VLADIMIR IVANOVICH VERNADSKY (ON THE 150TH ANNIVERSARY OF HIS BIRTH)

The geological history of the biosphere
opens to the man a huge future
if he understands it and does not use his mind
and his work on self-destruction.

V.I. Vernadsky

In 2013, the global scientific community celebrates the 150th anniversary of the birth of our great compatriot Academician Vladimir Ivanovich Vernadsky – scientist, thinker, humanist, science theorist, historian and organizer, as well as a social and political activist who has had and continues to exert an enormous influence on the development of modern science, our scientific thought, our scientific world, and our understandings.

Vladimir Vernadsky, in the words of his student Academician A.Ye. Fersman, is the "largest and original researcher of living and inanimate nature, a creator of new scientific trends, and a reformer and a founder of Russian mineralogy and the world geochemistry", whose way of life is "the way of hard work and bright creative thinking, a way that opens up new fields of science and outlines new directions of science in our country". With his scientific activity, V.I. Vernadsky – wrote his close friend, Professor B.L. Lichkov – "plowed the fields of many sciences: chemistry, mineralogy, geology, soil science, and biology; at the same time, he created new sciences – geochemistry and biogeochemistry. This fact is striking ... At our time of deep scientific expertise ... Vernadsky, as a type of scholar, throughout his work, is a rare exception. Amazing knowledge of the facts of the broad areas of nature and no less striking understanding of scientific methods and techniques, no matter where they are applied, are his characteristic features. He perceived science not as a system, like the dogmatized provisions of the present, but in a much wider sense: he perceived it deeply both dynamically and historically, as a living evolving entity, and he brilliantly knew its past... The range of his factual exact knowledge was striking ... He was a chemist, a geochemist, a biologist, and a soil scientist. But the most remarkable thing ... is that in all these branches of science, he was the *creator*, the creator of a large scale".

Indeed, now, in the second decade of the XXIth century, it is safe to say that Vladimir Ivanovich Vernadsky is an outstanding scholar

and encyclopaedist, who, for a variety of fields where he left a deep impression, cannot be matched. Vernadsky made an invaluable contribution to the creation, formation, and development of many scientific disciplines and fields: crystallography, genetics, chemical mineralogy, crystal chemistry, geochemistry, biogeochemistry, radiogeology, radiochemistry, cosmochemistry, meteoritics, geochemistry of natural waters, geochemical environmental science, landscape geochemistry, environmental geochemistry, hydrogeology, soil science, chemistry, biology, biogeocenology, ecology, geography, theory of science, history of science, terminology, museum studies, philosophy and logic, theory of the biosphere, living matter and its geochemical role of geochemical activity of man, minerals, dissymmetry of geological object, and optical activity of protoplasm; he developed the original concept of noosphere and a concept of space and time that is no less original. V.I. Vernadsky is the founder of a huge school of mineralogists, geochemists, biogeochemists, and representatives of other scientific fields that produced the world-renowned scientists: V.V. Arshinov, A.P. Vinogradov, K.A. Vlasov, A.A. Polkanov, A.A. Saukov, A.A. Tvalchrelidze, A.Ye. Fersman, V.G. Khlopin, D. Shcherbakov, and many others.

Scientific, organizational, and socio-political work of Vernadsky is striking in its ebullience, diversity, productivity, and originality. He is the author of more than 400 published scientific papers in his lifetime, not including impressive and fundamental works that were published after his death, numerous notes and references to various ministries, departments, and organizations (they have not lost their significance in our day), and a huge number of letters (as observed by one of his contemporary biographers, "Vernadsky could and loved to write letters"; their scientific, historical, cultural, and social significance is very high). Vernadsky's diary, which he kept throughout his adult life (the first record was made in 1877 and the last – on 24 December, 1944) has particular historical, cultural, and scientific importance.

