## THE SCIENTIFIC CONTRIBUTION BY PROFESSOR O.A. REUTOV TO ORGANOMETALLIC CHEMISTRY

On September 5th 1985, Professor Oleg Aleksandrovich Reutov, an eminent scientist in the field of physical organic and organometallic chemistry and a full member of the Academy of Sciences of the U.S.S.R., will celebrate his 65th birthday.

Professor Reutov was born in 1920 in the Ukrainian town of Makeevka. After graduating from the Department of Chemistry at Moscow State University in 1941 he volunteered to defend his country in the Second World War. For four years he served with distinction in the Soviet Army and in 1945 returned to the University and began his research work as an assistant to Professor A.N. Nesmeyanov. In 1948 he qualified as a Candidate, in 1953 was awarded a Doctor of Sciences degree and only a year later he was appointed as a Professor at Moscow State University. In 1958 O.A. Reutov was elected a Corresponding member of the Academy of Sciences of the USSR, and became a full member in 1964.

Presently Professor Reutov holds the chair of Organic Chemistry and is head of the Laboratory of Physical Organic Chemistry at Moscow State University and the Isotope Organic Chemistry Laboratory at the Institute of Organoelement Compounds of the Academy of Sciences of the USSR.

Professor Reutov is one of the most productive chemists at present active. Since he started in 1948 he has published more than 1000 items, including 6 books and 40 review articles. The range of his scientific interests is very broad and covers many topics of organic, physical-organic and organometallic chemistry. He is one of the pioneers of the foundation and development of physical organic chemistry through his studies of reaction mechanisms of organometallic compounds. Novelty, a rare ability to identify cornerstone problems of contemporary science, and the ability to make a coherent picture from scattered observations are characteristic of Professor Reutov.

In the early 50s when Prof. Reutov started his scientific research the concepts of organometallic reaction mechanisms had not been developed at all. Those on reactivity at that time were only based on organic model compounds and specifically on the two classic mechanisms of nucleophilic substitution: namely the concerted $S_N2$ and the non-concerted $S_N1$ processes involving carbocationic intermediates. Even at that time O.A. Reutov appreciated that for a complete picture there lacked two equally fundamental mechanisms involving electrophilic substitution, namely a concerted $S_E2$ and a non-concerted $S_E1$ process involving carbanionic intermediates, and he was one of the first to make use of new ideas in mechanistic studies of organometallic compounds. The polarity of the carbon–metal bonds in organometallic compounds matches better with the requirements of electrophilic substitution.

His ability to solve a number of problems by one deeply reasoned and carefully

designed experiment is combined with an ability to recognize quantitative and qualitative boundaries between similar but distinct phenomena. The obvious gap between the two boundary cases ($S_E1$(N) and $S_E2$; for the latter, O.A. Reutov suggested the "$S_E2$-rule": the rule of retention of steric configuration) was later filled when he discovered the intermediate ion-pair mechanism of electrophilic substitution $S_E2$(i.p.). Since the actual observation of possible versions of the $S_E$-mechanisms depends on the stability of the relevant carbanion O.A. Reutov by doing what could not have been done for the chemistry of carbocations, combining kinetics with thermodynamics: $\lg k = f(pK_a)$, established a universal polarographic acidity scale for CH acids, covering a $pK_a$ range from 0 to 60 units and this proved to be very useful in practice. This scale was based on the correlation of electrochemical reduction parameters for $R_2Hg$ with CH acidity of RH ($pK_a = f(\alpha E_{1/2})$). Together with the development of concepts of nucleophilic catalysis and the thorough investigation of factors governing competitive *C*- and *O*-alkylations of ambident ions and ion pairs, this constituted a new branch of physical organic chemistry, namely physical organometallic chemistry. Sir Christopher Ingold, who appreciated the work of O.A. Reutov very much, wrote in a review on one of Reutov's books that Professor Reutov and his pupils "developed... a school of reaction mechanism in the organometal field" which "brought into routine employment the physical methods on which such a subject must experimentally depend". *

Professor Reutov carried out many investigations of the reactions of a wide variety of saturated and unsaturated (olefin and acetylene), aryl, heteroaryl and alkylaryl derivatives of a number of non-transition metals (Hg, Sn, Ge, Si, Tl, ...) with a wide range of traditional ($H^+$, $Hal^+$, $Alk^+$, $Ac^+$, $M^+$, ...) and less traditional, or new, reactants (TCNE, $RS^+ X^-$, imonium salts, $BrONO_2$, zerovalent metals, Hg, Pd, Pt, and carbenoids, etc.). These studies often led to the discovery of new preparative synthetic pathways for many organic and organoelement compounds of various types. Among these were metallation of phosphorous ylides, synthesis of organic derivatives of Hg, Sn, As, Sb, Bi from diaryliodonium salts, preparation of bi- and oligo-metallic chains of Pt and Pd derivatives and of chelate metallocycles (including chiral species), alkylation and metallation of nitroarenes, aromatizing metallation of methylenecyclohexadienes, hydride abstraction from ethylorganometallic systems, conjugated and vinylic metallation and generation of a novel type of species, the "organic calomels" with $10^{-2}$–$10^{-4}$ s lifetime. Reutov is a master of isotopic studies having used D, T, $^{13}C$, and $^{203}Hg$ for probing reactions and uncovering new mechanisms. (It is relevant to note that the astonishingly rapid development of the chemistry of transition metal organic derivatives and catalysis by complexes of these metals was to a large extent made possible by theoretical concepts and methodological studies in the chemistry of organic derivatives of non-transition metals). Professor Reutov has also carried out much research in other fields of organic chemistry, in particular he studied free radicals and carbocations and discovered many new types of hydride and skeletal rearrangements.

Alongside his intensive scientific work Professor Reutov has always paid much attention to teaching. He is a gifted lecturer and this is much appreciated by his students. He also continues to guide them after graduation. He created a school of

* C.K. Ingold, J. Organomet. Chem., 16 (1969) 520.

chemists, which has produced 10 Professors and Doctors of Science and more than 100 Candidates of Science, who work all over the U.S.S.R.

Professor Reutov has been awarded several major scientific prizes, including the Lomonosov prize (1956), the Butlerov prize (1961) and the Lenin prize (1984), the highest scientific award in the U.S.S.R. He has received 8 decorations from the Soviet State, including combat awards. Having fought in the Great Patriotic War from its beginning he knows the value of peace, Professor Reutov is an active member of the Pugwash movement of scientists for the world's peace and Vice-President of the Soviet Committee for preservation of peace. His public activities include memberships of various All-Union and International scientific organizations and committees.

Professor Reutov in addition to being a distinguished scientist is also a very charming person and everybody enjoys his company. All his pupils, friends, and colleagues, and others, who contributed to this special issue dedicated to him, wish Professor Reutov good health and the continuation of his optimism and creativity for many more years to come.

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