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A celebration of inorganic lives

Interview with Konstantin Yatsimirskii

Vitaly V. Pavlishchuk *

Department of Chemistry, Drexel University, Philadelphia, PA 19104, USA

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Abstract

Konstantin Borisovich Yatsimirskii, Academician of the National Academy of Sciences of Ukraine (NASU) is a prominent scientist in physical, inorganic, analytical and bioinorganic chemistry, the winner of the Ukraine State Prize, the USSR Academy of Science L.A. Chugaev Prize, and the NASUs L.V. Pisarzhevskii Prize. The Czechoslovak Academy of Science J. Heyrovsky Gold Medal was awarded to him. He was elected Doctor honoris causa of the Wroclaw University and is an honorary member of the Polish Chemical Society, Corresponding Member of the Accademia Peloritana dei Pericolanti (Messina, Italy), Honored Prof. of the International Scientific Foundation. He is the author of over 1000 academic works, including 24 monographs and handbooks. He is the founder and head of the national school of coordination chemistry in the Ukraine. Among his disciples are 16 doctors and 55 candidates of sciences.

V.V.P.: Let's begin from the very beginning: tell us please, about your parents, your childhood. What do you think about the role of the genetic factors and propensities that influenced your destiny as a scientist?

Regarding my genealogy, both my grandfathers were priests of the Russian Orthodox Church. However, not all of their descendents have chosen the religious path. My parents were representatives of the middle class, referred to as the intelligentsia in Russia. My father—Boris Mikhailovich Yatsimirskii—was born in 1891

* Tel.: + 1-215-8951697; fax: + 1-215-8951265; e-mail: vp27@dunx1.ocs.drexel.edu.

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and in 1914 graduated from the Department of History and Philology of Kiev University with a silver medal for an essay in the field of Ukrainian ethnography. In general, the destiny of several generations of the Yatsimirskii family is connected with this University. My father graduated from this University, I taught some courses at the University between 1962 and 1981, my son and both my grandsons graduated from this University. My father was a well-known cataloger of Ukrainian customs and an expert in the field of Ukrainian ethnography, in the field of Ukrainian dialectology, and Slavonic languages—Ukrainian, Russian, Polish and Czech. My mother was a medical worker, the perfect medical assistant. She graduated from medical assistant's so-called Samaritanian courses. She worked in hospitals in and around Kiev, and during the First World War she worked in a military hospital. After that, she also worked some time as a teacher. My mother was a person of strict principles and extremely dependable.

V.V.P.: Why did you first choose a speciality of forestry?

My parents constantly inculcated in me a love of teaching, knowledge and science, and it seems they have succeeded in it. In particular, my father told me when I was 6 years: "Become a teacher. We do not live eternally and it is necessary, that our ideas, our image of actions will continue to live after our demise". From this point of view my father considered the speciality of the teacher as very important, as when the teacher puts into heads of students something new, he also puts a part of himself and thus lives after his death in the heads of his students, in their actions, their propensities and so on. My parents were not chemists and it seems that my predilection for chemistry appeared purely casually.

However, my inclination to research and teaching were not casual. My father was, in his nature, a researcher. I remember well because in 1928–1929 my father collected materials on the dialectology of the Ukrainian language and tried to involve me in this study. It was very interesting. We processed a huge amount of material concerning the spelling of different words or phrases and made an appropriate dialectological map. We discovered that with this map, one can see a good correlation between the borders separating different ancient tribes living 1000 years ago in the Ukraine, and appropriate dialects of the Ukrainian language. Thus, I am convinced that the inclination to research and to teaching was transferred genetically.

My father was a teacher/researcher. Mother, as I already told you, was also a teacher for some time. During my life I taught many disciplines, from my childhood when I was engaged with peasants and workers in eliminating their illiteracy, and finishing when I was a Prof. at Kiev University and then the Moscow Physical Technical University (its Kiev branch). I frequently recollect my childhood in Boyarka, near Kiev, where my father was a director of the apiculture technical school, in which post-graduate students of Kiev University engaged in half-time employment. I was highly impressed by one of them—a botanist Khoma Yu. Roodenko. He taught me how to manipulate a microscope and how to prepare slices of plants for examination, etc.

Once I was given the task of finding a rather rare plant—*Gentiana pneumonante*—in the woods. I searched for it for approximately 2 days. I slept badly because, even in dreams, I wondered where I could find it. Eventually, to my great pleasure, I found a large field filled with flowers of this plant. This was apparently my first research work and I was 9 years old.

Speaking about inclinations, in contrast to my father, I had no desire to be engaged in humanitarian sciences and nor did my father encourage me to. I had interests in natural sciences; primarily biology, more precisely botany. It was incorporated in me from earliest childhood, and remains one of my main interests.

The interest in chemistry awoke in me around 1928–1929. However, when I was 15, I contracted an unpleasant lung disease and I had to figure out for myself some employment which would be consistent with such lung disease. My parents categorically were against chemical technical school, which had attracted me. So I applied to a forestry technology school in Cherkassy. Later, this school moved to Chuguev near Kharkov. I graduated from this technical school in 1934, receiving a speciality as a forester. The forester should know dendrology—science about trees—as well as botany and have a huge knowledge of the life of plants, forestry, methods of their cultivation and a lot of other things. This study and work in forest management helped to strengthen my health, since I worked in the most perfect natural conditions. For instance, I worked in a forested area near Kharkov and then in Aman-Kutan, a small Muslim village in the Pamir-Alay mountain system in Central Asia. This is thousands of kilometers from the Ukraine. I worked there as a researcher of the so-called Uzbek forest experimental station (UzLOS). There I began my research activity and published my first investigational paper in the area of forestry. After 5 years of this life I spent in the woods, it appeared that my health was completely normal and I had no problems and difficulties with it. Thus, forestry was my passion and even side track in my professional activity. After finishing my work in Aman-Kutan in Uzbekistan, I applied to the Department of Chemistry of the Central Asian State University (CASU) in Tashkent and here I carried out my second dream of becoming a chemist.

V.V.P.: Why did you decide to leave forestry after publishing your first paper in forestry and devote your life to chemistry?

The work in UzLOS was very well paid for those times, it was so good that I earned in general more than a professor of university or than my father who was a senior lecturer of the pedagogical institute. When I arrived at university a lot of students asked me why I entered university, because from the point of view of prosperity it would give me eventually nothing, as the salary of a professor was lower than the salary of a forester. Of course forestry, from my viewpoint, is an attractive speciality but it has a very serious and incorrigible drawback. I am impatient; for me it is necessary to see the results of my work; experiments should come to fruition in the shortest term. In forestry, this is nearly always impossible. Sometime in the 19th century, a very original, interesting and promising way to

plant oak was created and only after 60 years did it appear that all oak trees planted with this technique perish. I felt awestruck: the scientist works, has made an invention—new technology for the cultivation of oak woods—but after his death 60 years later, this work is doomed to failure. The entire oak woods planted over 60 years by this technology were doomed.

I would like to engage in activity where I could see the results of the experiment in the shortest terms. Chemistry has attracted me as such a discipline in which I also took great interest at school. It attracted me somewhere from my initial school classes when I became acquainted with the basics of this subject and then in senior school classes when I was actively engaged in chemistry. I well remember obtaining once a silver acetylenide, by passing acetylene through a silver nitrate solution. I filtered the deposit and spread it out carefully on a window sill for drying. When my mother was cleaning the house and asked me what the deposit was, it all exploded at that moment. This accident showed me that there is a terrible chemistry and terrible consequences with careless performance of some experiments. Nevertheless it was pleasant to me. It attracted me because within a day or two or even within some hours I could get results, while in forestry I prepared the result for my grandsons, and that only by careful preservation of the documentation begun with planting.

