CONTRIBUTIONS TO THE DEVELOPMENT OF CHEMISTRY MADE BY GEORGIAN SCIENTISTS OVER THE LAST FORTY YEARS

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The development of chemical science in Georgia began with the establishment of Soviet rule, when as extensive system of scientific research institutions (over 130) and schools (18) was set up.

Starting with the classical legacy left by Russian and foreign scientists, Georgian chemists have given us the scientific principles of many technological processes and have carried out theoretical research of much importance in organic, inorganic, physical, colloid and other fields of chemistry. More specifically, Georgian chemists have contributed many new data to research concerned with the nature of chemical affinity, the mechanism of chemical reactions, the colloidochemical properties of substances, the selection of absorbents and catalysts with specific properties, obtaining a high-grade refractory and binding materials, the chemistry of rare and scattered elements, new method for processing mineral and agricultural raw materials, Georgian petroleums, drinking, waste and therapeutic waters, problems of hydrochemistry, agricultural chemistry, geochemistry etc.

The Georgian scientists Professor V. M. Petriashvili and P. G. Melikishvili initiated the development of chemical science in Georgia.

V. M. Petriashvili did much valuable work in organic and inorganic chemistry. He has given us magnificent textbooks in the Georgian language on viniculture and dairy farming.

P. G. Melikishvili studied glycidic acids, peroxides, per acids, developed a number of new analytical chemistry methods, etc. During the last ten years of his life, P. G. Melikishvili carried out valuable scientific research and educational work in Tbilisi, where he served as the first principal of the I. V. Stalin Tbilisi State University. He initiated the study of Georgian natural plant resources. Many of the young chemists who studied and worked with P. G. Melikishvili later became prominent Georgian scientists.

The Soviet scientist L. V. Pisarzhevskii, a student of P. G. Melikishvili's, deserves special mention for his part in the training of highly skilled chemist-teachers and scientific workers.

Pisarzhevskyi

Under L. V. Pisarzhevskii's direction, the scientific research institute now known as the P. G. Melikishvili Chemical Institute of the Georgian SSSR Academy of Sciences was organized in 1929 around the existing Georgian VSNKh laboratory. In his capacity as director of the department of physical chemistry (1929-1934), L. V. Pisarzhevskii successfully guided the development of scientific research work in the new institute.

An outstanding role in the education of highly skilled Georgian chemists was played by the prominent Soviet scientists A. E. Favorskii, N. D. Zelinskii, A. N. Nesmeyanov, B. A. Kazanskii, S. N. Danilov, Yu. S. Zal'kind, N. A. Tananaev, O. E. Zvyagintsev, I. N. Nazarov, A. D. Dobryanskii, A. I. Oparin, N. A. Preobrazhenskii, V. M. Rodionov, V. A. Kargin, N. N. Semenov, M. A. Rozenberg, A. D. Petrov, P. A. Rebinder et al.

Agladze

Chemical science in Georgia is now being developed along the same lines as chemistry in the Soviet Union.

Georgia is first in the world in the production of manganese ore. The production of calcium permanganate and electrolytic manganese in Georgia was organized under the direction of R. I. Agladze. Numerous manganese base alloys of great technical significance have been obtained. Several associated elements have been obtained from crude manganese ores—nickel, cobalt, chromium, etc.

Under V. M. Kakabadze's direction, processes to enrich lean manganese ores and to obtain manganic catalysts have been developed, as well as other methods of employing manganese.

Special attention is being given to the extraction of barium salts from native baryta—nitrates, carbonates, chlorides, sulfates etc. besides hydroxides—and to improving the manufacture of lithopone; this work is being carried out under the direction of G. M. Kuperman. Also to the latter's credit are a method of using Tkvibuli shales to obtain dyes and coagulants, a means of obtaining alum and aluminum sulfate from terra rossa and an electrolytic method of obtaining chromium, recovering sulfuric acid, etc.

