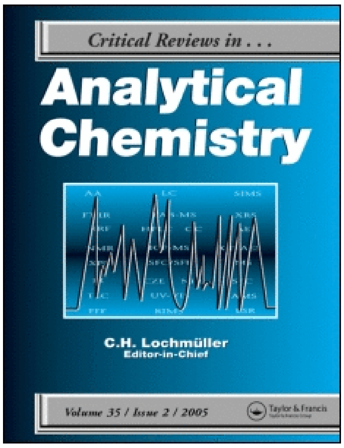

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Petr Zuman

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Electrolysis with a Dropping Mercury Electrode: J. Heyrovský's Contribution to Electrochemistry

Petr Zuman

Department of Chemistry, Box 5810, Clarkson University, Potsdam, NY 13699–5810

ABSTRACT: History of the development of the polarographic method from the birth of Professor Jaroslav Heyrovský in 1890 until the Nobel Prize award in 1959 is described. Background of the Nobel Laureate's family and education is given. Factors contributing to the discovery and development of the method are discussed.

On December 20, 1890 a son, Jaroslav Heyrovský, was born in Prague into the family of Leopold Heyrovský, Professor of Roman Law at Charles University. The juristic tradition had run in his family since the eighteenth century. Leopold's wife, Klára, born Hanlová, was a daughter of a state administrative officer. Young Jaroslav had three sisters (later married to a painter, a lawyer, and an officer, respectively) and a brother (who became an entomologist). Leopold was an advocate of Czech autonomy, friend of T.G. Masaryk (who later became the first president of Czechoslovak Republic), and author of the textbook The History and System of Roman Law which went through five editions.

Jaroslav Heyrovský as a child had great fantasy — together with his brother Leopold he created complex novel fairytales, the action of which took place in the streets of the Old Town quarter of Prague. He loved music and became an accomplished piano player. At high school he participated in chamber music, and his great love was Wagner's music. As a student, he attended the festival at Bayreuth. In his youth he enjoyed sports, in particular soccer, hiking, skiing, and swimming.

In 1901 Jaroslav entered high school (Akademické Gymnasium) in Prague, taking courses in Latin for 8 years and Greek for 5 years. His interests first encompassed botany and zoology, mineralogy and astronomy, but later turned to physics, mathematics, and chemistry. He became interested in the newly developing interdisciplinary field of physical chemistry and made up his mind to study this discipline. In 1909 he passed his final examination (called "maturity examination") at the high school and matriculated in the Faculty of Philosophy of the Czech University in Prague. During his freshman year he took courses in chemistry, physics, and mathematics and was strongly influenced by the lectures of B. Brauner on inorganic chemistry, as well as those of F. Záviška and B. Kučera on physics.

As there was no opportunity to study physical chemistry in Prague, young Heyrovský became attracted by British educational institutions. He was impressed by the work of Sir William Ramsay and was therefore thankful to his rather strict father (who was at the time Rector of the Czech University in Prague and was rather feared as examiner by the students of law) for the permission to continue his studies in London. In the fall of 1910 he matriculated at University College, part of the University of London, and attended the lectures on general and physical chemistry by Sir William Ramsay and William C. McLewis, on physics by F.T. Trouton and A. Porter, and on mathematics by L.N.G. Filon. In 1913 he received the B.Sc. degree of the University of London. In that year Sir William Ramsay retired. One wonders how Heyrovský's career would have developed, if this had not happened.

Ramsay was succeeded by the eminent physical chemist F.G. Donnan whose main research area was electrochemistry. Young Heyrovský was appointed demonstrator (teaching assistant) for the school year 1913/14 and started experimental research under Professor Donnan on a project involving determination of the electrode potential of aluminum. The use of the simple Nernst equa-

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tion for treatment of the potential of this electrode is prevented by a layer of oxides and other passivity effects. This adsorbed layer hinders the exchange reactions, and the measured potential is not a simple function of aluminum ion concentration. Moreover, the evolution of hydrogen causes fluctuations of the measured potential. Heyrovský grasped well several fundamental scientific problems involved and formulated in his laboratory notebook (which he was accustomed to keep carefully into advanced age) the following questions: "What is the mechanism of hydrogen evolution?" "In which way is the potential of an electrode established?"