V.V.P.: Well, you became a student of Central Asian State University (CASU). What was the spirit there?

CASU was a rather unusual university. In pre-Revolutionary times, the huge Asian territory occupied by Russia in the 19th century was referred to as Turkestan. Subsequently, more historically logical states such as Uzbekistan, Kazakhstan, Kyrgyzstan and Tadjikistan appeared in this territory. But in all Turkestan, which from the south to north and from east to west spread for many thousands of kilometers, there was no high school. Thus in the 1920s, under the Head of the Soviet Government—Lenin's initiative, in Central Asia the Central Asian State University (CASU) was founded. Several railway trucks with literature, chemicals and equipment were sent there from Russia. The best buildings of Tashkent were given to CASU. The best professorate of Moscow and St. Petersburg in Tashkent arrived and there began to arise new scientific schools. It is natural that in the beginning all classes were conducted in Russian, and only in the 1930s teaching in the Uzbek language began. The CASU's professors represented the best of Russian intelligentsia, and even the Russian aristocracy. The University community was unusual. Highly educated professors gave excellent lectures, attracting students with science and knowledge. The work conditions and study in CASU were very good. We had an excellent library, and an outstanding set of reagents, allowing us to work at a good level. Quite early on, I had my private workplace in the laboratory; and a desk with a drawer with lock and a key. I could come to the laboratory to work when necessary: from early morning till late night. Nobody impeded me and I could work even at hours when my presence at the laboratory was not obligatory

under the schedule. We had ideal conditions for dialogue between students and professors of the department, as the university was small. I well remember the chair of Physical Chemistry. We, together with the professors and mentors, made trips to the foothills of Tyan-Shan on the river Chirchik, where we had many interesting discussions of various problems. Thus unusual yet good conditions were created there, in spite of the fact that it was the 1930s, which were hard and dangerous years; the years when Stalin's terror was displayed largely here in Ukraine and in Russia. In Uzbekistan all this was softer, though waves of terror reached even there. Professorate with aristocratic roots did not suffer but the time was very hard and many of my friends in those times did suffer.

V.V.P.: What played the main role in your choice of a speciality—the personality of the teacher, conditions in the chair (scientific school) or appeal of a given area of knowledge?

Two prominent chemists worked in CASU at that time and they subsequently became academicians. One of them was my teacher—Prof. Mikhail I. Usanovich—who was born in Zhitomir city (Ukraine), not far from Kiev, and the other was Prof. Isaak P. Cukerwanik—an expert known in the field of organic chemistry by his investigation of the Friedel–Crafts reaction. The chair of inorganic chemistry was held then by Associate Prof. Eugene J. Pozner. He was a rather singular person and was very interesting, being a pre-Revolutionary professor trained under Prof. Alfred Werner in Zurich. At the lectures and conversations with us that proceeded in a very relaxing way, he told us a lot about the spirit in Werner's laboratory and about its personnel, who took such a great interest in coordination chemistry. He told us about meetings with Werner after he received the Nobel Prize. So the chemical community at CASU was composed of very interesting people.

My teacher, Prof. Usanovich—an outstanding scientist with a worldwide reputation—taught me: "You have to choose a chair for further specialization, taking into account not only what subjects are taught there and its mentors. You should also consider who is working there, who is the Head of the chair, whether a scientific school exists and if there is, what is its quality". From this point of view, I consider that I have made the right choice: I have become a physicochemist and I have obtained a chair where there was a perfect community, the scientific school, my chief and teacher Prof. Usanovich. Physical chemistry, from all the chemical sciences, was most attractive to me because chemical knowledge about different exotic conceivable and unexpected reactions combined here with calculations based on physics and mathematics—this I loved very much and this helped me in those times of my life, when I could not be engaged in experimental chemistry. However, it should be said that the organic chemistry chair was also very interesting, and my first paper in the field of chemistry was devoted to organic chemistry.

V.V.P.: Your Major degree work was graded as a candidate dissertation (the Ph.D. equivalent in Western countries). How did you manage to achieve such a result?

This case was rather unusual for me. Since then, I have not met any similar cases. In 1940 in Leningrad, an anniversary of the Russian Mendeleev Chemical Society was celebrated. My teacher and I announced here a lecture entitled ''Aprotic acids and bases'', devoted to the Brønsted-Usanovich-Lewis theory. It is natural that everyone expected that at such a solemn assembly, in which prominent metallurgist and chemist academician A.A. Baikov gave a lecture, our report would be given by Prof. Usanovich. However, what a surprise, when instead of him they saw the unknown fourth-year student Yatsimirskii making a report on his own, on behalf of Prof. Usanovich. Well, frankly I did not realize what danger I was in. Really, in the hall were scientists well-known not only in Russia but also beyond its borders: Profs. A. Favorskii, V. Ye. Tishchenko, V.G. Khlopin, A.A. Baikov and others. Some of the professorate from Leningrad tried to dissuade me from giving a lecture: they told me that I should become confused under the influence of such an audience, and so could not make the report and it would cause a trauma for all my life.

Nevertheless, Prof. Khlopin, a founder of Soviet and Russian radiochemistry insisted that I gave the lecture. I read the report, and read better than was expected because I did not realize what celebrities I was reading to. At first they wanted to omit questions, being afraid that I would get into a difficult situation. A few simple questions were asked. However I started a rather brisk discussion.

Afterwards Prof. Khlopin, already an academician, approached me and asked: ''Do you know what you have reported?''. I answered: ''Certainly I know, it is a report on aprotic acids''. He responded ''No, you have formally reported a Ph.D. dissertation, since all that is necessary here for it is a topical theme, completely original in its solution and a large amount of experimental material''. I thought that this conversation was more for encouragement. After some time, I was invited in Tashkent to the CASU administration and was informed that an inquiry had arrived from the Committee on Higher School Affairs. This inquiry permitted me to defend my Major's diploma work as a candidate dissertation (this corresponds to a Ph.D. at Western universities). This was completely unexpected, and I started urgently to prepare to receive this degree. It was necessary to pass over five examinations on a very wide program, and to submit some papers to journals. I remember well, that after very complex examinations, and the writing of the dissertation, I presented it for defense on June 21, 1941, i.e. 1 day prior to the beginning of war between Germany and the Soviet Union (the Great Patriotic War). June 22; the War started. Its echo did not yet reach Tashkent, and the dissertation already lay with the Scientific Council and awaited defense. In the beginning of August, I presented a lecture on the dissertation at a session of the Scientific Council. I unanimously received the scientific degree of 'Candidate of Chemical Sciences' (Ph.D.) with speciality in 'Physical Chemistry'.

V.V.P.: What were your impressions from the first meetings with outstanding scientists?

In Tashkent, I met some outstanding scientists who largely determined my later scientific path. In those times, in the 1930s, the trip to Central Asia was considered a completely exotic event due to the enormous extent of the USSR. The trip from Moscow to Tashkent took 5 days by an ordinary train or 4 days by express. Half of the distance was through desert and Tashkent represented an oasis in this desert. After such a long train trip, a stranger met the Tashkent oasis in all its eastern unexpected phenomena, beauty, mountains, rivers with falls, beautiful architecture with the residues of ancient cultures, unusual clothes and climate. Famous scientists from Moscow and Leningrad came to Tashkent to give lectures or simply to get acquainted with science and education in Central Asia.

In Tashkent I met an outstanding electrochemist, academician Alexander N. Frumkin, and academician Alexander A. Grinberg—one of the Lev A. Chugaev pupils—a world-known scientist in the area of coordination chemistry. These scientists came to meet with the students. My teacher organized personal meetings for me with these scientists and conversation concerning the area of my scientific activity. I was highly impressed by these meetings and it was an additional stimulus for scientific work.