Georgia is prominent in the production of refractory and binding materials and silicates. The substitution of local trachytes for hard-to-obtain soda in glass manufacture, which was proposed by the Georgian scientists K. S. Kutateladze, A. I. Pitskhelauri, M. Sh. Khananashvili, O. K. Kurdevanidze, T. R. Gamsakhurdiya, S. S. Filatov, M. A. Merabishvili, V. I. Shapakidze, N. A. Kakabadze et al., has improved both the quality of production and the technological process. New makes of high-quality cements were obtained. Attention was focused on the manufacture of the new binding material, Gazhtsement, which has found wide use in construction.

The binding and plastic properties of the Georgian bentonite, Askangel', make it an excellent clay substitute for the manufacture of chinaware. Askangel' is used as plastic admixture in the production of fire proof water. It is also an excellent catalyst for many chemical reactions.

The Georgian clays Askanite and Gumbrin are being used with great success in the USSR as bleaching agents to replace imported floridin in the refinement of petroleum products and plant oils.

Kh. G. Purtseladze is working with the production of mineral fertilizers and manganese concentrates from manganese carbonate, which is unsuited for other purposes. The recent introduction of this method to industry is a great benefit to the national economy. The concentrates are widely used in the metallurgic industry for the production of metallic manganese and high-grade alloys, and the fertilizers are valuable in that they contain other elements beside manganese (cobalt, nickel et al.).

Ya. P. Moseshvili and his students are doing creative work in the field of inorganic chemistry. Mr. Moseshvili is directing a study of the various rare and scattered elements contained in different types of Georgian mineral resources and raw materials.

N. I. Pirtskhalava's field is the theory of solutions. He has discovered that the dissociation of fatty acids depends on the nature of the solvent and the temperature; he has also made a study of the electrical conductivity of non-aqueous solutions. The author used the electrical conductivity method to establish the formation of solvates and new complex compounds. A. A. Kalandiya and co-workers obtained new tungsten bronzes, extremely stable in relation to chemical reagents, which have found wide technical use. R. N. Nikoladze and P. V. Gogorishvili established that nitrates and nitrites form upon the action of ultraviolet rays on an oxygen-ammonia mixture (in a quartz vessel). P. V. Gogorishvili obtained a whole series of complex cobalt compounds and developed a new and original method to separate iodine from oil well waters.

Georgian chemists have done very interesting work in the field of analytical chemistry: P. V. Gogorishvili and co-workers have developed a method to determine nitrogen in various complex compounds. A tin amalgam was obtained by E. G. Davitashvili, who has proposed a new method for separating tin, copper, lead, iron, molybdenum and barium from each other. E. S. Dzhaparidze worked out conditions for assaying potassium in carnallite; she has also done valuable research on ferrocyanides. S. G. Kurashvili has contributed a potentiometric method of determining arsenic in ore and a speeded-up method of determining magnesium and calcium in manganese ore.

M. Ya. Giorgobiani has made a study of indicators and developed a volumetric method of determining zinc and lead. S. A. Beruchyan and N. D. Sadzhaya have been investigating the use of organic reagents in analytical chemistry. A fast and accurate method of determining manganese, manganese dioxide and manganate and permanganate ions in manganese compounds was developed by P. D. Tsiskarishvili. V. L. Khukhiya investigated problems of coprecipitation phenomena and the hydrogeochemistry of Georgian mineral waters. Interesting work is being done by K. A. Gamsakhurdiya in the field of potentiometry, colorimetry and chromatography, by M. A. Khundadze in the field of electrometry and by G. P. Sagaradze et al. in electrolysis.

An interesting part of the study of Georgian mineral resources and raw materials is the study of Georgian petroleum which is under way at the Chemical Institute of the Georgian SSR Academy of Sciences. The research on Georgian petroleums has emphasized the study of their fractional composition, the refining of petroleum products and the development of new research methods.