In 1884, still a young man, V.I. Vernadsky has formulated his life credo: "The man's task is to bring the best possible benefit to others". Later, in 1866, in his letters to N.Ye. Vernadskaya he clearly pointed out his future activities and his understanding of the world: "Now I found out the way, the conditions, which will be my life. This will be the scientific, public, and journalistic activities... I ... am convinced that one of the necessary conditions for further development of human existence itself is that everyone lives according to his beliefs and works as hard as possible for the general benefit; I consider "personal sanctity" one of the important conditions of such life... It's such a life where the words are where the conviction is, where I help, as I am able to, my brothers, all people, so I contribute, as much as possible of good, honest, and spiritual, so I inflict as little as possible of distress, suffering, illness, and death. This is such a life that at my death-bed, I could say: I did everything I could. I didn't make anyone miserable, I tried that after my death my goal would be pursued and my place would be taken by the same, no, by better workers than I." Vladimir Vernadsky followed firmly these beliefs all his life – long and full with creativity and events; he remembered, until the end of his days, his ideals; the program of "Brotherhood" (a coterie of the university youth founded in 1886) – to devote life to science and education of and assistance to people, to other practical work for the benefit of society

In 1885, after graduating from the Natural History Department of Physics and Mathematics Faculty of St. Petersburg University, Vernadsky was a keeper of the Mineralogical Cabinet of St. Petersburg University (1885–1890), then Privatdocent, and (since 1898), Professor of Moscow University (until 1911), Professor at the Higher Courses for Women (1897–1906), Head of the Mineralogical Museum of the Geological Department of the Academy of Sciences (1906–1914), Director of the Geological and Mineralogical Museum of the Academy of Sciences (since 1914, and since 1921 also directed its Meteorite Department),

Chairman of the Commission for the Study of the Natural Productive Forces of Russia (KEPS) (1915–1930), the first President of the Ukrainian Academy of Sciences (1918–1919), Professor and President of Tauride University (1920–1921), Director of the Radium Institute (1922–1939), Director of the Library of Geological Sciences of the USSR (1926–1929); he headed the Department on Living Matter of KEPS, Laboratory of Biogeochemistry (BIOGEL), and the Laboratory of Geochemical Problems of the USSR Academy of Sciences named after him (1921–1944).

Vernadsky conducted incredibly extensive work at the Academy of Sciences, leading many of its scientific and organizational commissions and committees (on meteorites, heavy water, history of knowledge, definition of geological age using atomic decay, isotopes of radium, mineral waters, underground water, etc.) and participating in other committees (Polar, on the study of Lake Baikal, on the library studies; on the study of the ethnic population of Russia, Caucasus, standard of radium, stratosphere, spectra of rare elements, permafrost, uranium, viruses, history of the USSR, history of biology, etc.). The total number of academic boards and committees in which, at various times, Vernadsky worked exceeded 60 (this does not include academic and institutional commissions and committees of other ministries and agencies where he was involved). Vernadsky was also a member of the Scientific Council of the Moscow Research Institute, of the Scientific Council of the Ministry of Agriculture, of the Statistical Council of the Ministry of Internal Affairs, of the Council of Dokuchaev Soil Committee of the General Directorate of Agriculture and Land Management, of the Board of Floating Marine Institute, of the Council of V.V. Dokuchaev Soil Science Institute, of the Council of the Special Research Committee of the Union and Autonomous republics, of the Academic Council of the Institute of the History of Science and Technology, of the Academic Council of the Institute of the History of Science; he was the Chairman of the scientific committee of the Agricultural Department of the Ministry of Agriculture; he was Vice-President of the International Commission for the Determination of Age of the Earth by radioactive methods; he represented the USSR Academy of Sciences in the Scientific Council of the Geological Committee of the Supreme Council of National Economy; he was a USSR member at the administrative committee of the magazine "Zeitschrift für Krystallographie und Mineralogie", which, since 1927, has become an international publication.

V.I. Vernadsky possessed outstanding, we may say unique, abilities of a science organizer. As noted by A.Ye. Fersman, "we cannot even fully count all the brilliant initiatives put forward by Vladimir Ivanovich". On the direct initiative or with the participation of Vernadsky, there were created: the Ukrainian Academy of Sciences, A.L. Shanyavsky Moscow Peoples' University, Platinum Institute, Institute of Physical and Chemical Analysis, Hydrogeological Institute, Sand and Desert Institute, Soil Science Institute, Institute of History of Science and Technology, Radium Institute, Biogeochemical Laboratory and Laboratory for Geochemical Problems (later, V.I. Vernadsky Institute of Geochemistry and Analytical Chemistry), Laboratory of Oceanology (based on which, P.P. Shirshov Institute of Oceanology was created in 1946), Chemical Association, the Academy of Sciences of the USSR, various scientific committees of the Academy of Sciences (some of which later became scientific institutes), Commission for the Study of the Natural Productive Forces of Russia (1930), Sapropel Laboratory, and others; he participated, as a consultant of the USSR Academy of Sciences, in the organization of the Academy of Sciences of the Georgian SSR. According to A.Ye. Fersman, he "dreamed and wrote about the necessity of the Soviet Antarctic Expedition, considering that Russian science has to cover also southern countries of the Earth's hemisphere". Vernadsky was also a member of the Editorial Committee of the USSR Academy of Sciences for the publication of a series of "Scientific Legacy" and the Commission for the preparation

