Prof. Iar. Przheborovskii, "Achievements of chemistry during the world war," *Krasnaia nov'* no. (1922): 301-309.

Article I. Chemistry in Russia, 1918-1921. [There does not seem to have been a second article.]

Only comparatively recently has the possibility arisen of restoring to some extent the scientific ties broken both in Russia and abroad. Of course, one cannot say that the more or less important works in the field of chemistry produced abroad will be elucidated with sufficient completeness in these essays. Even for the works produced in Russia we lack sufficiently complete information, but what we have managed to collect on the scientific and applied work in the field of chemistry in Russia in the period from 1918 to 1921 is of undoubted interest. The centers of scientific and applied work in the field of chemistry were Moscow and Petrograd. Both in Moscow and in Petrograd a number of institutions were founded. Thus, in Moscow there were 1) the Karpov Chemical Institute of the Supreme Soviet of the People's Economy (VSNKh) (formerly its chemical division's Central Chemical Laboratory); 2) the Biochemical Institute (State Scientific Institute of Public Health of the People's Commissariat of Health; 3) the Institute for the Manufacture of Chemically Pure Reagents, Scientific-Technical Department, VSNKh; 4) the Russian Scientific Chemical Institute, People's Commissariat of Education. In Petrograd during this period the following institutes were in operation: 1) the Institute of Applied Chemistry; 2) the Institute for the Study of Rare Metals; 3) the Institute of Physico-Chemical Analysis; 4) the Ceramic Institute. At the Academy of Sciences a Radium Panel operates which is being converted into the Radium Institute. Problems posed by the chemical industry clearly require purely scientific methods for their solution. That has long been proven. And the most notable example is Germany, both in peacetime and especially in the World War. In the following essay we will introduce readers to the way Germany used its chemical industry during the World War. Thus each institution, each institute of an applied nature should employ purely scientific methods in its work, and should treat problems posed by industry as problems subject to purely scientific cultivation, and only where this creative spirit of science initiative resides, only there is genuine work possible, work not just meeting the demands of the moment, but truly the catalyst that is so necessary for the development of Russia's productive forces in Russia at the moment. In this regard the Karpov Institute and the Institute of Biochemistry have successfully combined these two tasks. While meeting the needs of the present moment, the two institutes are at the same time developing scientific work. These two institutes have obtained results of great importance along both lines.

Among the works of major importance for the chemical industry we may indicate the following: 1) A method for purification of aluminum sulfate developed by B. I. Zbarskii. For more than fifty years the chemical industry has been looking for a method for purifying aluminum sulfate from iron. Thus the solution to this problem at the Karpov Institute takes on great importance not only for Russian, but certainly also for the global chemical industry. 2) An extensive study of the use of hydro-peat [for use as fuel]. The hydro-mass is processed by a colloidal solution of iron oxide, and after this treatment it acquires the ability to be pressed into briquettes with favorable dry-matter content. Based on these studies the Institute has designed a factory for artificial dehydration of peat and manufacture of peat powder. This factory can be operated during the spring, summer, fall, and part of winter. 3) Studies are under way for obtaining glycerol from sugars by the method of Neuberg. Yeast cultures have been derived which grow well in solutions containing more than 20% bisulfite (the presence of this substance is necessary for the formation

of glycerol). 4) Studies of so-called Siberian casein, which goes into the production of adhesives. From Siberian casein they managed to obtain a product pleasant to the taste and suitable for consumption, containing 13.96% nitrogen. Without dwelling on a number of other works which are of great practical importance, we will give them a brief description.

