Si–H bond and the dehydrocondensation, reduction, and hydrosilylation of sulfur-containing organic compounds of silicon, heteroorganic silicon compounds containing the heteroatoms B, Al, Sn, Sb, P, As, Ti, V, Mo, etc. His investigations on organosilicon and silicon heteroorganic compounds have been expounded in seven treatises, published in the USSR, USA, and England. These include a fundamental treatise "The Siloxane Bond" and a three-volume work "Heterosiloxanes" published in Russian and English.

Voronkov has led a series of original fundamental investigations in the region of carbofunctional, unsaturated macrocyclic, high-molecular, and biologically active organosilicon and organic compounds. A special place in these investigations is taken by nitrogen-containing organosilicon compounds (derivatives of amino alcohols and amino acids, nitrogen-containing heterocycles) and also monomers and polymers containing nitrogen and sulfur atoms (separately or simultaneously) in the alkyl radicals at the silicon atom.

Voronkov used quantum-chemical and physicochemical methods extensively and at a theoretical level in the study of organic and heteroorganic compounds (IR, UV, Raman, and photoelectron spectroscopy, mass spectrometry, ^1H , ^{13}C , ^{15}N , ^{19}F , and ^{29}Si NMR, NQR, ESR, dielectric constant measurement, refractometry, X-ray crystallographic analysis, the Kerr effect, calorimetry, polarography, and others) for investigation of the molecular structure and electronic structure of heteroorganic and organic compounds. In particular fundamental investigations of chlorine-containing organosilicon compounds were carried by nuclear quadrupole resonance. Here for the first time a relation was established between the ^{35}Cl NQR frequency and the electronic effects of the substituents at the central C, Si, and Ge atom and also the length of the polymethylene chain in aliphatic mono- and dichlorides. The use of ESR in biochemistry and in medicine did not remain unnoticed.

Voronkov was attracted by new types of organosulfur compounds – sulfur-containing macroheterocycles, thioaldehydes and thioketones, α -halo thioketones, α -halo gemdithioles, dithiirane derivatives, condensed heterocyclic systems, 1,2-dithiolene-3-thiones, derivatives of arylheteroacetic acids (effective biostimulants and adaptogens), organic derivatives of germanium, tin, phosphorus, and fluorine. A series of investigations was devoted to the high-temperature synthesis and thermal transformations of

organosulfur compounds involving thiyl radicals. The discovered cleavage of the C–O–C, C–O–Si, and Si–O–Si groups by trimethyliodosilane is now widely used in organic and organosilicon synthesis.

During investigation of the liquid-phase transformations involving silanols, taking place under mild conditions, Voronkov discovered new reactions involving the cleavage of Si–C and Si–O bonds in peralkyldisiloxanes by gallium and indium triiodides and tribromides, which take place through the intermediate formation of dialkylsilanones. It was found that dialkylsilanones are intermediates in a series of organosilicon reactions, e.g., in the reaction of organylchlorosilanes with DMSO and the oxides of certain metals, the electrochemical reaction of diorganylchlorosilanes with superoxide or peroxide anions, etc. These investigations resulted in a new theory for the processes involved in the formation and destruction of siloxane structures with silanones as intermediates. Organosilicon superbases of the $XCH_2Si(OCH_2CH_2)_3N$ type ($X = N, O, S, Cl$, etc.) were discovered and actively investigated.

A series of investigations by Voronkov was devoted to the organic compounds of germanium and tin. He has the honor of discovering the class of chelate complex organic compounds of pentacoordinated germanium – organogermatranes – and studying their physicochemical characteristics and biological activity. A valuable contribution to organotin chemistry was made by his investigations devoted to compounds containing a stannane bond (Sn–S) and a hypervalent tin atom and to homolytic addition to alkenylstannanes, to the possibilities of using organotin compounds in organic synthesis, and others. The use of the compounds of elements such as Si, Na, K, Mg, Hg, B, Al, Ga, In, Ti, P, As, Sb, Se, Te, V, Mo, Fe, Co, Ni, and platinoids was examined in numerous publications.

Voronkov worked up the processes involved in the hydrophobization and surface modification of materials with organosilicon monomers and oligomers in both theoretical and applied aspects. A series of Voronkov's developments have been introduced into industry, agriculture, and medicine (biostimulants, adaptogens, catalysts for microbiological synthesis, hydrophobic and bioprotective organosilicon coatings, sorbents, and ion exchangers, special materials for microelectronics, a universal aqueous quenching medium, lubricant additives, polymers that reduce hydrodynamic resistance, materials for special technologies, etc.). Under Voronkov's leadership a series of medicinal products not having analogs in world chemistry were created (feracryl, argacryl, acyzolum, trecrezan, silacast, silimine, dibutyryne, cobazol, sibusol, etc.).