of the publication of the Soviet review journal in chemistry. At his suggestion, since 1930, "Proceedings of the Biogeochemical Laboratory" was published, which had articles on biogeochemistry, environmental geochemistry, geochemistry, and related fields of knowledge and which played an important role in the development of scientific fields in our country (in 2003, the 24th volume of the "Proceedings" was the last volume published) In 1945, A.Ye. Fersman, remembering his teacher, wrote that "in all cases, Vladimir Ivanovich was at the launch of the most daring endeavors of the Academy", and Academician L.S. Berg said figuratively that Vernadsky "in himself, represents the entire Academy".

Of particular note is the outstanding role and work of Vernadsky in the Commission for the Study of the Natural Productive Forces of Russia (KEPS) – at that time the largest institution of the Academy of Sciences, whose main purpose was to organize a nationwide, as accurate as possible, complete and systematic accounting of its natural resources. The Commission consisted of the greatest Russian scientists D.N. Anuchin, P.I. Walden, K.D. Glinka, B.B. Golitsyn, I.A. Kablukov, N.S. Kurnakov, F.Yu. Levinson-Lessing, V.A. Obruchev, D.N. Pryanishnikov, V.Ye.Tishchenko, A.S. Famintsyn, Ye.S. Fedorov, A.Ye. Fersman, N.A. Kholodkovsky, A.Ye. Chichibabin, L.A. Chugai, and many others. From the first days of the KEPS, Vernadsky was Chairman of its Interim Bureau, and, then (11 October, 1915) was elected by secret ballot Chairman of the KEPS Board and of most of its sub-committees (on bitumens, clay, fire-resistant materials, microscopy, platinum, soils, study of the North, salt, "white coal", i.e. hydro-power, and zoology). He also served at other sub-committees: on botany, artesian waters, and use of wind power; he was Chairman of the Editorial Board for the publication of the "Natural Productive Forces of Russia", a member of the Editorial Board for the publication of "Materials for the Study of the Productive Forces of Russia". The KEPS was a truly democratic institution, whose governing bodies were elected by secret ballot. The most fundamental questions concerning the work of the Commission were discussed at the General Meeting and by the Board and Sub-Committees. The KEPS leaders sought to consider all views of scientists on various aspects of its work. The Commission's work has played a prominent role in the development of scientific and organizational approaches to the study of resource capacity and development of mineral resources of the country, including the integration of the natural productive forces, search for new sources of strategic raw materials, meeting demands of defense organizations, and publishing literature about the natural resources of the country. In November 1916, Vernadsky made a presentation at the KEPS Council with a program of the creation of a wide network of research institutions, some of which located in different climatic zones for an integrated and comprehensive study of the nature, while others, particularly in the existing research centers, focused on particular problems. It is important to note that a number of the KEPS sub-committees transformed later into independent research institutions (Platinum, Ceramic, Physical-Chemical Analysis, etc.). In 1930, on the base of the KEPS, the KIPS (Permanent Commission for the Study of the Ethnic Structure of the Population of Russia and Neighboring Countries) and the KYaR (Committee for the Study of the Yakut Republic) the SOPS (Council for the Study of Productive Forces) was established. The activities of the SOPS were focused on studying the country's natural resource potential for a radical transformation of its economy and were reflected in the prewar five-year plans. Vernadsky strongly supported this institution and wrote a note on "The Tasks of SOPS".