When I arrived in Leningrad in 1940, meeting with the most famous scientists of that time was completely unexpected for me. I met with academicians Favorskii and Tishchenko-outstanding scientists in the field of organic chemistry whom I considered as celestial beings. I also met with academician Khlopin and other scientists. These meetings were extremely pleasant and exciting to me. I felt as if the gods came down from the heavens and had informal conversations with me about chemistry. These meetings strongly affected my later life and choice of a direction. During my stay in Leningrad (it was 1940), all over the world there was a great interest concerning the discovery of new nuclear reactions, in particular, the spontaneous fission of the uranium nucleus. I spent several days in the Institute of Radium. Prof. Khlopin, the Director of the Institute, was a very interesting and enthusiastic person. Once our conversation was interrupted by some fellow and Prof. Khlopin hurtled away. When he returned, he was glowing, showing figures demonstrating there is a spontaneous fission of uranium nuclei into two parts without influence of neutrons. This was a discovery made by Prof.s Petrzhak and G.N. Flyorov, who made a great impact on the field of transuranium elements chemistry. This event was unusually consummate!

V.V.P.: Tell me please about your activity during World War II.

In August, 1941, very weak echoes of the war reached Tashkent in the form of unfortunate refugees. Only from them and from broadcasts did we hear about things that had occurred. It is natural that upon hearing of the German Nazi invasion everyone wished to participate in this decisive battle for our Motherland.

At that time, I already worked as an Assistant Prof. of Physical Chemistry. As I was untrained in military affairs, I could go in the army only as a conscript. Also at this time, Officers of the Military Academy of Chemical Defense arrived. We were offered an opportunity to enlist in the Military Academy of Chemical Defense in order to pass an accelerated course for Officers of Chemical Defense. This was needed as the threat of the application of terrible chemical weapons by German Nazis was too real.

I gave immediate consent because call-up in the army of persons with scientific Ph.D. degrees and higher was limited, despite the fact that there was a war. This was surprising, because in such times when there is a war everyone should be called up.

In the middle of October I left for Moscow. Moscow was in a zone close to military action. The cannonade was audible, German air-raids were almost daily and the front was less than 100 km distant. What a surprise it was when our group of volunteers learned that the Academy had evacuated from Moscow to Tashkent, and that we had made this multi-day move in vain. We tried to be enlisted and to participate in the military action, but we were told that untrained volunteers would be killed in the first battle and that such sarcrifice are useless. So we made a trip back to the place of assignment in Tashkent and then further—to Samarkand. The return trip in the beginning of November again occupied several days and I arrived in the Academy where outstanding chemists of that time taught. We were prepared as experts only in the field of chemical defense and any preparations for running a chemical attack were not made. I was examined by General Mikhail M. Doobinin—a well known scientist in adsorption science who taught us the theory of a gas mask device and protection against poisonous substances.

In April–May, 1942 we finished accelerated courses and were sent to Moscow under the command of the Personnel Department of the Staff of the Supreme Commander to receive an assignment. To my surprise, I was retained in Moscow for some time. I did not understand what that meant. It turned out that according to the order of the Supreme Commander as a person with a Ph.D. degree I did not have the right to be used by the army in the field and in any areas where there were active military actions. I was directed to the rear, however not very deep-within 400 km from Moscow to the Podolsk Infantry Military School which was transferred to Ivanovo. I was nominated as an Officer to teach a Chemical Defense course. I was in charge of teaching and training future officers how to use a gas mask, methods of protection from poisonous substances of various action, and to acquaint them with methods for decontamination and overcoming territories infected by poisonous substances. The squad of students in this school was rather unusual: there were students from Baltic states—Estonians, Latvians, Lithuanians, partisans from Tito's army and, certainly, a large percentage of Russians. Life was extremely intense until 1943. After that the pressure decreased, when the Fascist troops were defeated in the Battle of Stalingrad. My great desire to engage in chemical science and research was displayed here again. It became possible, because we had one day per week off to visit the library to read scientific literature. At this time I began to carry out my calculations in the area of thermochemistry as well as in the field of

ionic interaction, the behavior of ions in various situations, the energy of the crystal lattices of ionic compounds, etc. I tried to introduce the concept of the ionic lattice of complex compounds, and the concept of the effective radius of non-spherical particles. This concept in those times seemed a not so strict, but very effective method. I was very interested by these calculations in those military times being an officer of the Podolsk Infantry Military School. Discussions with the professorate of Ivanovo University of Chemical Engineering were very helpful for me. Here I became acquainted with such scientists as Prof.s Eugene A. Shilov, Ivan I. Zaslavskii and some others. They advised me, I gave there reports and lectures and it was all during the war, in conditions of complete blackout, in conditions when squadrons of Nazi bombers flew above Ivanovo. Here in Ivanovo I was convinced that it is possible to be engaged in research under any conditions, even in conditions of the complete absence of a laboratory!

My activity found support from the world-renowned scientist, academician Anatolii F. Kapustinskii, whose name is mentioned in many chemistry textbooks printed in Russia, and far beyond its borders (particularly in the textbook on inorganic chemistry by Prof. J. Huheey). I was advised to send my calculations and results to Prof. A. Kapustinskii in Moscow who worked at that time in the Institute of General and Inorganic Chemistry of the USSR Academy of Sciences and in Mendeleev's University of Chemical Engineering. It was my surprise, when in 10 days I received a most detailed answer from him with indication that I had found a correct way, and that he supported me. He made a number of very useful remarks. Further, after 2 years he told me: "Well, you have shown that to a certain extent you have taken possession of area of the thermodynamics of chemical processes. Now it is time for its application. We have a perfect school of chemists—experts in the field of coordination chemistry, all of them are pupils of the famous Prof. Lev A. Chugaev. They are Profs. Il'ya I. Chernyaev, Alexander A. Grinberg, Vyacheslav V. Lebedinskii and some others. If you can find an opportunity to study coordination chemistry in depth and to apply there your knowledge of thermochemistry, it is possible to expect interesting results".

Such was the start of my engagement in a problem which my second teacher—Prof. A. Kapustinskii—called the thermochemistry of complex compounds. It is interesting that Prof. Kapustinskii was also born in Zhitomir near Kiev in the same city as my first teacher—Prof. M. Usanovich. Zhitomir certainly is a rather small city, but as you can see, even in such a small city, two of my teachers were already placed. I may add that in this city a well-known designer of rockets, Sergey P. Korolev, was also born. Clearly Zhitomir is an unusual geographical point. I may also mention that a great French writer Honoré de Balzac lived for some time in this city and was married in Berdichev near Zhitomir.

V.V.P.: How do you explain the fact that you, being an expert in physical-inorganic chemistry, headed a chair of analytical chemistry for a long period of time? What courses did you teach during your teaching activity?

After the war ended, I was going to return to Tashkent where all my family lived.

However, I was invited to begin work in the Ivanovo University of Chemical Engineering in the city where I was an officer. At first I worked as Associate Professor in Inorganic Chemistry. In order to occupy this position, I was obliged to teach a course. However, there was a high concentration of experts in chemistry and the best lecture courses were already occupied by them. There was only one free course—in mineralogy—which all chemists refused to teach. I proposed to teach this course and I was told that in the event I was successful the scientific title of Associate Professor would be awarded to me. To my surprise, I was extremely fascinated by mineralogy, though it was obviously not a chemical discipline. I was mainly interested in the chemical aspects of it and first of all in geochemistry.