When experiments with solid aluminum electrodes did not yield satisfactory results, Professor Donnan advised Heyrovský to use a dilute aluminum amalgam and suggested that he let the amalgam flow slowly out of a glass capillary. This approach was based on the assumption that the continuous renewal of the surface would prevent passivation phenomena. This was a device similar to that used earlier by Donnan in his study of membrane equilibria.

Heyrovský's experiments with aluminum amalgam were only slightly better than those with solid aluminum electrodes, as the evolution of hydrogen affected the measurements. However, even when the results were negative for the solution of the particular problem, these studies strongly influenced Heyrovský's future studies. He saw the advantages of liquid metallic electrodes, in particular their periodically renewable surface and he learned how to use capillary electrodes.

Laboratory notebooks bear witness of that in London as later in Prague, Heyrovský spent almost all his time carrying out experimental research. Days upon days were spent in the laboratory. The stay in London had a profound effect both on his way of thinking, on his conduct of research, and on his life style. The visible signs were his laboratory notebooks, which until the end of his life were written in English, afternoon teas with his co-workers and a courtly approach to both visitors and subordinates.

The experimental work in London was interrupted in the summer of 1914. Heyrovský was visiting his parents in Prague when World War I broke out and he was unable to return to London. For a short time he was able to carry out some experiments using facilities made available by Professor J.S. Štěrba-Böhm at the Chemical Institute of the Czech University at Prague. In January 1915 he was called up for military service in the Austro-Hungarian Army, but because of his weak physical constitution he was posted as dispensing chemist and roentgenologist in a hospital at Tábor in South Bohemia. Here he was unable to carry out experiments, but his notebooks indicate that he was able to carry out evaluation and discussion of the experimental data obtained in London. In 1916 the hospital was transferred to Igls (close to Innsbruck in Austria) where Heyrovský was able to carry out limited experiments in the pharmacy, dealing mainly with dissolution of aluminum in acids and alkali metal hydroxides. He was also able to prepare his thesis, entitled *The Electro-Affinity of Aluminium*, which he submitted to the Philosophical Faculty of the Czech University in Prague. He passed his final examinations, and on September 26, 1918 was granted the Ph.D. degree.

Final examinations consisted in a longer oral examination in the major field-chemistry and a shorter examination in the minor field-physics. It was the examination in physics that strongly affected Heyrovský's scientific career. The examiner was B. Kučera (1874–1921), Professor of Experimental Physics, who gave him a question dealing with the electrocapillarity of mercury. Heyrovský knew that examiners at this level often ask questions that have some relation to their own work, and was prepared for it. Professor Kučera had developed a new experimental technique for the measurement of electrocapillary curves based on weighing the mercury drops fallen from a glass capillary, connected to a mercury reservoir. Such measurements of electrocapillary curves showing the dependence of the surface tension of mercury on its electrochemical potential were alternative to those using a capillary electrometer, introduced in 1873 by G. Lippmann. As Heyrovský was knowledgeable of Kučera's research, the examination became a discussion, during which Professor Kučera described to the candidate some of his results obtained recently. In those experiments, some of the electrocapillary curves obtained with the dropping mercury electrode showed discontinuous maxima that were absent on electrocapillary curves recorded in the same solution using the capillary electrometer. Professor Kučera expressed the view that such anomalies could be explained only by a physical chemist and proposed to the candidate that he should carry on the research of the surface tension of mercury electrodes to which a voltage has been applied.

Professor B. Kučera invited Heyrovský to visit him the following day in his institute and showed him how to construct the dropping mercury electrode, using a glass capillary connected to a mercury reservoir placed so high above the capillary that a drop of mercury would fall from its orifice every few seconds. He also advised him to collaborate on the tedious weighing of mercury drops with Dr. R. Šimůnek, who was at that time an assistant of experimental physics. For the next 2 years the two young scientists spent their free hours collecting drops of mercury that had fallen from the capillary electrode at varying voltages, weighing them accurately and plotting the weight as a function of the applied voltage.