The investigations of Kh. I. Areshidze and co-workers have analyzed the composition of Georgian petroleums; the petroleum of western Georgia was found to be an excellent source of aromatic hydrocarbons. Kh. I. Areshidze studied thermal splitting of paraffin hydrocarbons and their catalytic aromatization. L. D. Melikadze and co-workers (N. G. Bekauri, T. A. Éliava et al.) have been investigating the separation of petroleum products according to their commodity properties and have studied the refining of lubrication oils. L. D. Melikadze has isolated Mirzaanite, a rubbery substance of high molecular weight, and Noriol, a crystalline product, from Georgian petroleums.

Georgia has rich coal deposits. One of the Tkvibuli deposits contains a large quantity of pitch coal—rhabdopisite—which is used in P. D. Tsiskarishvili's method to obtain plastic substitutes for phenolaldehyde plastic. V. T. Chagunava is directing research concerned with purifying industrial gases of harmful ingredients. The use of manganese mass to desulfurize fuel gases has been introduced into a nitrogen fertilizer factory and other concerns.

In the field of organic chemistry, particular attention is being given in Georgia to the study of natural resources and to the development of organic synthesis. The works of N. S. Tsitsishvili, who is carrying on P. G. Melikishvili's work, are of special merit. Working with G. I. Tsitsishvili, T. N. Kiparenko et al., N. S. Tsitsishvili studied the effects of different factors on the accumulation process of vitamin C and other products in citrus fruits. She has carried out other research as well. N. S. Tsitsishvili has studied determination of the theine content of tea leaves , the chemical composition of the walnut, many fruits, corn, potatoes, Georgian wine, et al. V. P. Gogundze studied the chemical composition of Georgian tea seeds, tung oil and saponin. Purified tea oils have many technical uses. A method was developed for the manufacture of industrial saponin, and tea oil saponin was established to possess great surface activity.

Valuable work on the utilization of plant resources to fill the need for medicinal preparations in Georgia has been done under the direction of I. G. Kutateladze. A number of biologically active substances were obtained: cardiac glycosides, vitamins, vermifuge preparations, alkaloids, et al.

S. V. Durmishidze has made a study of Georgian vineyards.

A. M. Gakhokidze, N. D. Sadzhaya and N. V. Aleksidze separated a pigment from tung oil cake. A. M. Gakhokidze and M. E. Shishniashvili obtained trihydroxyglutaric acid from the waste of pentosan-containing substances (sunflower husks, cottonseed cake, straw) by oxidation. From the waste products of tobaco (tobacco dust, stems, coarse leaves), A. M. Gakhokidze obtained citric acid.

G. I. Tsitsishvili has outlined the possible uses for the non-drying oil he isolated from the Georgian wheat, "Makhobel." N. D. Sadzhaya has established the composition of a new phosphorus compound isolated from milk. G. G. Kikodze, V. G. Gegele and I. S. Rukhadze collaborated in a work determining the composition of Georgian tea. Individual acids, aldehydes, ketones, phenols, alcohols and other organic substances were isolated from the essential oil obtained after fermentation of the tea leaf.

Sericulture is of great interest in Georgia. M. S. Bekaya and K. A. Gamsakhurdiya have investigated mulberry leaves. A. A. Nakhapetyan studied the conditions required for hydrogenating the oil of mulberry silkworm cocoons and demonstrated that this oil could serve the pharmaceutical industry as a substitute for cocoa butter. He also showed that the balsam derived from the Caucasian fir is identical to Canada balsam and studied the yield and composition of the essential oil as compared with the Siberian fir. A technological process of isolating vegetable casein from oil cake for industrial purposes was developed by the same chemist.

Intensive work is being done by Georgian chemists in the field of synthetic chemistry. The research of I. M. Gverdtsiteli and A. I. Nogaideli, scientists attached to the I. V. Stalin State University, is outstanding in the field. Their various works are concerned with the synthesis and hydrogenation of unsaturated hydrocarbons and their derivatives.