I managed to make this science fascinating not only for myself, but also for the students and we made a trip to the Urals to become acquainted with the minerals. There only in the Il'meny reservation several hundred different kinds of minerals were assembled in one place. With Prof. Zaslavskii's assistance and mainly with the help and constant advice of Prof. Kapustinskii, I continued to be engaged in problems about the thermochemistry of complex compounds. In 1948 with Prof. Kapustinskii's recommendation, I presented my doctor's habilitat dissertation for defense in the famous Moscow Institute of General and Inorganic Chemistry of the USSR Academy of Sciences. This Institute was headed at that time by Prof. I. Chernyaev, my adviser for all questions of coordination chemistry. The dissertation title was 'The Thermochemistry of Complex Compounds'. My opponents were Chugaev's pupils: Profs. A.A. Grinberg and V.V. Lebedinckii and Prof. K.G. Khomyakov—an expert in thermochemistry. After the defense, I received the diploma of the doctor of sciences (habilitat) giving me the right in those times to occupy a position of Full Professor. To occupy a position of professor in those times I had to hold a chair. The conditions were strict, as it was necessary to occupy only a vacant chair. Only one chair—the chair of analytical chemistry—remained vacant. It was recommended to me rather persistently to head the Chair of analytical chemistry and to obtain thus the professorship in analytical chemistry. Earlier I had been offered a vacant analytical chemistry chair in the Leningrad Institute of Chemical Engineering. I refused. Firstly, because I had already settled down in Ivanovo, and secondly, as it seemed to me that I was not adapted at all to analytical chemistry. Analytical chemistry of all chemical sciences, seemed the most alien to me. However, it was impossible to remain any longer in the chair of inorganic chemistry, being a doctor of chemical sciences. The Communist Party organization of the Ivanovo University of Chemical Engineering and its Administration persuasively recommended me to occupy a position as the Head of the Chair of analytical chemistry. It was necessary to agree. And I do not regret this because analytical chemistry appeared not so boring and uninteresting as it had during my student years.

I continued to be engaged in problems of the thermochemistry of complex compounds, though this did not match analytical chemistry. I also started rather seriously to investigate problems of complex formation in aqueous solutions. This was important for analytical chemistry. I also decided to use kinetic parameters,

first of all for catalytic reactions for the quantitative determination of chemical elements, due to their kinetic or catalytic effect. We also made serious steps in this direction, by using this group of methods for the determination of molybdenum at microconcentrations by its catalytic action on the reaction of iodide oxidation by hydrogen peroxide. I published a monograph 'The Kinetic Methods of Analysis' and began to feel rather cozy in the chair of analytical chemistry. Nowadays I continue to consider that analytical chemistry is one of the most interesting fields of chemistry where inorganic, organic and physical chemistry meet and where the research area of complex formation has special importance as I was convinced during all my activity in this area of a science.

V.V.P.: Recollect the most interesting meetings with well-known foreign scientists.

Those times differed sharply from the present time. In the Soviet Union we were rather rigidly protected from dialogue with Western scientists. We had the literature, the periodicals, the monographs, but did not have an opportunity to establish personal contacts. It was even worse for scientists working in such a provincial city as Ivanovo. I was extremely surprised in 1957 when I was informed that a known Polish scientist Prof. Boguslawa Jezowska-Trzebyatowska had decided to visit Ivanovo and our chair. At that time, the arrival of a foreign scientist in the city of Ivanovo was a sensation, as even the arrival of a foreign scientist in Moscow was considered a great event. I remember well the paper of a well-known American chemist-analyst I.M. Kolthoff published in one of the American Chemical Society journals about his visit to the Soviet Union. There he described many curious details: as he passed through customs, as he was accommodated in hotels, etc. So, to our surprise, Prof. Jezowska-Trzebyatowska instead of only visiting Moscow and Leningrad, as was the usual practice by foreign scientists, suddenly insisted that she wanted to come to Ivanovo and familiarize herself with our work in the field of thermodynamics of coordination compounds. Her arrival was a rather unusual event for me and my pupils.

Prof. Jezowska-Trzebyatowska was a very active and interesting scientist. She presented an interesting lecture devoted to the formation of Mn(V) compounds and their stability. In the beginning a language barrier existed but Prof. Jezowska-Trzebyatowska proposed a choice of two languages for dialogue: Polish and German. Everyone voted in favor of the Polish language, since many Russians, and especially Ukrainians, knew the Polish language rather well. Such close contacts with Prof. Jezowska-Trzebyatowska and her spouse—the internationally known chemist and President of the Polish Academy of Sciences, Prof. Vlodzimerz Trzebyatowskii, were maintained for a long time. Later I visited Wroclaw University several times and also the Institute of Chemistry, created and headed by Prof. Jezowska-Trzebyatowska.

My first trip abroad was in 1958 to Czechoslovakia. It was for me both completely unexpected and pleasant. I had seen a new country. I became acquainted with a people with a different way of thinking. I was highly impressed by

meeting with the Nobel Prize winner Prof. Yaroslaw Heyrovsky who convinced me that polarography had a brilliant future and that mercury is a completely surprising metal. There I met known experts in analytical chemistry, the Czechoslovak Profs. Vaclaw Govorka, Arnost Okach and young experts in the field of coordination chemistry Antonin Vlcek, Irji Koryta, Jan Gazo and others.

Further as Invited Professor I visited Hungary, Czechoslovakia and Poland. With warmth I remember my meeting in Moscow with the extraordinary person and scientist—Swedish Prof. Lars Gunnar Sillén. We discussed a wide range of problems, in particular the creation of an international project to compose a stability constants reference book. This was interesting to me since my monograph with Prof. Vladimir P. Vasil'ev was published at this time and then translated abroad. Prof. Sillen was a very fascinating person. He invited me to present a lecture in Sweden. But for reasons far from science which were typical of that severe time, I did not visit Sweden. My first visit to a Western country was only in 1964 to Austria at the 8th ICCC. Meetings with the great chemists of that time made a huge impression on me. I met there Profs. V. Gutmann, R. Nyholm, J. Bailar, J. Bjerrum, K.Yamasaki and others.

V.V.P.: I heard that President Kennedy intervened to organize your scientific visit to USA. Is this true?

Prof. Stanley Kirschner, whom I very much appreciate and with whom we have a very warm relationship, told me about the following incident. Prof. Kirschner was the organizer of the ICCC in the USA and he invited me to participate in this ICCC. The Soviet Government directed the inquiry for my visa to the State Department who took a long time to respond. Breaking all the norms of the State Department, Prof. Kirschner decided to call President Kennedy in order to help me get the visa. I was told that he succeeded in reaching the President by phone, and the President asked whether this Russian is so important for this conference. Prof. Kirschner confirmed the necessity of my presence at the ICCC. The president answered that the visa will be given. The visa was granted, but owing to the situation in our country, the trip was not held.

My first visit to the American continent was held in 1972 in Canada, where I met a lot of Canadian scientists, in particular, Profs. A.B.P. Lever, A.D. Allen and C.H. Langford. It was one of my first meetings with Prof. Lever who headed the ICCC Program Committee. After that I did go to the USA and due to the diligence of my American colleagues, I managed to meet many interesting scientists and visit many interesting Universities. I recall meeting experts in the field of coordination chemistry and catalysis, in particular, Prof. Jack Halpern in Chicago, Prof. S. Kirschner in Detroit, Prof. Fred Basolo in Evanston, Prof. J. Turkevich in Princeton, and many other outstanding chemists. It was very pleasant for me to become acquainted with American traditions in teaching and in the organization of science. I was greatly impressed by the excellent equipment of the chemical laboratories in the USA, as well as from the friendly, easy spirited contacts with the students

and the opportunity for discussion on the most varied subjects at American universities.