The electrochemical work proceeded slowly. In January 1919 Heyrovský was appointed Reader in the Department of Inorganic and Analytical Chemistry. The head of this department was Professor B. Brauner, a former intimate friend of D.I. Mendeleev and R. Abegg, one of the early proponents of the periodical system and proposer of the use of the value 16.00 for the atomic weight of oxygen. Brauner, who was particularly interested in the chemistry of lanthanides, directed Heyrovský's attention to the problems of chemical affinity and valency. The work on aluminic acid, the structure of aluminates and amphotericity, reflecting the influence of the environment in Professor Brauner's laboratories, was submitted by Heyrovský as a "Habilitation Thesis." In 1920, Heyrovský published three papers summarizing his studies on aluminum[1] and submitted them for the D.Sc. to the University of London that conferred the degree on him in 1921. Based on this research, Heyrovský was appointed on August 2, 1920 as the first Docent (Associate Professor) in Physical Chemistry at the Czech University in Prague, henceforth called Charles University.

This new appointment demanded from Heyrovský organization of a laboratory and a series of lectures on physical chemistry. Nevertheless, all of his spare time in the Institute of Physical Chemistry was devoted to the study and interpretation of electrocapillary curves. These experiments were rather time-consuming.

Heyrovský developed a modification based on measurement of the drop-time which shortened the time spent by drying and weighing mercury drops. Furthermore, Heyrovský observed the changes in electrocapillary curves in the presence of some metal ions, such as Zn^{2+}, Cd^{2+}, Mn^{2+}, and Ba^{2+} and studied the possibility of measuring their deposition voltages using such an approach. He reported his results at a meeting of the Czech Mathematical and Physical Society in the fall of 1920, at which Professor B. Kučera participated, who unfortunately did not live to see the full success of his pupil, because he passed away in 1921.

The laboratory notebooks of J. Heyrovský indicate that during 1921 he came to the conclusion that electrocapillary curves are not suitable for investigation of the processes occurring at the dropping mercury electrode. Sometime toward the end of 1921 the idea to measure the current flowing through the electrolysis cell was developed. The first experiment to measure such current was carried out on January 1, 1922 but was not fully successful because Heyrovský did not have a sufficiently sensitive galvanometer. He spent the rest of January remeasuring electrocapillary curves, but at the same time tried to acquire the needed instrumentation. Because limited funds did not allow for the purchase of a galvanometer, he contacted his former teacher of physics, Professor F. Záviška, who loaned to him a sensitive galvanometer and a potentiometer. On February 10, 1922, J. Heyrovský built a circuit consisting of a potentiometer, an electrolytic cell and the galvanometer. He placed a solution of 1 *M* NaOH into the cell, immersed a dropping mercury electrode into this solution and added some metallic mercury to form a mercury pool electrode that was used as a reference electrode. The current flowing between the dropping mercury and mercury pool electrodes was indicated by the galvanometer. Already, when a small voltage was applied, Heyrovský observed and recorded that the galvanometer indicated a weak current, the intensity of which oscillated rhythmically with replacement of drops. With stepwise increase in voltage the current increased somewhat and at a more negative voltage increased again. These current increases corresponded to reduction of oxygen, which was understood in detail by Heyrovský only later. In the region between –1.9 and –2.0 V, Heyrovský observed on February 10, 1922, a substantial increase in current, corresponding to deposition of alkali metal ions (Na^+) forming an amalgam, and that became the center of his interest. Thanks to his background in electrochemistry, Heyrovský clearly recognized that he was on the track of an important scientific discovery.