I. M. Gverdtsiteli obtained a new form of plastic from tung oil cake. A. I. Kakhniashvili, another scientists at Tbilisi State University, condensed alicyclic and cyclic compounds with phenols in the presence of Askanite and other catalysts. The resulting compounds were found to be biologically active substances (plant growth stimulators). V. P. Goguadze has been working with the synthesis of aromatic principles for use in aromatization of tea and separation of organic acids.

Very interesting work is being done on the condensation of polyatomic alcohols with esters formed from the acetylene series of glycols under the direction of R. M. Lagidze. Working with N. T. Iremadze, L. M. Chigogidze synthesized new preparations which are now used for perfume manufacture, to obtain biologically active substances, in the study of petroleum products etc.

A. M. Gakhokidze is working with the synthesis and isomerization of disaccharides. He has developed an original method of determining the structure of disaccharides. The synthesis of aldehydes from acid halide being carried out under A. A. Nakhapetyan's direction deserves special attention.

M. I. Shalamberidze has done work of great merit in the development of organic chemistry in Georgia and in the preparation of highly trained specialists. He is also the author of the first original textbook on organic chemistry written in the Georgian language.

In the field of physical chemistry, Georgian research has concentrated on chemical kinetics, surface phenomena the structure of substances, important problems of thermodynamics etc.

D. I. Éristavi and co-workers studied the physicochemical properties of the ferrocyanides of heavy metals, the effect of ultra-short waves on various chemical compounds, important geochemical problems etc. Éristavi proposed an original method of determining manganese, lead, zinc, calcium etc. and has established the typical formulas of the ferrocyanides.

V. I. Kokochashvili has been working with problems of kinetics and photochemical reactions. A. Ya. Vardukadze investigated the adsorption of electrolytic ions to the surfaces of compounds of high molecular weight. G. V. Tsitsishvili studied the intramolecular hydrogen bond and investigated the association of hydrogen halides and the nature of hydrogen imide in certain heterocycles. G. V. Tsitsishvili is using Georgian clays to study surface phenomena.

N. A. Landiya is conducting successful investigations in the field of thermodynamics. He has developed a new and original method for determining the heat capacity of a number of inorganic substances at high temperatures.

In the field of colloid chemistry, research has continued on the study of gels and artificial and natural aluminosilicate systems. B. S. Kandelaki collaborated with I. I. Mikadze, I. D. Tavberidze, I. T. Setashvili and G. G. Kikodze on a study of the formation and properties of gels; the properties of Georgian kaolin and bentonite clays were also studied in order to determine the suitability of these clays for use in drilling oil wells.

Adsorption processes have been studied by M. E. Shishniashvili, E. M. Nanobashvili and S. N. Papuashvili. Their investigations led these authors to conclude that highly-refined aluminosilicates are electrochemically neutral substances and do not possess exchange adsorption properties.

M. E. Shishniashvili and M. Pirtskhalava have developed a rational method for chemical amelioration of Georgian red soils in order to increase the agricultural crop yield.

Nanobashvili

The new chemical field of radiation chemistry is being developed with great success in Georgia under the direction of E. M. Nanobashvili. The effect of radiation on various organic and inorganic compounds, their oxidation, reduction etc. are being investigated. Radiochemical transformations in certain heterocyclic systems containing nitrogen, sulfur, phosphorus etc. have been investigated.

E. M. Nanobashvili and co-workers have used physicochemical analysis and electrochemical and radiochemical research methods to study reactions forming the sulfides of iron, copper, zinc, lead etc. and of rare and scattered elements. She has developed new analytical methods, including a novel and original method of using radioactive sulfur and selenium isotopes to determine small quantities of rare and scattered elements.

The investigations outlined above are a measure of the vigorous development of the scientific research carried out by Georgian chemical scientists during the forty years of Soviet rule in Georgia.

The present large-scale development of the chemical industry will stimulate Georgian chemists to new and further advances in scientific research.