In particular, I recollect an extremely warm meeting with Prof. Fred Basolo, whom I met many times at the ICCC. He was extremely hospitable and arranged a wonderful barbecue where we communicated and conversed on various themes, including science, society, art, concerning both the US and the former USSR.

V.V.P.: In the 1950-60s it was difficult in the USSR to move from one city to another. How did you move from the Russian city of Ivanovo to the capital of Ukraine, Kiev?

There were some reasons. I am ethnic Ukrainian and my childhood was passed in Kiev and in its suburbs. My parents spring from the Ukraine. In my family, many Ukrainian traditions were kept, including language and close contacts with Ukrainians. But perhaps the principal reason was scientific. In spite of the fact that Ivanovo is perfect for scientific work, in spite of the fact that I am very much obliged to this city for my scientific career, in spite of the fact that in Ivanovo I had and still have perfect pupils, Ivanovo was a provincial city. I was invited to Kiev by former Ivanovo Prof. E.A. Shilov who was elected as Academician of the Academy of Sciences of Ukraine. I also was invited to Kiev by Academician Yu. K. Delimarskii, an expert in the field of electrochemistry and by Academician Anatoly K. Babko-an expert in the field of analytical chemistry and by many other scientists. Thus, even when I lived in Ivanovo, I had a rather close connection with Kiev. It is very pleasant for me to note, that Ivanovo after creation there of my laboratory on complex formation reactions, become a favorite place to visit for many scientists. We were frequently visited by Profs. I. Chernyaev, A. Grinberg, I. Alimarin and many other outstanding chemists.

However of especial pleasure to me, was the dialogue not only with my Russian colleagues, but with chemists from other republics, a dialogue with scientists from Ukraine, especially from Kiev. I frequently heard from them in Ukrainian "Come back to the Motherland". I expressed a desire to return to my native land at the end of the 1950s. Then in 1961, I was elected as the Corresponding Member of the Academy of Sciences of Ukraine. I was invited to head the laboratory for the chemistry of coordination compounds in Kiev, headed previously by Prof. Ya. Fialkov. I started actively to visit Kiev working simultaneously in Kiev and in Ivanovo which are separated by approximately 900 miles, combining my duties in Kiev and in Ivanovo. In 1962, a final move to Kiev was made. I started to work simultaneously in the Academy of Sciences and in Kiev University: in the fall of 1962 I started to teach the course on chemical bonding theory for students of the Department of Chemistry of Kiev University.

V.V.P.: Why did you change the area of your scientific interests several times during your scientific career?

There are scientists who are engaged in one problem all their life and receive interesting results. I have a different temperament: in science I am changeable to

some extent. I am usually interested in a given scientific activity no more than 10 years. I was interested in the theory of aprotic acids of my teacher—Prof. M. Usanovich. I still consider that this theory is extremely interesting. It is little known in the West because Prof. M. Usanovich published the majority of papers on this in Russian. The analogous Lewis acid theory is much more popular in Western countries. Despite their different approaches, these theories are parallel to a certain extent.

I finished my Ph.D. work in this area of research. It was defended, and probably would have been continued further by me. However, the war began and I was engaged in the army. The further development of this work required new experiments which were impossible to make in the Infantry School. Here I started activity in scientific work which did not need a laboratory, chemicals and equipment. I started calculations of ionic interactions in a lattice between a complex ion and any counter ions present. Prof. Usanovich taught me that the process of interaction between the acid and base is a complex formation process. In this case the central ion acts as an acid, and the base acts as ligand. I liked this idea very much and it may be for this reason I became interested in coordination chemistry.

Certainly, it is impossible to deny the influence of circumstances which can develop rather unexpectedly. In particular, why did the thermochemistry of coordination compounds become my first work in the field of coordination chemistry? Because the most perfect world-wide known Prof. Chugaev's scientific school in the field of chemistry of complex compounds existed in the Soviet Union. Thus it was extremely favourable soil for using the ideas from the physical chemistry in coordination chemistry or chemistry of complex compounds as it was then called. In the beginning, I had extremely limited opportunities for chemical experiments. Namely, I had a home-made calorimeter, made by my own hands. I started to measure systematically the heats of formation of various cobalt coordination compounds. After that I developed this work and measured the heats of formation of various metal complexes. I published some papers on thermochemistry of coordination compounds and I generalized it in the monograph. After that, I wanted to expand the thermodynamic aspects and tried to determine the free energy change of these complex formation reactions i.e. to find the stability constants for complex formation. This work was summarized in several publications. We, along with my pupil Prof. Lev I. Budarin, created a method for the definition of equilibrium constants using the measured physico-chemical characteristics of the reaction mixture.

In the beginning of the 1960s in connection with my move to Kiev, I again made some changes of scientific direction. I moved to a well-equipped laboratory, which for a long time was engaged in rare-earth element coordination chemistry. Certainly it would be a crime to simply cut off this research.

Here I was very much helped by my pupils—Profs. Nataly K. Davidenko and Nina A. Kostromina. This research convinced me that it was necessary to use the advantages of electronic spectroscopy on the one hand, and secondly, it was

necessary to understand the reason for complex formation under various conditions. From here began my transition to the widespread use of spectral methods for the investigation of coordination compounds. Since I had been invited to teach chemical bond theory to the students of Kiev University, this pushed me during the preparation of this course to be engaged in problems of chemical structure and chemical bonding.

So there was a new branch—the spectroscopy and electronic structure of coordination compounds of transition metals.

At the same time, I saw the birth and development of those directions of coordination chemistry which are connected to biology—so-called bioinorganic chemistry or more precisely, biocoordination chemistry. There were some incentives to this. One incentive was here in Kiev when scientists from the Institute of Gerontology of the Academy of Sciences of Ukraine asked me to investigate complex formation between iron and nucleic acids. In their opinion, this should affect the aging processes. I started the research on bioinorganic chemistry in my laboratory with Dr Eugeniya E. Kriss on native nucleic acids. Perhaps my memories from childhood and early youth when I was engaged in biology, botany, and forestry influenced me to make efforts in bioinorganic chemistry. In 1972 in Alma-Ata, where some foreign scientists were present, I gave my first lecture on problems of bioinorganic chemistry. I organized in Kiev in my lab a group engaged in bioinorganic chemistry, in particular in research on complex formation with such bioligands as aminoacids and simple peptides.

However, I experienced difficulties to be engaged in modern bioinorganic chemistry due to the lack of appropriate equipment and biochemical reagents. Taking into account my previous history and experience, I decided that for me to focus on chemistry will be better, than on biology. I decided to look at different sorts of bioinorganic models, i.e. I became interested in biomimetic chemistry. In particular, it was very challenging to assemble appropriate models with crown-ethers, and macrocyclic ligands incorporating such donor atoms as nitrogen, sulfur etc. There was also bioinorganic chemistry in connection with pharmacology, the work of my pupils Profs. Anna S. Grigor'yeva and Peter A. Manorik in the field of complexes formed by metal ions and bioligands.

V.V.P.: With your pupils you made significant contributions in different fields of modern coordination chemistry. What, from these directions, is the most precious and interesting to you? Which pupils would you like to mention?

It is possible to compare each of the stages of development of my work in the field of coordination chemistry to the various stages of development of the relations between man and woman: admiration, enthusiasm, rough activity and gradual cooling with the appearance of a new subject of admiration, new scientific direction. My enthusiasm lasts somewhere from seven till ten years, however always in one main direction, coordination chemistry.