A means has been developed for using cyanide sludge from a gas plant, important research has been carried out on vegetable oils and fats that are important for the production of linseed oil for soap making, a method has been developed for producing artificial varnish, etc. Along with the works that have an applied nature and were promoted by the need of the moment, the Karpov Institute has also carried out a number of works of a purely scientific nature. These works mainly dealt with the processes associated with the action of enzymes, and were executed under the direction of A. N. Bakh, director of the institute. It is an extremely important method for the quantitative determination of enzymes jointly present in a drop of blood (catalysis, peroxidase and lipase). Lack of an accurate microscopic method for working with minimal amounts of blood has so far made it impossible to explore systematically the work of fermentations [enzymatic processes] in the normal and pathological condition of an organism. The method of A. N. Bakh gives the opportunity to work with a single cubic millimeter of blood (a drop of blood, approximately the size of a small pinhead). At the request of the Institute ten special calorimeters have been constructed which have also been provided to hospitals for systematic studies. In addition there are a number of papers studying the effect of different enzymes, the action of hydrogen peroxide, etc. The Biochemical Institute, which emerged relatively recently, on January 6, 1921, carried out a number of works in the field of blood enzymology. The work on the determination of enzymes in the blood by the method of A. N. Bakh has been published in *Biochemische Zeitschrift*. An Institute staff member, Dr. A. E. Sharpenak, studies the effect of blood fermentations [enzymes], depending on diet. A new method for the determination of blood enzymes has attracted interest among doctors. Doctors have been dispatched from most of the Moscow University clinics as well as from the provinces (Kharkov, Voronezh, Pyatigorsk, Saratov, Tomsk, etc.) to review the method of A. N. Bakh. No less than thirty physicians passed through the laboratory of the Institute. In Moscow the study of blood according to Bakh's method is currently being carried out in the clinics of Professors Konchalovskii, Fedynskii, and Dietrich. Of great interest is work on the study of blood and milk of goats whose thyroid glands have been removed. A number of other papers have been sent for publication in *Biochemische Zeitschrift*. In addition to these activities, the institute conducted a course on theory and practice of enzymology for physicians. A necessary condition for scientific work, besides special equipment, is also the opportunity to have the necessary chemicals in so-called chemically pure form. Before the war, chemically pure and guaranteed reagents were obtained mainly from Germany. The best known firms are Kahlbaum and Merck. Already during the war the shortage of reagents was felt strongly, and the question was raised about the need to organize an institute in Russia for the manufacture of chemically pure reagents, and also the development of methods for the manufacture and purification of chemical compounds. But such an institute, of course, cannot be a simple techno-chemical laboratory. It would certainly be a scientific institution. Not only the methods of chemical synthesis, but no less the methods of purification are in essence real scientific work and what is more, the kind that requires not only experienced, but persistent, one might say, stubborn researchers. The Kahlbaum and Merck firms gained international fame in this respect.

Founded in 1918 in Moscow, the Institute for the Manufacture of Chemically Pure Reagents (IREA, in the Scientific and Technical Department of VSNKh) had to take on the challenge: 1) to organize the production of chemically pure reagents, the need for which was more than sharp; 2) to develop methods for the preparation and purification of chemically pure compounds. This task is difficult even in normal conditions. Yet this institute completed its task as far as circumstances permitted, and helped both individual laboratories and academic institutions. Thus, some of the works carried out at the Russian Chemical Research Institute (more below) could be performed only with the assistance of IREA.

IREA conducts its work in the following areas: 1) purely scientific work, 2) development of methods for the synthesis or purification of reagents, 3) industrial activity. In addition, IREA is currently managing the publication *Reagent Encyclopedia*. The need for such an encyclopedia has been great indeed. Anyone who has had to conduct scientific work knows the high value of this encyclopedia. The Korenblit guide in Russian was completely unsatisfactory, while Bender's German guide was too concise and clearly unsatisfactory. Merck's well-known book on testing the purity of reagents also left much to be desired. *Reagent encyclopedia*, some of whose articles are already ready, should consist of a series of articles written by experts. In these articles detailed guidance will be given for methods of obtaining, purifying, and testing the purity of chemical compounds. The properties and applications of a given reagent are indicated in scientific work, in the factory chemical laboratory, in medicine, in agriculture, etc. The importance of this encyclopedia may be compared to the importance attained by Ostwald's classic guide, a guide devoted to physical and chemical measurements. As already mentioned, the work of IREA is inevitably connected with purely scientific work. The institute has completed up to 25 such works. Up to 140 works possessing scientific value have been completed. Without going into details, we will give the reader an overview of other aspects of the IREA. This review will show that in this respect, despite conditions not conducive to productive work, the institute has done quite a bit. Development of chemically pure compounds has gotten up to eight poods per month (a fairly high figure amid the present lack of raw materials and so on). A custom order to two German factories has been developed by the institute, with drawings for special installations for the production of reagents.

