POLAROGRAPHIC PROCEDURE – 50 YEARS

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Fifty years ago Heyrovsky published a paper on electrolysis with a dropping mercury cathode in the Czechoslovak journal "Chemické Listy." This was the start of contemporary polarographic analysis. Even in its first few years this method showed great promise for solving various problems in analytical chemistry. V. I. Vernadskii and A. N. Frumkin showed particular interest. A. P. Vinogradov made a special study of this method in Czechoslovakia in the thirties, and was thus responsible for one of the first publications on the polarographic method in the USSR– A. P. Vinogradov, "The polarographic method in analytical chemistry," Proceedings of the All-Union Conference on Analytical Chemistry (1933).

Extensive development of the method began in the second half of the thirties, when E. S. Burkser began to direct courses on polarographic analysis at Odessa, and production of the first Russian polarographs commenced.

The polarographic method was of interest to analysts because of its sensitivity, the possibility of determining several ions at the same time, and prospects for automation of analysis. The number of publications on this subject rapidly increased. Thus in 1940 some 40 papers on the polarographic method were published in various journals printed in the USSR. Amongst these were papers by S. I. Sinyakova, T. A. Kryukova, Yu. I. Usatenko, and Ya. P. Gokhshtein.

In 1939 there was a Section on Polarographic Analysis at the First All-Union Conference of Workers in Plant Laboratories.

The war years delayed further development of the method. Its further development began only in the years 1946 to 1948. New investigators then entered the field: E. M. Skobets, Yu. K. Delimarskii, Yu. I. Vainshtein, V. F. Toropova, and A. G. Stromberg. These are now the leaders of the polarographic schools in the Soviet Union. During this period centers for polarographic analysis were already being formed at Moscow, Kazan, Kiev, Dnepropetrovsk, Rostov, and other cities. Apart from the extension of classical polarographic analysis with a dropping mercury cathode, Yu. K. Delimarskii, E. M. Skobets, and Yu. S. Lyalikov began the development of polarography at solid electrodes and the particularly interesting new field of polarography in fused media. Development of the method was assisted by the publication in 1948 of a translation of the fundamental monograph, Polarography, by I. M. Kolthof and J. J. Lingane. From this time onwards began the introduction of the method into the practice of the analytical laboratories of scientific research institutes and plant laboratories. Numerous papers appeared, dealing with the analysis of technical products: steels, nonferrous metals, products of chemical industry, ores, and minerals. It was about this time that increased development commenced in the polarography of organic compounds.

The end of the forties and the beginning of the fifties were characterized by the further development of classical polarographic analysis and further development of methods for amperometric titration (O. A. Songina and Yu. I. Usatenko). The method appealed to investigators, and particularly to plant workers, because of the simplicity of the equipment and the speed of determination. In 1952 about 15% of the publications on polarography were devoted to amperometric titration. Another method, amalgam polarography, was introduced at the beginning of the fifties and was widely used subsequently. At the same time, development began in the Soviet Union of another important branch of polarographic analysis, namely oscillographic polarography. S. B. Tsfasman and Ya. P. Gokhshtein, working in Moscow, and R. Sh. Nigmatulin, in Kazan, constructed the first Soviet oscillographic polarographs. A number of instrument construction plants began the commercial production of various models of Russian polarographs. This facilitated the further development of the method and its wide-scale introduction, not only into scientific research laboratories, but into plant laboratories.

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An important event in the development of the polarographic method was the publication in 1959 of the first comprehensive Russian monograph, Polarographic Analysis, by T. A. Kryukova, S. I. Sinyakova, and T. V. Aref'eva. This gave the theory of the method, including its later developments, and correlated experience on the practical uses of polarography for the determination of various elements and the analysis of many practical materials. For many years this was the essential reference book for all polarographists in the Soviet Union.

The First All-Union Conference on Polarographic Analysis was held in Kishinev in 1959. This considerably facilitated the association of polarographists, the exchange of views on directions for the development of polarography, its possibilities, and its practical use. From then onwards a conference on the polarographic method in the USSR became traditional, and was held regularly every two or three years.

The beginning of the sixties was characterized by the development in the Soviet Union of new branches of polarographic analysis—alternating current, pulse, and radio frequency polarography, variants of amalgam polarography, inverse and other forms of polarography. The use of these considerably improved the sensitivity and resolving power of the method, made possible the construction of a variety of automatic concentration meters based on polarography, and promoted the use of polarography for the solution of theoretical problems.

Today, both in significance and development, the polarographic method occupies one of the first places among electrochemical methods. It is specified in a number of All-Union State Standards and technical specifications and is widely used in the practice of industrial laboratories. Polarographic techniques have been described for the determination of nearly all the elements in the periodic system, including the actinoid and lanthanoid series, and many sparsely distributed elements. The method is being used increasingly for the analysis of organic substances.

If we look back on the progress of polarography in the 50 years of its existence, and 40 years' development in the USSR, we can clearly see the advances made. There is no large industrial or scientific research laboratory where the method is not employed for a variety of purposes. It can be used with advantage for determining trace impurities, at concentrations of the order 10^{-6} to 10^{-8}%, in specially pure materials. Polarographic methods are widely applied for investigating complexes in solution elucidating the structures of organic compounds, studying reaction kinetics, and for solving various theoretical problems. The polarographic method reveals great possibilities for dealing with the immediate tasks of technical progress.