In 1982 after the creation and introduction of polymolecular organosilicon compounds Voronkov was awarded a State Prize of the Ukrainian SSR, and in 1983 he was awarded the title of "Honorary Chemist of the USSR;" his name was placed in the "Book of Honor" at the Ministry of Chemical Industry of the USSR. In 1991 for the creation of organosilicon materials for microelectronics he was awarded the Prize of the Council of Ministers of the USSR.

The results of more than half a century's investigations by Voronkov are reflected in more than 2000 scientific papers (200 of which were published abroad), 37 monographs (15 of them published in the USA, England, the Federal Republic of Germany, Japan, the Democratic Republic of Germany, Poland, Rumania), and also 60 reviews published at home and abroad, and many popular scientific articles. He has about 500 author's certificates of the USSR and more than 50 foreign patents.

Among M. G. Voronkov's students there are 30 doctors of science and more than a hundred candidates of science.

Voronkov combined his vigorous scientific work with great scientific management skills and social activities. For a quarter of a century he headed the Irkutsk Institute of Organic Chemistry of the Siberian Branch, Russian Academy of Sciences of the USSR. From 1973 to 1984 he was Vice-President of the Presidium of the East-Siberian Branch (later the Irkutsk Scientific Center of the Siberian Branch, Academy of Sciences of the USSR). From 1982 to 1989 he was general director of the Scientific-Production association "Khimiya." From 1965 he was Vice-Chairman and from 1986 Chairman of the Scientific Council of the State Committee of the USSR on science and technology (later the Ministry of Industry, Science, and Technology of the Russian Federation) on "Chemistry and technology of organic compounds of sulfur." He is also a scientific-technical expert at this ministry. In 1966 Voronkov was elected Corresponding Member of the Academy of Sciences of

the Latvian SSR and in 1990 active member of the Academy of Sciences of the USSR (the Russian Academy of Sciences). Voronkov is a member of three departments and two scientific councils of the Russian Academy of Sciences, the editorial boards of the "Journal of General Chemistry" and three international journals "Journal of Organometallic Chemistry," "Synthesis and Reactivity in Inorganic and Metal-Organic Chemistry," and "Chemistry of Heterocyclic Compounds" and also the international electronic journal "ARKIVOC."

Voronkov was one of the organizers and Vice-Chief-Editor of the journal "Bulletin of the Academy of Sciences of the Latvian SSR, Chemical Series" and "Chemistry of Heterocyclic Compounds," a member of the editorial teams of "Organometallic Chemistry" and "Siberian Chemical Journal," compiler and managing editor of the six-volume "Chemistry and Practical Application of Organosilicon Compounds" (Leningrad, 1958-1961) and the textbook "Advances of Organosilicon Chemistry in the USSR" published in English (Moscow, 1988).

International recognition of Voronkov's scientific contributions was marked in his election as Foreign Member of the Latvian Academy of Sciences (1992); corresponding member of the Braunschweig Scientific Society (Federal Republic of Germany, 1976); doctor *honoris causa* (Poland, 1975); member of the chemical societies of Japan and Latvia; member of the International Society of Research into the Environment and Health Protection SIRES (France); active member of the Asiatic-Pacific Ocean Academy of Materials (1998); Honorary Member of the Florida Institute of Heterocyclic Chemistry (USA, 1998). He also received the medal of the Academy of Sciences of the Mongolian Peoples Republic and the order of the "Polar Star" and the "Friendship" medal from the Great Peoples Hural of the Mongolian Peoples Republic.

In the number of citations in the world literature in 1981-1985 (Scientist, 1990) Voronkov was second among chemists of the USSR (1981-1990) and third among world scientists. According to data from the Internet, 1981-1997, he was fourth among all Russian chemists.

As member of the organizing committee and plenary lecturer Voronkov has taken part in many foreign international symposia and conferences and in nearly all the international symposia on organosilicon chemistry. He presented papers at the fortieth Nobel Symposium (Stockholm), of which he was member of the consultative council, at the twenty fourth congress of IUPAC (Hamburg), at eight international symposia on the chemistry of the organic compounds of sulfur, and others.

Voronkov was awarded orders of the "Great Patriotic War," "Labor of the Red Banner," "Friendship of Peoples," and "For Service to the Fatherland" and 18 medals.

Voronkov's chronological age in no way corresponds to his biological age – he is distinguished by prodigious capacity for work, an abundance of original scientific ideas, breadth of scientific interests, a high level of erudition, a benevolent attitude toward colleagues and collaborators, and inexhaustible humor. M. G. Voronkov continues active scientific work at the Irkutsk Institute of Chemistry, Siberian Branch, Russian Academy of Sciences. He is an adviser at the Russian Academy of Sciences and a consultant at a series of chemical enterprises, scientific centers, and institutes in Russia, Ukraine, China, and Mongolia.

B. A. Trofimov

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