Vernadsky was by no means an armchair scientist. His numerous publications were the result of his research, expeditions, and experimental work carried out during the whole life. He was a participant of the famous territorial (Nizhny Novgorod and Poltava) "soil" expeditions of V.V. Dokuchaev; in different years, he conducted field research in the

Volyn, Vyatka, Ekaterinburg, Ekaterinoslav, Irkutsk, Moscow, Perm, Poltava, Saratov, Smolensk, Tauride, and Tambov oblasts; in Transbaikal, Orenburg, Perm, Tomsk, and Ferghana regions; in Finland, Caucasus, and Altai. He traveled along the Volga and the Dnieper rivers, made geological and mineralogical research trips to many countries in Europe (Austria, France, Germany, Holland, Greece, Denmark, Italy, Norway, Poland, France, Czech Republic, Switzerland, and Sweden); visited Canada and the U.S., the Balkan countries (Bulgaria, Bosnia, and Serbia) and the old mining areas of Central Europe and Scandinavia. He worked at the Pierre Curie Radium Institute in Paris, at the Murmansk and Staroselskaya Biological Stations; he lectured on the geochemistry at Charles University in Prague and at Paris University.

Vernadsky took part in the sessions of the International Geological Congresses (London in 1888, St. Petersburg in 1897; Paris in 1900, Vienna in 1903, Ottawa in 1913, and Moscow in 1937), Congress of the British Academy of Sciences (Dublin, 1908), Meeting of the International Union of Academies (1913), 2nd Congress of Practical Geology (Moscow, 1911), Special Meeting on the Development of the Background of the Draft Law on the All-Russian National Museum (1915), Conference on Weather Service convened at the Main Geophysical Observatory (1927, as a representative of the USSR Academy of Sciences), meetings on accounting of the livestock abundance of the USSR (1927, Chair), meetings of the GOSPLAN of the USSR on the problem of coordination of the geological and exploration work of the Academy of Sciences and the Geological Committee of the Supreme Council of National Economy (1927, by the order of the Presidium of the USSR), 1st International Congress for the Study of Radioactivity (Münster, Germany, 1932), XII Congress of Russian Naturalists and Physicians (Moscow, December 28, 1909 – January 6, 1910), Mendeleev Congresses (at the 2nd Congress in 1911 Vernadsky made a report on "The Gas Exchange of the Crust"), All-Union Geological Congress (Kiev, 1926, Chair), 1st All-Union Conference on Radioactivity (Leningrad, 1932, Chair), Conference on the Genesis of Ores of Iron, Manganese, and Aluminum (Moscow, 1935), 2nd Conference on Experimental Mineralogy and Petrology (Moscow, 1936), Conference on Comparative Physiology (Kiev, 1940), Conference on Pegmatites (Kyiv, 1940); he participated in many sessions of the USSR Academy of Sciences and in the meetings of its departments. He was the official agent of V.V. Dokuchaev at the World Expo (Paris, 1889) where the Department of Russian Soils received a gold medal and Dokuchaev, as the organizer, was awarded the Order "For Services to Agriculture" and the title "Chevalier du mèrite agricole."

Being an extraordinary person, a humanist, and a citizen of his country, Vernadsky productively combined his titanic scientific, organizational, and educational work with social and political activities. "The main strength of Vladimir Ivanovich in life" – wrote A.Ye. Fersman – "was his love for people, the ability to walk up to a person, to understand him". It is true to say that humanity, as a whole, was unthinkable to Vernadsky without due attention to an individual elevated to the status of "the greatest value." These human qualities of Vernadsky, a strong opponent of the death penalty, in many ways determined the directions of his social and political activities. In 1892, he was elected a member of the Territorial Council of the Morshansk Territory, Tambov Province; he became a member of the Audit and the Budget Committees of the Territorial Council. In the same year, he was elected Justice of the Peace for the Morshansk Territory for three years (1893–1895). A few miles away from the station Vernadovka (now, Pichaevsky Rayon, Tambov Oblast), at his own expense, he built a school, which, until 1917, he financed himself providing educational aids and taking care of the selection and training of teachers (some of them received teaching training with his funds). In 1891–1892, when drought covered almost the entire Black Belt region and a terrible famine began in most grain provinces, Vernadsky