During the following weeks his normally high intensity of work was raised to a feverish pitch. Every page of a 200-page-thick notebook was filled with laboratory notes during a period of 7 weeks. One week after he recorded the first current-voltage curve he restricted his experimental work to obtaining such curves. Soon he realized that oxygen is reduced at the dropping mercury electrode (D.M.E.) in two steps and also that the current due to oxygen reduction interferes with measurements of currents due to other reduction processes. From the beginning of April, Heyrovský removed the dissolved oxygen (present in solutions in contact with air) by bubbling through the solution in the electrolytic cell a stream of hydrogen that he generated in a Kipp apparatus.

Heyrovský was aware that it is of importance not only to make a discovery, but that it is necessary to make one's colleagues aware of the results. He described the results of his first experiments on electrolysis with a dropping mercury cathode in Czech in the October issue of the journal "Chemické listy"[2]. He nevertheless realized that publication in the Czech language limits the news to a relatively small circle, and so he prepared an English version dealing with electrodeposition of alkali and alkaline earth metals, which was published in *Philosophical Magazine*.[3] He followed Newton's motto "A man must resolve either to put out nothing new or to become a slave to defend it." In this year Heyrovský was promoted to extraordinarius (Associate) Professor. He also became the head of the newly established Department of Physical Chemistry at Charles University. The excitement and feverish activity during this period took its toll and Heyrovský had to take leave on July 12, 1922 from which he returned only on October 27.

When Heyrovský resumed his teaching duties in the fall semester, he was joined by his first five graduate students. He was also joined by the Japanese physical chemist M. Shikata who came from his research stay in Berlin. Heyrovský reported on November 26, 1923 in London at the General Discussion of the Faraday Society dealing with electrode reactions and equilibria about his research.[4,5] In the first of these contributions Heyrovský recognized that at sufficiently low concentration of the metal ion, a limiting current (that over a range of applied voltage remains practically independent of applied voltage) can be observed. The S-shaped increase of the current followed by the limiting current was denoted as "wave." He also concluded that at such conditions the ions in the vicinity of the electrode are exhausted by reduction and that the current intensity depends mostly on the number of metal ions transported into this space by diffusion. He also pointed out that the position of the wave on the potential axis is characteristic of the reduced species and can be used for qualitative analysis. M. Shikata, at the same meeting, reported[6] the possibility of carrying out the reduction at the D.M.E. in a nonaqueous system — in sodium ethoxide. In the following year, the Japanese chemist reported also the first reduction of an organic compound, nitrobenzene.[7,8]

The progress of the extension of investigation of the electrolysis with the D.M.E. by J. Heyrovský and his research group to other species and systems was limited by the fact that the point-by-point measurements and plotting of current-voltage curves was tedious and time consuming. Considerable improvement was achieved in 1924, when the cooperation of J. Heyrovský and M. Shikata led to the construction of an apparatus[9] that registered current-voltage curves automatically. The new instrument recorded photographically such a curve in several minutes, whereas manual recording took an hour or longer. Development of an automatic method of recording, a short time after the discovery of the new technique, played an important role in the development and dissemination of methods based on electrolysis with D.M.E. Currently, most physicochemical and analytical methods are carried out using automated techniques, but in the early twenties an automated instrument represented very progressive and advanced instrumentation (e.g., recording spectrophotometers became generally accessible only two decades later).

In their joint paper, Heyrovský and Shikata proposed for the instrument the name "polarograph" and for the studies of electrolysis with the dropping mercury electrode, coined the term "polarography." Publication activity reflects Heyrovský's early recognition of the duty of a creative scientist to share his results and ideas with the scientific community. In accordance with his belief a printed inscription of Faraday's words "Work, finish, publish" was found on the walls of laboratories in which he worked and followed him wherever he moved.