My first pupils appeared naturally in Ivanovo. I frequently recollect with a real warmth my first pupil becoming a professor—Vladimir P. Vasil'yev, a brilliant experimenter with whom I was engaged in thermochemistry research on the equilibrium of different acidocomplexes in solution. I also recollect another of my Ivanovo pupils: Prof. Boris Dm. Beryosin, an Academician of the Russian Academy of Natural Sciences who is engaged in porphyrin coordination chemistry. I have to mention here Prof. Gennady A. Krestov who was elected as a Corresponding Member of the Russian Academy of Sciences, with whom I for the first time began to investigate the complete thermodynamic characteristics of coordination compounds. Further Prof. Gennady A. Krestov devoted himself to the problem of the interaction of different inorganic species in non-aqueous solutions. Thus, I had at least three pupils in Ivanovo who created their own directions.

In Ivanovo, we started to develop kinetic methods of analysis. One of my closest and also dearest pupil was Prof. L. Budarin, with whom I became acquainted in Tashkent, then he moved to Ivanovo, where he defended his Ph.D. dissertation, then he followed me to Kiev where he became Professor and has headed a large department in the Institute of Physical Chemistry of the National Academy of Sciences of Ukraine. He was a most original scientist, an expert on the production of original ideas.

A special area of coordination chemistry is the chemistry of complexes in ionic melts. Such an investigation is difficult because the most interesting processes occur in ionic melts at high temperatures where the usual spectrophotometers and devices cannot be used. Hence, there was a problem to create equipment which could be used to record spectra at high temperatures. In this area my pupil, Prof. Sergey V. Volkov, nowadays an Academician of the National Academy of Science of Ukraine and Director of the Institute of General and Inorganic Chemistry was engaged. He devoted himself to the coordination chemistry of transition metals with various ligands in particular with such unusual ligands as sulfur and other chalcogenide chlorides in various melts and in non-aqueous solutions.

I have already mentioned Prof. N.K. Davidenko, who was engaged in the study of complex formation with aminoacids, peptides, nucleotides and other bioligands. The very special field which attracts me even now for many reasons is the field of oscillating reactions. Its extraordinary character attracts me first of all with beauty and grace, that the concentration of one of the substances changes in an oscillating mode. Especially if the substance is colored it causes aesthetic pleasure. In this area I worked with Prof. Liliya P. Tikhonova paying attention to the application of coordination compounds in oscillating reactions. My interest to this field was provoked to some extent by a conversation with Prof. Lever in Bratislava during the conference on coordination chemistry. Prof. Lever invited me to write a review in his journal 'Coordination Chemistry Reviews'. We discussed an opportunity for a review devoted to the application of complexes as catalysts in oscillation reactions, and this was subsequently published [Coord. Chem. Rev. 63 (1985) 241]. Earlier Prof. N.K. Davidenko and I had published in this journal a review devoted to rare-earth element coordination compounds [Coord. Chem. Rev. 27 (1979) 223].

A very interesting problem was solved by one of my pupils—Prof. Alexei P. Filippov—who studied complex formation on the surface of sorbents upon which various ligands were immobilized. These sorbents extract such noble metals, as palladium, forming unusual complexes. I can mention also Prof. Julia I. Bratushko who investigated dioxygen carriers using cobalt coordination compounds including some immobilized on a surface.

As to macrocyclic compounds, my attitude to them is special. I like these ligands very much and they are still part of my interests and sympathies. We have studied various complexes with different macrocyclic ligands. My students who work in this area include Dr Yaroslaw D. Lampeka and Dr Alexander G. Kolchinskii, now working in the USA with Prof. Daryle Busch—an outstanding expert in the field of macrocyclic complexes. By the way, I should say that my interest in macrocyclic compounds was to a certain extent stimulated by Busch's lecture devoted to this field at the ICCC in Switzerland in 1966. While Drs Lampeka and Kolchinskii are working with azamacrocyclic complexes, my pupil Prof. Vitaly V. Pavlishchuk is studying thiomacrocyclic complexes of transition metals. Thialigands are interesting for soft metal complexation. His work concerning the redox reactions of such complexes with copper(II/I) mimic the same copper transitions in blue copper proteins in biosystems. One of my fields of interests is to model cation transport through a membrane. In this interesting area, my pupil Dr Galina G. Talanova made much progress using crown ethers as cation carriers through liquid membranes. She is also interested in complex formation with such ligands as crown-ethers adhered to silicate and polymeric matrices and is working currently in Texas Technical University.

Some Bulgarian chemists asked me to arrange the training of their students in Kiev. The first such pupil from Bulgaria is the now well-known Bulgarian scientist Prof. Panayot Bontchev who worked here for more than 6 months and developed basic aspects of the kinetic methods of analysis with application for catalysts of chemical processes. Prof. George Nikolov from Bulgaria worked with me for a long time and was engaged in solving a number of theoretical problems, including quantum-chemical calculations and the theory of the chemical bond in coordination compounds. Further I had a pupil from Slovakia—Dr Jan Labuda, working in Bratislava—who is concerned with the application of macrocyclic compounds in analytical chemistry and electrochemistry. Another pupil, Prof. Sharipa Zhorobekova, from the Central Asian country Kyrgyzstan, is a leading chemist in this country and is working with great success in the field of bioinorganic chemistry.

V.V.P.: You have written 24 monographs and a textbook. What do you think of these?

It is impossible simply to summarize the monographs and textbooks. Some were written mostly or even completely by me, but I also participated in writing monographs in cooperation with my colleagues. My first monograph, 'Thermochemistry of Complex Compounds', was translated into German. This monograph is very dear to me as it reflected therein the ideas which were embodied in my

doctor's work under the guidance, as I already told you, of the academician Kapustinskii. The rather unusual ideas for that time were developed in this work.

Following that I wrote in collaboration with Prof. Vasil'yev the monograph 'The Instability Constants of Complex Compounds'. This monograph consisted of two parts. The first part was devoted to methods of determination of instability constants and the second part contained tables of such constants and a rather exhaustive bibliographic summary on the stability of complex compounds. It was very pleasant for me that this monograph immediately received an international response, and was translated into English and Chinese. What was most important, was that after the English translation, I began to receive many inquiries concerning these instability constants, methods of their determination, etc. I also received a proposal from Prof. Sillen to join the International Commission on Equilibrium and worked some time there. So this monograph convinced me that publishing a monograph only in Russian does not spread ideas throughout the chemical world.

Then there is the monograph 'The Kinetic Methods of Analysis', which was very interesting for me because it was my attempt to involve my knowledge of physical chemistry in solving problems of analytical chemistry. This monograph also unexpectedly received a wide resonance. It was published by Pergamon Press in England, and was also published in Hungary and Poland. This book interested many scientists, and as a consequence I received many invitations and opportunities to present reports at many analytical congresses. In particular, I remember an international congress in Budapest in 1961, when after my lecture the Chairman of the Congress Prof. P. West told me: "The report was very interesting, but these methods belong to the end of the 20th and beginning of the 21st centuries". He was right as nowadays these methods have received complete recognition and wide application. I might also mention my small monograph devoted to problems in bioinorganic chemistry, which was translated into German and Chinese. I also wish to mention the monograph devoted to macrocyclic compounds, written together with Dr Lampeka and the monograph devoted to the synthesis of such compounds, written in co-authorship with Drs Kolchinskii, Talanova and Prof. Pavlishchuk.

V.V.P.: Upon which journal Editorial Boards did you act?

I was lucky to be the Editor-Founder of at least two journals. The 'Proceedings of High Schools of the USSR. A Series Chemical', started in Ivanovo and I was the Chief editor for about two years until I moved to Kiev. Secondly and my favorite, I founded in 1965 in Kiev, 'Theoretical and Experimental Chemistry'. We involved in this journal outstanding scientists both from inside and outside Ukraine. The presence of such close contacts between Ukrainian scientists and scientists from Moscow, Leningrad, Novosibirsk, and from other republics of the USSR was beneficial to all journals. This journal is especially dear to me, it is still published, and immediately from its beginning it was translated and published in English by Plenum Press. I also remember that I was included on the first staff of the Editorial Board of the Russian Journal of Inorganic Chemistry which was headed by Prof.