participated in the organization of assistance to the starving farmers of the Morshansk and Kirsanov Territories of the Tambov Province. Since 1892, V.I. Vernadsky was periodically re-elected a member of the Territorial Council of the Tambov Province and was elected Honorary Justice of the Peace for the next period (1896–1898); he took part in work of the Budget, Agricultural, and other Province Commissions. In 1904, he was a delegate to the Territory Congress that demanded the introduction of the Constitution, civil liberties, and election of the State Duma; in 1905, he participated in the All-Territorial Congresses and became a member of the Bureau of the Territorial Congress formed in Moscow. In 1903, he was among the founders of the "Union of Liberation" and, in 1905, of the Constitutional Democratic Party, whose Central Committee member he remained until 1918. In October 1918, immediately after his election the first President of the Ukrainian Academy of Sciences, he publicly announced his withdrawal from the Constitutional Democratic Party with the motivation that the head of the Academy and organizer of science must be non-partisan and should abandon political activity. In the end of 1920 Vernadsky completely ceased political activity. In 1914–1915, Vernadsky worked in various guardianships where a network of institutions for the care of children was formed.

Three times (1906, 1908–1911, and 1916–1917) Vernadsky was elected to the State Council (the upper house of the legislative institutions of the Russian Empire in 1906–1917) from the academic curia (i.e., from the Academy of Sciences and universities). In 1908, he was a member of its Agrarian Commission; in 1916, the Economic Commission, the Russian Parliamentary Economic Committee, and various Conciliation commissions for the discussion that arose between the Duma and the Council of State on disagreements on a number of bills. In 1917, Vernadsky headed the Commission on Reform of Higher Education Institutions under the Ministry of Education (from March 21 through June 10, 1917, 20 meetings of the Commission were held, where, in particular, there was a discussion on the creation of new institutions of higher education: Tbilisi Polytechnic Institute, Universities of Perm and Rostov-on-Don, and Women's Pedagogical Institute in St. Petersburg). By the Decree of the Provisional Government from August 11, 1917, Vernadsky was appointed the Deputy Minister of National Education. "In the short time when I had to work there" – he later recalled – "Perm State University was opened, ...the discussion on the establishment of new academies started, ... the question was raised on the Georgian Academy of Sciences and the Academy of Sciences of Ukraine and in Siberia ... ". In 1933–1935, Vernadsky was a member of the Karel-Murmansk Committee of the Presidium of the Executive Committee of the Leningrad People's Deputies Council.

In his socio-political and public activities, Vernadsky was largely guided by the need to solve two problems. First, one of the most important public policy goals, in his view, was "the task of preserving the unity of the Russian State – reduction of the centrifugal forces in its organization". Second, science and education, in his opinion, should be a sort of "state religion", and the main task of the state is "not a government organization of science, but the state aid to scientific work of the nation ... We should not regulate scientific work in some scientific discipline ... but need to regulate the implementation of a specific *scientific task*, necessary to the nation". He was convinced that "scientific work of society is one of the most important elements of its vitality and the most solid basis for its future because the future belongs to the nation and to society that will be the owner of the source of power, and this power, in our time and for our nearest generation, ... is in effective knowledge of nature and the active development of mathematical thinking. The nation where there is creative work in sciences, where a genius of invention, application of science to life, the conscious use of natural energy, and coordinating the strength to society or human labor are alive, can easily look into the future".

Over 20 years (1890 to 1911), academic and social activities of Vernadsky were associated with the Moscow University. In fact, it was in this period when his formation as a scholar, teacher, organizer, historian of science, and public figure happened. He defended (1891) his Master's thesis "On the Group of Sillimanite and the Role of Alumina in Silicates" where he developed the concept of the structure of silicates that was named the Theory of the Kaolin Ring (the famous French chemist Le Chatelier called the Vernadsky's ideas on the chemical constitution of alumosilicates the "ingenious hypothesis"); in 1897, he defended his Doctoral thesis "The Crystalline Substance Slip". In 1906, he was elected an adjunct member of the Physics and Mathematics Faculty (mineralogy) of the St. Petersburg Academy of Sciences; in 1912, he became Full Academician of the St. Petersburg Academy of Sciences. He published the books "Fundamentals of Crystallography", "Physical-Crystal Studies", "Practice of Descriptive Mineralogy"; he delivered a famous speech at the XII Congress of Russian Naturalists and Physicians "The Paragenesis of the Chemical Elements in the Earth's Crust" (thus founding a new science – geochemistry); he wrote extensively on the history and methodology of science and genetic mineralogy. He began to develop radio-geological, biosphere, and biogeochemical problems (he wrote in his diary: "I ran into biogeochemical problems in 1891 when I began to teach the course in mineralogy at Moscow University ... "); he wrote a series of feature articles and notes on higher education, the state system, and social movement. At the same time, Vernadsky, in his words, "clearly separated mineralogy from crystallography, shifting the center of gravity towards chemistry as a natural geological process .... In 1897, I began to move away from crystallography and became more and more deeply involved into the chemical mineralogy in the geological aspect".