In 1926 Heyrovský was appointed Professor of Physical Chemistry at the Charles University and in the same year he married Marie Kořánová, the daughter of a brewer, and his wife who was the daughter of a cousin of J. Heyrovský's father. They married when Heyrovský was thirty-six and later he indicated occasionally to his graduate students that this is the right age for a polarographer to marry. (This particular advice was not heeded by a considerable fraction of his students.) His devoted and charming wife Marie supported and encouraged her husband during the remainder of Heyrovský's scientific career and lightened his burden by conscientiously taking care of his correspondence and collecting a bibliography of polarography, among other tasks. She gave him two children, daughter Jitka (Czech for Judith), who became a biochemist and worked in a research institute for food science, and a son Michael (named after Michael Faraday), who received his Ph.D. in Cambridge in 1966 and became an electrochemist working in the institute bearing his father's name. In 1926 Heyrovský received a Rockefeller Fellowship, which enabled him to work in the laboratory of Professor G. Urbain at the Sorbonne in Paris for 5 months.

Toward the end of the 1920s and the beginning of the 1930s about 40 co-workers were in Heyrovský's research group. Among them were four: R. Brdička, W. Kemula, G. Semerano, and D. Ilkovič, who particularly distinguished themselves in the development of polarography. Of those, W. Kemula started an active center of polarographic research in Poland. The second generation of Kemula's co-workers contributed to the flourishing of Polish electrochemistry in the 1970s and 1980s. G. Semerano had a similar impact on Italian electrochemistry; he founded a polarographic institute in Padua in the 1930s that had a profound influence on electrochemistry in the Mediterranean region.

In order to make new results obtained in Czech chemical laboratories accessible to the scientific world, Heyrovský together with his senior colleague, professor of the Prague Technical University Emil Votoček, in 1929 founded the journal *Collection of Czechoslovak Chemical Communications*. In that monthly periodical the papers by Czech authors are being published in foreign languages, at present mostly in English. Thus, the papers on polarography from the Prague group became know abroad.

The dissemination of the knowledge of polarography in the 1930s was in particular influenced by two publications in book form by Heyrovský and by his two trips abroad.

The first Czech book[10] was revised, extended, and translated into Russian, whereas an Italian monograph was published by Semerano.[11] The Heyrovský chapter in the prestigious monograph on physical methods in analytical chemistry edited by W. Böttger had a strong impact. In 1932, Böttger, a well-known analytical chemist from Leipzig, spent 2 weeks in Heyrovský's laboratories to get acquainted with the new technique before asking Heyrovský for his contribution. Inclusion of polarography in this volume[12] represented its official acceptance as an acknowledged analytical method, particularly among German-speaking chemists.

A visit to the United States in 1933 contributed substantially to the spread of the knowledge of polarography in the English-speaking world. Heyrovský was awarded a visiting professorship by the Carnegie Foundation. He crossed the Atlantic on "Europa" and the American continent by rail. He lectured for 6 months at the University of California at Berkeley, where he gave two seminars per week for the physical chemists, and one per week for the biochemists. He also gave talks at Stanford University, at the California Institute of Technology, and at the Universities of Minnesota and Wisconsin, at Ohio State University, and at Princeton and Cornell Universities. He was impressed by the American scientists and found their approach to research similar to his, but different from that common in Central Europe.

> In addition to technical culture, the modern American scientists possess high awareness in natural sciences and in general culture. Their working habits are superior to ours mostly because they are more systematic in their approach and their work is better organized. The chemists from all areas meet at least once a week for seminars and discussions about their individual research projects. All help each other altruistically, ready to assist their colleagues by sharing their knowledge and to collaborate experimentally. In this way, their approach differs sharply from ours, which is highly individualistic. Each of us is used to work as an independent unit, circumvallated by a Chinese Wall against all influences and suggestions from one's surrounding, which we treat rather with mistrust.[13]

The thriving research spirit of the Department of Physical Chemistry at the Charles University in Prague was broken up by the closing of the Czech Universities by the Nazi German occupants of Czechoslovakia in November 1939. The Czech professors were sent into early retirement; buildings, furnishings, and equipment were confiscated by the German University of Prague. Thanks to friendly efforts of Heyrovský's colleague, a quiet but personally audacious German anti-Nazi Professor, J. Böhm, his laboratory remained at his disposal during World War II. He could carry on his experiments, even though he was without students and co-workers. During this period Heyrovský was able to finish his large textbook on polarography,[14] which was considered of such importance that it was reprinted in Ann Arbor, Michigan, in 1944.