The order has been transmitted via the Foreign Trade department and the hard currency has been obtained. IREA is extending its activity beyond Moscow as well. Thus a commission for the manufacture of chemically pure reagents has been organized at the University of the Urals. This commission conducts development of reagents and pure acids in an amount that could satisfy the needs of the Urals and the nearby Siberian region. From the work of IREA that has achieved great practical importance we can point to work on the use of hydrocyanic acid as a suffocating gas in the fight against parasites. This method was successfully used for the destruction of lice eggs in rail cars, jail cells, in the premises of evacuation hospitals, etc. The same method was used to eliminate pests that destroy the exhibits in the ethnographic department of the Rumiantsev Museum. The data of all these works have been used by the People's Commissariat of Health for the works of the sanitary disinfection base.

But scientific work also was not interrupted during the years 1918-1921. In the scientific department of the People's Commissariat of Education in the summer of 1919 the Russian Research Institute of Chemistry (RRIC) was opened, consisting of five divisions: 1) Department

of Biological Chemistry, 2) Department of Organic Chemistry, 3) Department of Physical Chemistry, 4) Department of Inorganic Chemistry, and 5) Department of Electrochemistry.

As we have already pointed out, it is long-established fact that modern industry is entirely constructed on a purely scientific foundation, and the powerful development of the productive forces of Western Europe and the United States is based on the close, organized tie between the work of scientific institutions and industrial enterprises. For example, in Germany the foundation of its entire chemical industry was the work of scientific chemical research institutes. These institutions on the one hand were located at higher schools and, on the other hand, were separate entities, like, for example, the [Kaiser] Wilhelm Institute, the Institute for Coal Research, and others. Scientific work in Germany took on the character of mass, organized, almost factory work. A whole series of factories and plants organized their own special research laboratories and even entire institutes where one might say entire brigades of chemists worked under the guidance of outstanding scientists (thus as many as 200 chemists worked in the scientific laboratory of the famous factory for the production of aniline dyes). In Russia the need for a scientific center has long been felt, one which would unite scientific work in chemistry with the chemical industry. In this center of scientific work closely tied to the needs of the chemical industry, it would be necessary to create conditions that would provide the opportunity to arrange the work not only at the ordinary laboratory scale, but also the semi-production scale, which is especially important for preliminary development of processes with technical importance. If in the West with its much more favorable conditions for scientific work it was already found necessary to create scientific institutes, this need is especially felt in Russia amid the comparative poverty of laboratories at universities both in terms of space and in terms of equipment. The Russian Research Institute of Chemistry also had to be such a center uniting scientific work in chemistry in the country, establishing a close relationship between science and the chemical industry, and working towards the promotion of maximum development of productive forces. But the task of the institute was not just laboratory work alone. The Institute has as its objective to promote the development of the chemical industry and other tools, such as study and research of the natural resources of the country, training of scientific workers, consulting, etc. The Institute began its work with the solution of problems having the most important practical value, but at the same time also developed a number of problems that are no less important from the theoretical side.

One of the important issues of great importance for the chemical industry is the manufacture of dyes. In this respect before the war one of the top places belonged to Germany. Among the dyes produced by German chemical factories indigo blue dye, called the ‘king of dyes,’ was especially famous for its beauty and strength. The RRIC’s Department of Organic Chemistry set as one of its objectives the development of a method which would make it possible to obtain some dyes from materials more cheaply and easily obtainable in Russia. “Dimethyl indigo” and some of its derivatives turned out to be such dyes. Dyes with different shades have been obtained—purple, blue, etc. Experiments conducted dying fabrics and testing the strength of these dyes in relation to light gave fully satisfactory results. ‘Dibromdimethyl indigo’ yields especially clean and bright shades, and this dye is distinguished by its resisting to fading. One of the dyes (dimethyl indigo sulfuric acid) yields a more fade-resistant and purer blue shade in wool dying than the corresponding derivative of the ‘king of colors’ indigo. AT present the production of these dyes is being prepared at the pilot plant of “Main Aniline” (Glavanil). A full production design has been assembled. The dimensions of the equipment have been calculated to obtain in every

operation up to half a pood of dimethyl indigo. This method has received an award from the Committee for Inventions.

In addition, a number of studies have been carried out on the production of substances that are source materials for dyes. The results of this work have been transferred to the aniline plant in Kineshma.