In 1890, Vernadsky became Assistant Professor of mineralogy and crystallography, and Acting Guardian of the Mineralogical Cabinet of Moscow University; in 1892, he became a member of the Physics and Mathematics Faculty with a deliberative and casting vote in cases involving the Mineralogical Museum, and Guardian of the Mineralogical Museum (by 1911, the Museum has become one of the largest in Europe); in 1898 and 1902, he became an Extraordinary and Ordinary Professor, respectively; he lectured at Moscow University, simultaneously at two Faculties: in 1891–1911, at the Physics and Mathematics Faculty (crystallography in the first half of the year and mineralogy in the second, with practical sessions on both courses) and, in 1891–1898, at the Faculty of Medicine (a short course of mineralogy and elective practical sessions); in 1902–1903, he taught an elective course on the history of science; in 1905–1906, he was Assistant to the President of the Moscow University.

In 1896, Vernadsky was the first in Russia to introduce into the curriculum systematic mineralogical excursions (or, in modern terms, field practice) for students. The staff that worked with Vernadsky in the Mineralogical Cabinet also participated in the excursions. The first tour took place in May 1896 to the Urals (Zlatoust–Yekaterinburg–Tagil). Then, the mineralogical excursions were held regularly in the Moscow region and other regions of Russia. By the way, V.I. Vernadsky was a strict and fair teacher who did not tolerate a "formal" attitude of students to any course or exam. Thus, he recalled in 1943, the situation at the Faculty of Medicine during an exam on mineralogy: "... it was a custom that a student said that he was "without a fight" and he received a satisfactory grade without being tested. I disagreed firmly. ... As a result, ... I gave 42 unsatisfactory grades and caused a terrible racket. I gave them all the re-examination. The next, day I was called to the Dean, but I asked him not to interfere ...The course took my side; the students tightened up, and almost all passed, except for two or three people".

In November 1901, at the Mineralogical Cabinet, Vernadsky organized a mineralogical study group, consisting of his students and staff. This club, which lasted until December 1910, was instrumental in the development of genetic mineralogy and geochemistry in

Russia and was, according to A.Ye. Fersman, a "great generator of new ideas and new initiatives ... it was there where the great science was created". During the ten years of the club's existence, 77 reports were made at its meetings, of which almost half presented the results of original investigations of the speakers. Among the reports' authors, besides Vernadsky himself, were subsequently recognized scientists A.D. Archangelsky, A.Ye. Fersman, Yu.V. Wolf, A.V. Shubnikov, and Ya.V. Samoilov. As A.Ye. Fersman recalled later, in Moscow Vernadsky "developed the breadth of the world understanding and created, around him, a great academic school, bringing together university youth. This school became a powerful source of new ideas and new initiatives ... In the walls of the old university building, he gradually expanded the premises of the Mineralogical Cabinet; he also expanded and improved the Mineralogical Museum by appending the famous Rumyantsev's collection of minerals to it and making this modest laboratory the center of national importance".

In 1911, Vernadsky (along with a group of other faculty members – a total of over 130 people) left Moscow University (in protest against the reactionary policies of the Minister of Education L.A. Kasso and oppression of students.) In 1917, Vernadsky was elected again Ordinary Professor of the Faculty of Geology and Mineralogy of Moscow University and continued in his position at the Academy of Sciences.