Chernyaev and after his death, by Prof. V.I. Spitsin. In recent years, I have participated in the Editorial Boards of the journals 'Theoretical and Experimental Chemistry' and the international 'Journal of Coordination Chemistry'.

V.V.P.: Which awards have you received?

In the Soviet era, I was awarded four orders, and seven medals as well as other awards and prizes. The last order 'for merits' of 3rd degree, I received from the President of Ukraine. This last award is very pleasant to me as it is the first award of Ukraine as an independent state. The first one I obtained in the difficult military period on February 23, 1944. The announcer of Moscow radio informed at 7 o'clock News that I had been awarded 'A Symbol of Honor' for success in the preparation of the officer staff. This was a very high award for me and I received it working in the rear, being engaged in the humane business of the preparation of future officers for defense against a possible chemical weapon attack of the enemy. Further, I received orders of the 'Labor Red Banner' and 'Order of the October Revolution'. Among other awards, one that made a strong emotional impression, was that I was elected a Doctor Honoris Causa of Wroclaw University in Poland. This ceremony was extremely solemn and unusual for me. It was also very pleasant for me to receive the J. Heyrovsky Golden Medal of the Czechoslovak Academy of Sciences. This award is very dear to me as I knew Prof. Heyrovsky personally, and we cooperated closely with the Czech and Slovak chemists. I also received with my pupils—Prof. Volkov and Prof. Davidenko—the important award the Chugaev's Prize of the Academy of Sciences of the USSR for spectral research of coordination compounds of transition and rare-earth metals. The Ukrainian Academy of Sciences Pisarzhevskii Prize (Lev Pisarzhevskii was an outstanding Ukrainian chemist) was awarded me in 1970 for activity in complex formation reactions and application of those results to chemical analysis. In 1992 at the General Session of Accademia Peloritana dei Pericolanti (Messina, Italy) I was elected as its Corresponding Member.

V.V.P.: As far as I know, you are the only example of a Director of a Chemical Institute of the Academy of Sciences of Ukraine who voluntarily resigned from this post. Why did you do it?

At the beginning of the interview, I told you that I consider that people are divided not on tendencies towards sciences for example to chemistry, physics, biology etc., but on their tendency to a particular kind of activity. I am attracted very much first by research activity and second by teaching activity, transmitting knowledge to students. There are people with strong interests in commercial activity, or in financial and economic activity, or administrative and management activity. I learned frequently to my cost that I do not have the talents for these kinds of activity. When I worked in the forest area, I found that I could plant the

woods, but not carry out the management activity, and it became difficult to work in the forestry business. It was a great honor for me when in 1969 I was elected the Director of L.V. Pisarzhevskii Institute of Physical Chemistry of the National Academy of Sciences of Ukraine. This is one of the best institutes in the Ukraine. While I expected that my scientific work in this institute would be pleasant, I was uneasy to be its Director, the manager. From 1969 to 1982, I worked as the Director of the L.V. Pisarzhevskii Institute of physical chemistry and in the scientific field it was possible to do something useful. However, the work of the manager tired me terribly, especially in the early 1980s, when I started to have a health problem. I therefore asked to be released from this honorable position. When my request was granted by the President of the Academy, the academician Boris Paton, I breathed a huge sigh of relief. Time for my scientific research and for teaching was liberated and my mood became much better, because I did not have to care about how to help the employees satisfy their various needs. Administrative work is a kind of activity that can be interesting, but not for me.

V.V.P.: Please, tell me your recipe for creative longevity.

I think that creative longevity is achieved by constant training of the brain and constant occupation with any scientific activity. Constant research and constant exercise of the brain is completely necessary for its proper work. Exactly as the muscles do not work without exercising, the brain also does not work without constantly solving problems at home and in the Institute. Nowadays I am very much interested in two problems connected with chemistry in general and in particular with coordination chemistry. These are the manifestation of relativistic effects in the properties of coordination compounds and problems of the stabilization of unstable oxidation states. Continuous communication with students and colleagues is also very important. I appreciate the dialogue with students and we are necessary for each other for participation in discussion and for the generation of new ideas and new approaches during such interactions. Certainly when I was younger, ski training and strolls through the woods were helpful. Now this kind of activity is limited for me. To train oneself is necessary, but first of all I consider that the training of the brain is the most important.

V.V.P.: Tell us please about your family.

I met my wife—Lidiya Evseevna Yatsimirskaya—a long time ago, it is already nearly 60 years, and we married in 1940. Since then, we have been inseparable in heart and mind. My wife is a biologist with her principal interest in geobotany. We have two sons. Our son Vitaly is a Prof. of Kiev University, where he is Head of the Chair of physical chemistry. The second son Anatoly is also a Professor, who worked at Moscow University. He is on leave now from Moscow University working in the University of Mexico City, Mexico. I have two grandsons: one is a

physicist and the second is a chemist. My grand-daughter now works in the USA, and she is also a chemist, an expert in the area of immunochemistry.

V.V.P.: What are you engaged in besides science?

Besides science, my main enthusiasm is in the study of flora. When I arrive in a new place, I find out which plants grow there, and which plants do not grow and why. In particular, visiting any country, including such exotic places as Australia I was very interested in their flora, applying the knowledge I received from forestry. I am naturally interested in other aspects of forest life and nature, and in particular, ornithology. When I go to any woods, I find out which kinds of birds live there, what is their behavior, what nests they build, etc. Thus my main enthusiasm is to have a dialogue with nature in any of its aspects.

V.V.P.: Coordination theory enters the second century of its history. Can you make any forecasts for interesting areas of development and the results which will be obtained?

This question is very broad and difficult to answer briefly. I would like to note one very serious and crucial moment in the history of coordination chemistry in the 20th century. This was the transition from research on an individual isolated, identified and crystallized coordination compound to the research of complexes existing in equilibrium in solution. In particular, the stepwise complex formation ideas advanced by Jannik Bjerrum. Here it is possible to determine an appropriate boundary—the middle of the 20th century. Before this date it was possible to discuss only those coordination compounds which were individual substances synthesized, purified and crystallized. In the second half of this century, it became possible to discuss coordination compounds, whose existence was proven in a solution without isolation in a pure state and moreover existing in a solution in a mixture with other compounds.

The most interesting question to a chemist concerns the structure of a coordination compound, structure in a broad sense of the word. Mainly of great interest are the determination of the geometrical structure, i.e. the location of the central ion and ligand donor atoms around it and the electronic structure of the coordination unit. Again the middle of the 20th century brought radical changes in both these areas. Until the middle of the 20th century, X-ray structure determination of coordination compounds required a lot of time—some months at best, and a year or two was not unusual. During the second half of the 20th century this method became routine. However this method is not an universal panacea for solving tasks connected with the structure of coordination compounds, because many complexes cannot be isolated as monocrystals, and because many compounds exist only in equilibrium with products of their disintegration and co-products of their synthesis. Thus I suggest that in the close future, the development of methods for molecular

structure determination in solution, of compounds which cannot be isolated is one of the important tasks for coordination chemistry. Such methods already exist, we could mention EXAFS. However, though this method is graceful and beautiful and with a great future, it will be of limited use because the equipment needed for this method is accessible only to very advanced and hence few laboratories in the world.