No less important substances than dying agents are pharmaceutical compounds. In this respect before and during the World War Russia depended to a great extent on foreign countries. The Department of Biological Chemistry has developed a method that gives the possibility of obtaining raw material for drugs like theobromine and caffeine. It is known that these substances are in close relation to so-called uric acid. Already in 1897 the German chemist E. Fischer managed to find transitions from uric acid to theobromine and caffeine. Thus the problem of obtaining theobromine and caffeine from uric acid by technical means has been posed. Uric acid is a significant part of the excrement of birds, reptiles, and snakes. The Department of Biological Chemistry has developed a method for obtaining uric acid from pigeon droppings, a material that is sufficiently cheap. This method makes it possible to obtain uric acid from pigeon droppings at factory scale, and received an award from the Department for Inventions.

One of the most interesting questions in chemistry is the problem of protein structure. In this regard work is continuing on the study of the decay products of gelatin (so-called acid hydrolysis). Further studies are being produced, directed to the elucidation of the genesis of intestinal intoxication, and the effects on carnosine and histidine of pure cultures of several kinds of micro-organisms of the intestinal flora are being studied.

[Przheborovski goes on like this for another two pages...]

A radium panel has been working at the Academy of Sciences. Radium compounds have recently acquired special interest and importance. Radium, an emanation of radium, actinium, mesothorium, and radiothorium, is already obtained in special factories and has spawned an entire industry. A characteristic feature of this industry is that it obtains only milligrams or in the best case grams of radioactive substances from huge amounts of raw materials, with these substances commanding immense prices. The increase in these prices may be called “radium fever.” In 1902 one milligram of radium preparation was worth roughly ten marks (about five rubles). But when it was found that the radiation emitted by radium compounds destroys cancer cells, and it began to be used in the treatment of cancer, private clinics, cities, and so forth began to stock radioactive drugs, and prices rose rapidly.

In 1918 a milligram of radium compound in Germany was worth 600 marks. It would take up to 60 grams of radium in order to meet the needs of all medical institutes, but this quantity is currently not yet available. The use of radium compounds in medicine is increasing, and of course there are also professionals who use radium compounds in cosmetics. We find further application of these drugs in agriculture, as a fertilizing agent, and in the manufacture of luminous dyes, and even lightning device.

Even before the World War there were a huge number of enterprises in the field of radioactive industry—in Germany, Austria-Hungary, France, Portugal, England, the United States, and

Australia. North America, according to recent data, can obtain up to six grams of radium compound a year. According to the calculations of Petrachek earth's supply of radium is 425 grams. Currently America mines half of world production of radium compounds. The number of radium compounds obtained annually is growing. The need for these drugs for medical purposes is especially great: Radium rays and mesothorium are used to treat cancers of the skin, and this method has the advantage compared to surgery that no or almost no disfiguring scars remain, for example, on the face. Radioactive agents have been successfully applied when treating chronic diseases of the joints, in some heart diseases, neuralgia, sciatica, etc. Pulmonary tuberculosis is not amenable to radioactive substances, but good results are often obtained in tuberculosis of the joints. Recently X-rays have started to compete with radioactive substances, but often their combined effect is applied—the radium or mesothorium rays act on the internal portion of the organ while the X-rays simultaneously act on the surface. Experiments with the use of radioactive substances as fertilizers have given interesting results: harvest yield is increased by more than one hundred percent. At the same time the plants become more resistant to weather influences.

We will not dwell on further applications of radioactive substances, since we will acquaint the reader with these applications in an upcoming article. The Radium Commission at the Academy of Sciences has set itself the task of obtaining radium compounds. The first concentrates have already been obtained, and by spring the commission hopes to receive the first portions of radioactive compounds.

The issue of deposits of radioactive minerals is of no small importance. In Russia such deposits are located in Turkestan and the Trans-Baikal region, but this requires extensive research to determine the deposit capacity, etc., of radioactive species. It is estimated that the value of the radioactive substances which could be extracted from Russian locales could cover the entire cost of the World War

From this short sketch it is clear that in the period from 1918 to 1921 both scientific and applied scientific work did not come to a stop. In these years a number of scientific institutes have been established whose work has brought valuable results, but of course much more still remains to be done. The isolation of individual workers and institutions is still felt, and a congress is especially necessary for chemists. This congress would not only refresh work, but would give the chance to coordinate more closely, to address more accurately the needs of the chemical industry at the moment, and to construct a harmonious, sustained plan for further work uniting all scientific institutes and institutions. An All-Russian Mendeleev Congress of Chemists is currently being organized by the Russian Physico-Chemical Society with the participation of the chemical department of VSNKh... The Congress is expected to open in May 1922 in St. Petersburg.

Translation: KH