You can hardly find a natural scientist, whose work in the history of science, history of knowledge, and history of human thought would occupy such a large place, as in the work of Vernadsky, and whose legacy in this area would have been as great. In his view, "the history of human thought and creativity ... is not only an area of knowledge that is the key to revealing the truth; it is necessary for so needed, especially in our country, continuity of scientific creativity and awareness and continuity of research work and for an individual field rooted in the scientific life of society." A modern science historian A.P. Ogurtsov, having examined the scientific and historical ideas of Vernadsky, identified the following trends in his historical and scientific work: 1) history of science as the development of the scientific world outlook, 2) history of science as the development of forms of organization of scientific work, 3) history of science as the development of individual disciplines, 4) history of science from the perspective of scientific problems, 5) history of Russian science, 6) biographies and assessment of contributions of different individual scientists of the past, and 7) historiographical work. We must add to this the numerous Vernadsky's notes about the research work of his contemporaries and reviews of work and activity of his colleagues and students. To Vernadsky, the study of the history of scientific ideas was a means of thorough analysis of their current status and helped formulating the task of further development. He always started the study of a particular issue or problem with an accurate historical analysis because he considered that "a naturalist ... must always know the past of the science to understand its present. Only in this way there can be a correct and complete assessment of what is produced by modern science and what is treated by it as important, true, or correct". Moreover, Vernadsky was convinced that "the scientific study of the past, including scientific thought, always leads to the introduction of a new human consciousness ... The way forward is the result of a long, invisible, and unconscious preparatory work of generations. Having reached a new and unknown, we are always surprised to find predecessors in the past". Reality often proved the correctness of Vernadsky. Among other things, at his own expense, he worked extensively for the collection of the manuscripts of M.V. Lomonosov and he gave the collected material to the Academy.

V.I. Vernadsky was a supporter of unity and internationality of science. He believed that science "is a complex social creation of mankind, the only and incomparable, because, more than literature and art, it is global in nature, weakly linked to the forms of government or public life. This is a universal

panhuman creation because it is based on the same *universally equal binding scientific facts and generalizations*. Nothing like this exists in any other field of human spiritual life". Freedom of thought, for Vernadsky, was the basis of all creative activities, especially scientific. "In scientific work, personal creative work, free and fetterless, besides personal preferences and understanding of science, is its main characteristic feature. Scientific work, along with artistic creativity, is one of the most striking manifestations of a human person and personality ... Science ... is a cultural organization with little dependency on the state or tribal framework. Science is indivisible. Its goal is to search for the truth for the sake of truth; and the truth which is found, after an effort of a century of scientific work, is far from the historical situation in the moment, it is universal and is indivisible for all, without distinction". He rightly argued that "from year to year, the value of independent research as a key element of culture becomes more and more important and inevitable. Because gradually and rapidly the globe becomes the arena of public interest, because technology is being penetrated with scientific thought more deeply and the results of scientific work, with every moment, are penetrating increasingly deeper into all areas of human consciousness". One cannot fail to recall the wonderful thought of Vernadsky that "a characteristic feature of scientific work of our time is that it is determined not by the logical boundaries of science, but by the logic of the challenges".

Vernadsky recognized all learning ways for the sake of true knowledge: scientific, philosophical, religious, artistic, etc., but it is scientific knowledge (based, he stated, on "mental hygiene") that is a completely new force in the history of the biosphere and he assigned the crucial importance to it. He considered scientific work a part of the national culture. Perhaps for the first time ever, Vernadsky has declared loudly that in science, "the principal and alive content is ... scientific work of live people. Specifically these real people – scientists – comprise science in its public manifestation: their mood, their skills, their understanding and satisfaction with the accomplished, their will, the world's scientific public opinion – is one of the main factors of the historical progress of scientific knowledge ... Scientific thought itself does not exist, it is created by a human living person and is his manifestation. In the real world, there really exist persons who create and express scientific ideas and are engaged in scientific creative work exerting spiritual energy. Created by them, weightlessness value – scientific thought and scientific discovery – subsequently change the course of the processes in the biosphere and the nature around us".