With respect to the electronic structure of coordination compounds, coordination chemistry of the 20th century was tested against many quantum-chemical models. I mean the theory of quantum-chemical methods such as crystal field and ligand field theory were tested first of all and most fruitfully with coordination chemistry, against a great variety of geometrical and electronic structures. The greatest achievement of coordination chemistry in the 20th century is the explanation of the nature of electronic, IR, Raman, ESR and NMR spectra of coordination compounds and a wide use of spectroscopy for the investigation of electronic and geometric structure of complexes. This field is in development now and in the 21st century, certainly, the determination of the electronic structure of a coordination compound both on the basis of quantum chemistry and on the basis of physico-chemical methods will move forward.

I have not had an opportunity to dwell on two very important aspects of the development of coordination chemistry, namely the physical chemistry of coordination compounds. I mean here the thermodynamics, kinetics and catalysis. Much progress was made in thermodynamics of coordination compounds in the 20th century, due to equilibrium studies of complex formation. However, many such thermodynamic characteristics are incomplete and represent only one part of the problem, namely the Gibbs energy change. Meanwhile such major characteristics as heats of formation, and entropy have generally not been obtained.

Clearly there will be further development in coordination chemistry in the direction of the synthesis of new complexes. In the middle of the 20th century new types of ligands were introduced to coordination chemistry. Don't forget the widespread application of polydentate complexing agents in the many industries and technologies. There is also widespread development of macrocyclic ligands but I think that the study of complex formation with bulky bioligands, i.e. peptides, polypeptides, nucleic acids, etc. has only just begun. Only the first steps have been made, because of the enormous number of such ligands as well as the enormous number of possible combinations of metal ions with them. Therefore, in the near future, I expect the appearance of new ligand classes which will be of great interest.

Very interesting also are those ligands which do not exist in a free state but only in the metal coordination compound. As soon as the central ion is withdrawn, the ligand either collapses or changes its structure. The opposite task—ligand synthesis at a metal ion-template—began in the 20th century and received wide utilization.

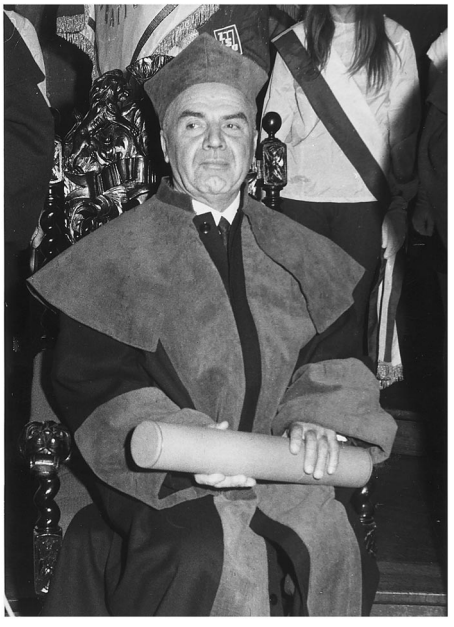
The coordination chemistry of heavy and superheavy metal compounds will develop rapidly in the near future. In particular, several tens of transactinide coordination compounds were recently described. Here we expect completely new results. The coordination compounds of these heavy metals should be unusual

because besides the usual forces of chemical affinity, the relativistic effects play an important role.

The synthesis of coordination compounds in exotic oxidation states is a very interesting area in which progress can be made. Compounds of special interest are those in which the oxidation state of an element exceeds its group number, for example Hg(III) complexes. It is interesting, that even Mendeleev considered the possibility of isolation of compounds with oxidation states exceeding VIII. In Mendeleev's times, compounds of Os(VIII)) and Ru(VIII) were already known but nobody in that time did not even dream of compounds with higher states of oxidation. "The time for recognition of forms exceeding RX_8 lie ahead in my opinion, but it will come" (D.I. Mendeleev, Basics of Chemistry, vol. 2).

Finally, I believe that coordination chemistry in the 21st century will be focused on solving problems of global importance: development of economies, well-being and other aspects of human history. In this connection, I have in mind at least three such global problems. First is in biology and its applied areas, such as medicine. We already have plenty of medicines based on the use of coordination compounds. It is enough to recollect *cis*-platine and a number of other medicines, which only work as coordination compounds. Next, the application of complex compounds in agronomy for the development of agriculture, for example in plant-growing. The second global problem lies in material science, when new materials will be created using coordination compounds. There are also applications in metallurgy—the separation and isolation of various metals—the separation and isolation of transuranium elements. The role of coordination compounds with polydentate ligands in the processing and separation of nuclear fuels is also quite important.

Finally, the third global problem is ecology, which is becoming more and more important and urgent. With the application of coordination compounds, new methods of ecological protection and new ecologically pure technologies can be created. In this respect, a significant role will be played by catalysis using coordination compounds. Especially important will be the application of such complexes which are analogues of coordination units existing in biological systems. This area is close to biology and called biomimetic chemistry, when scientists or technologists imitate nature, using synthetic substances.



Biography

Konstantin B. Yatsimirskii was born on April 4, 1916 in the Ukrainian village of Pologi. In 1931 he finished 7-year public school. Between 1931 and 1934 he studied in a forestry technical school, from which he graduated in 1934 with a specialty as a forester, and in 1934–1935 he worked as a forester in the Kharkov area of Ukraine. In 1934 he moved to Central Asia where in 1935–1936 he was head of Uzbek forest experimental station in the village of Aman-Kutan in the Pamir-Alay mountain region. In 1934 he applied to the Department of Chemistry in Central Asian University (SAGU) in Tashkent city. He graduated from University in 1945 as a Physical Chemistry major. In August, 1945 he defended his Ph.D. dissertation with specialty in 'Physical Chemistry' and became Assistant Professor of the Department of Chemistry in SAGU. During WW II, in 1942, he finished at the Military Academy of Chemical Defense in order to pass an accelerated course for Officer of Chemical Defense and received the military rank of Lieutenant. Between 1942 and 1945 he taught a Chemical Defense course in the Podolsk Infantry Military School. After the war, in 1946–1947, he was an Associate Professor of Inorganic Chemistry in the Ivanovo University of Chemical Engineering. Between 1948 and 1962 he was head of the chair of Analytical Chemistry in this University. In 1949 he defended doctor's Habilitat dissertation specializing in 'Inorganic Chemistry' and received a title of Full Professor. In 1961 he was elected a

Corresponding Member of the Academy of Sciences of Ukraine. During the years 1961–1969 he headed the laboratory of Chemistry of Complex Compounds in the Institute of General and Inorganic Chemistry of the Academy of Sciences of Ukraine in Kiev. Between 1962 and 1981 he was the Professor of Chemistry in Kiev State University. In 1961 he was also appointed Head of the Chemistry and Chemical Engineering Department of the Academy of Sciences of Ukraine and in 1964 was elected as Academician of the Academy of Sciences of Ukraine. Between 1965 and 1983 he was Editor-in-Chief of the *Journal of Theoretical and Experimental Chemistry*, while during 1969–1982 he was the Director of the L.V. Pisarzhevskii Institute of Physical Chemistry of the Academy of Sciences of Ukraine, where between 1969 and 1987 he headed the laboratory of Bioinorganic Chemistry of this Institute. Since 1987 he has been an Advisor of the Board of Directors of this Institute. During the ten-year period 1982–1992 he was a Professor of Bioinorganic Chemistry in the Kiev branch of the Moscow Physical–Technical University. He has been a participant in 11 ICCC meetings, six Mendeleev Congresses and the International Symposium of Applied Bioinorganic Chemistry (1990), as well as in numerous other international chemical congresses and meetings. He is the author of over 1000 academic works, including 24 monographs and handbooks. He was awarded five Orders, and seven medals of the USSR and Ukraine, as well as numerous other awards and prizes in the USSR and abroad. He has been married to Lidiya Evseevna Yatsimirskaya since 1940. He has two sons, both of them Professors of Chemistry, two grandsons and one granddaughter.