Jaroslav Heyrovský, the inventor of polarography

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Jaroslav Heyrovský (1890–1967) an eminent Czechoslovak scientist, was born in Prague on 20 December 1890. He invented polarography, an ingenious method of studying electrochemical phenomena using a polarizable electrode, and it fetched him the 1959 Nobel Prize for Chemistry.

Heyrovský used liquid mercury dropping regularly from a capillary orfice into the solution as an ideal polarizable electrode. By applying different voltages between the dropping mercury electrode (DME) and a suitable reference electrode (see Figure 1), he found that the changes in current in the circuit were characteristic of the depolarizer (oxidizable or reducible component) present in the solution. The change in current, caused by the oxidation or reduction process, when plotted as a function of the applied voltage, forms an S-shaped curve/wave (see Figure 2). The potential corresponding to the midpoint of the wave, called the half-wave potential, $E_{1/2}$, is characteristic of the redox couple, and the current corresponding to the height of the wave is proportional to the concentration of the depolarizer in the solution. Since the DME produces a constantly renewed fresh metallic surface, the current–voltage curves are perfectly reproducible. Thus the method tells us both about the kind and amount of the depolarizer present in the solution, even at very low concentrations.

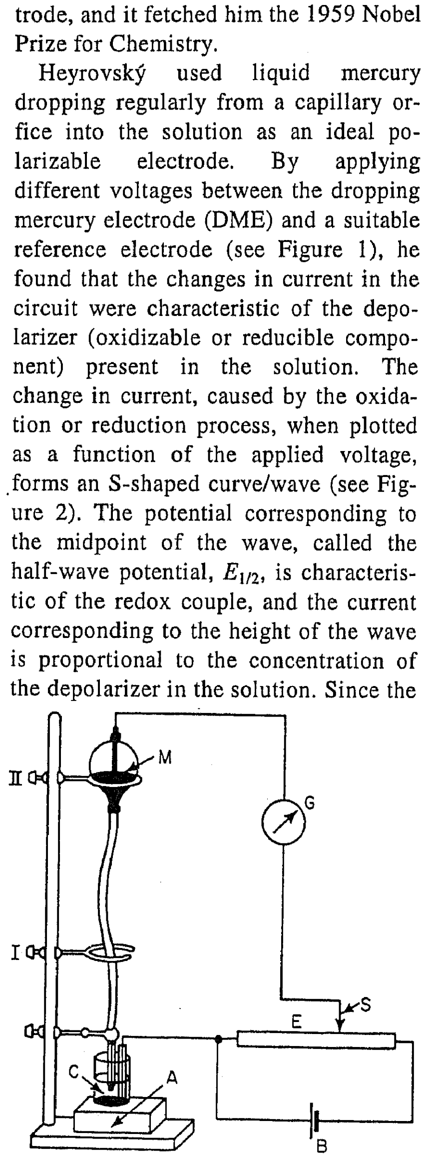

Figure 1. The polarographic circuit. Main parts: The electrolytic cell (C) with the tip of the capillary electrode dipping into the solution and a pool of mercury at the bottom as the reference electrode. Mercury from a reservoir (M) flows through the capillary. The e.m.f. from the battery (B) is applied to the cell through a potentiometer (E) and the current is measured by the galvanometer (G). (From *Practical Polarography*, by J. Heyrovský and P. Zuman, Academic Press, London and New York, 1968.)

This made polarography a very reliable and widespread analytical method. In addition, over the years, it has become an excellent method of studying various electrochemical and interfacial processes in inorganic, organic and biochemical contexts. Heyrovský's first polarograph (Figure 3) has been gradually improved into a versatile, portable and computerized version (Figure 4). Thus Heyrovský's wishful dreams have now become a reality.

Jaroslav Heyrovský's biography has been published on many occasions during his lifetime and after. Of these, the version published in the *Collection of Czechoslovak Chemical Communications* by his former pupil, R. Brdička in 1950 on the occasion of his sixtieth birthday, is considered as the most authentic account. He was born as the fifth child of Klára and Leopold Heyrovský, Professor of Roman Law at the then called Czech Charles-Ferdinand University. After completing the primary school in 1901, he studied in the Akademické Gymnasium and his favourite subjects were mathematics and physics. In 1909 he passed the maturity examination and joined the Philosophical Faculty of the Czech University in Prague and specialized in physics, chemistry and mathematics. He was most impressed by the lectures on inorganic chemistry by B. Brauner and on physics by F. Záviška and B. Kučera.

At this time, as he was very much taken by the achievements of Sir William Ramsay, he went over to London, matriculated in 1910 and started his studies in the University College. There he followed enthusiastically the lectures by W. Ramsay and W. C. McC. Lewis on general and physical chemistry, by F. T. Trouton and A. Porter on physics and by L. N. G. Filon on mathematics. His father financed his education. In 1913 he obtained the B Sc degree of the University of London. In that year Ramsay retired and was succeeded by the eminent physical chemist, F. G. Donnan. Through him Heyrovký turned to electrochemistry and soon became a demonstrator in the practical class of physical chemistry during 1913–1914. Heyrovký's experimental work was decisively influenced by the research topic for the D Sc thesis suggested by Donnan, viz. the determination of the electrode potential of aluminium. The passivity of this metal made it necessary to amalgamate its surface. However, the fluctuations of the electrode potential caused by the evolution of hydrogen led Donnan to advise Heyrovský to use a dilute aluminium amalgam dropping slowly out of a capillary, so that the electrode surface was constantly renewed. Donnan himself had used a dilute sodium amalgam dropping from a capillary for his study of membrane equilibria. The experience Heyrovský gained during these investigations laid the foundations for his future work; and his contacts with the eminent personalities left their imprints on him.

When Heyrovský returned home for the summer in 1914, his work at the University College got interrupted by the outbreak of World War I. He was then offered the facilities to continue his researches in the laboratory of J. S. Šterba–Böhm at the Chemical Institute of the University of Prague. In 1915 he was summoned for military service and due to his weak physical constitution, he was posted in a military hospital as a dispensing chemist and roentgenologist till the end of the war. This gave him enough time to complete his work and present his dissertation entitled 'The electro-affinity of aluminium' to the Philosophical Faculty of the Czech University in Prague. He thus obtained the degree of Philosophiae Doctor (PhDr) in 1918, after passing the final examinations. During the examination in physics, his teacher, Bohumil Kučera questioned him about the electrocapillarity of mercury. From the textbook on electrochemistry by F. Plzák and J. Baborovský, Heyrovský had prior