Vernadsky, as a scholar, teacher, organizer of science, and social activist, acquired an exceptional reputation and great respect, both in Russia and abroad. He spoke French, German, English, Scandinavian languages and languages of the Slavic peoples; he read in some other European languages; he was familiar, was a friend, or was in close contact with many prominent Russian and foreign representatives of different branches of science and culture, community and state leaders, whose listing only would take many pages. Vigorous, diverse, and incredibly productive scientific and public activity of Vernadsky amazed even his contemporaries. The well-known geologist, mineralogist, and soil scientist Professor V.K. Agafonov asked Vernadsky: "Where do you draw your ability to give time the duration and to turn a day into a few days?" Russian historian, teacher, regional ethnographer, and social activist I.M. Grevs recalled Vernadsky-student: "Even then he was a clearly defined very talented future research scientist, naturalist-experimentalist, but with a philosophical mind fold. His erudition was amazing"; and a historian, social activist, Professor of St. Petersburg Polytechnic Institute A.A. Kornilov said about Vernadsky that "... his mind is prone to generalization and constantly sought to embrace science as a whole, and therefore there was not a branch of human knowledge, which would not interest Vernadsky". Prominent geologist, Professor of the University of Lausanne N.A. Ulyanov in 1925, noted that the book

by Vernadsky "Geochemistry" "is a synthesis, a bold, original generalization that defines many new ways for work, puts the final points on the completion of the phases, and points to the areas where our knowledge is still weak".

Academician Vernadsky was elected and (or) was Honorary Member of many (more than 35) Russian scientific societies and public organizations; he was Professor of Mineralogy of the University of Paris (Sorbonne); Member of the Czech and Yugoslav Academies of Sciences; Corresponding Member of the French Academy of Sciences; Fellow of the Royal Society of Great Britain, French Mineralogical Society, German Chemical Society, Geological Society of France, Mineralogical Society of the USA, and Mineralogical Society of Germany; Honorary Member of the Indian Society of Biological Chemistry; Corresponding Member of the British Association for the Advancement of Science, Natural History Club in Prague, Czechoslovak Mineralogical and Geological Society, and Geological Society of Belgium. Among other things, since 1911 Academician Vernadsky was Actual State Councillor (civil rank of the 4th grade, which belonged to the 1st of the four groups of officials and unified those who determined the course of government policy; the persons who had that title usually held positions such as Director of Department, Governor, or Mayor). He had awards of the Russian Empire; in 1942, he was awarded the Order of Red Banner of Labor for "the outstanding contributions to the development of genetic mineralogy and geochemistry"; in 1943, for "the long-term outstanding work in Science and Technology" he was awarded the 1st degree Stalin (State) Award, half of which (100 thousand rubles) he gave to the war effort. Judging by the records in the diaries, Vernadsky treated the "non-scientific" awards rather indifferently.

The life and work of Vernadsky fell on the years of great events in the history of the world and Russian society: Russian-Turkish War (1877–1878), Russian-Japanese War (1904–1905), World War I (1914–1918), February and October revolutions (1917), Civil War (1918–1922), first decades of the Soviet regime, and Second World War (1939–1945). In November 1917, after the October Revolution, Academician Vernadsky, Permanent Member of the Kadet Central Committee, Deputy Minister of Public Education in the Provisional Government, became a member of the Small Council of Ministers that declared Soviet government illegal. Hiding from arrest, Vernadsky went from Petersburg to the south of Russia, where he endured the horrors of multiple power shifts. Only in March 1921, he returned from Crimea to Moscow and, then, to Petrograd, where in July 1921, he was arrested by the Cheka and was set free only because N.N. Kuzmin, N.A. Semashko, and A.V. Lunacharsky interfered.

In subsequent years, scientific, philosophical, and ideological ideas and views of Vernadsky were often subjected to harsh criticism; he was accused of "vitalism"; that his views were just "one of the innumerable, unoriginal, and reactionary" attempts in a "crusade against science and the protection of religion under the guise of the natural science itself"; that his work and the world outlook "are an instructive example of the pitiful state to which falls the science in captivity of bourgeois ideology". However, in the words of Vernadsky, "the vitality and importance of ideas are only recognized by long experience. The value of the creative work of a scientist is determined by time". Time and experience have shown and proved the vitality and importance of the ideas and views of Vernadsky and the value of his creative work. And words of A.Ye. Fersman are still just; in 1946, he spoke of his great teacher Academician Vladimir Ivanovich Vernadsky: "For decades and for whole centuries, his brilliant ideas and his writings will be studied and deepened – new pages will be opened, they will be the source of new quests; many researchers will have to learn his acute, persistent and minted creative thought, always brilliant but difficult to comprehend; for the younger generations, he will always be a teacher in science and a shining example of a life lived productively".

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