Industrial development during World War II and immediately afterward resulted in the need for sensitive and rapid methods for analysis of raw materials, intermediates, and products in metallurgy, in the heavy chemical, pharmaceutical, and food industry, in synthetic rubber manufacture and in particular in the development of atomic energy and numerous other areas. Polarography proved in many instances to be better suited to meet such requirements than other analytical methods available during that period and soon was among the five most frequently used analytical methods. The increased use of polarography was facilitated by the availability of commercially produced polarographs. The manufacture of the first such instruments was started by V. and J. Nejedlý in Prague in 1929; and the number of instruments produced increased yearly. Since 1939 polarographs have been produced by E.H. Sargent & Co. in the U.S.A. The adoption of polarography in the English-speaking world was considerably influenced by the interest of the eminent American analytical chemist I.M. Kolthoff. After a visit in Heyrovský's institute he began to publish in the area in 1939, and, together with J.J. Lingane, produced a widely accepted monograph,[15] whose two editions served as an important source of information.

The end of World War II and the liberation of Czechoslovakia from German occupation enabled Charles University to reopen in the summer of 1945. The pent-up energy of young people who had been deprived for 6 years of the opportunity to study resulted in a phenomenal upsurge in activity both in teaching and research. Papers that could not have been published for years, because Nazis did not allow publication of Czech scientific journals, appeared suddenly in print in 1947.

The Department of Physical Chemistry again became a center of polarographic research. The difficult task of the new organization, of teaching, and the reequipment of the department was undertaken by two of Heyrovský's prominent coworkers, Professor R. Brdička and M. Kalousek. After the war, the friendly help of Professor J. Böhm was for some time misrepresented by some of Heyrovský's colleagues, yet soon thorough rehabilitation followed and Heyrovský's attitude was fully justified. Delicate health due to the privations suffered during World War II forced Professor Heyrovský to limit his teaching to lectures on polarography. He, nevertheless, took part actively in seminars, in supervision of graduate students, and in travel to lecture abroad, for example, in 1947 to England, Sweden, and Denmark.

The atmosphere in the department during the period between 1948 and 1950 was the most vigorous in the development of scientific ideas that this author has ever encountered. Weekly seminars were inspiring and scientific discussions continued incessantly throughout the long working days — in the laboratories, in corridors, even in the lavatories. Progress was made by continuous reevaluation of ideas, reinterpretation of experimental results, as well as by carefully planned experiments. In all these activities all members of the group participated as equals, including first-year graduate students.

Progress in polarography in this period was demonstrated by the First International Congress of Polarography held in Prague in 1951 and the Second in Cambridge (England) in 1959.

In Czechoslovakia, the scientific and practical importance of polarography was well recognized, and hence in May 1950 the Center for Research and Technological Development founded a Central Polarographic Institute in Prague. It was one of the seven institutes founded as a kernel for the development of the reorganized Czechoslovak Academy of Sciences. Heyrovský became the first Director of this Institute, but he remained an Honorary Professor at the Charles University, where he taught theoretical and practical courses on polarography for another decade.

Professor Heyrovský was accompanied in his move to the Polarographic Institute by twelve of his most recent graduate students. They were soon joined by some of his older pupils. In this way, one of his ambitions became fulfilled — to see his co-workers, whom he taught and made interested in polarography, able to carry on research in this and related fields of electrochemistry.

In 1952 the reorganization of the Czechoslovak Academy of Sciences was realized and the Institute became the Polarographic Institute of the Czechoslovak Academy of Sciences. As the number of the research associates in the Institute increased, the space at the original site at 25 Opletalova Street in Prague became insufficient. New laboratories were established in separate buildings in various, rather distant parts of Prague. This affected the coherence of the group. To minimize effects of geographical separation, seminars were held each Thursday morning (8 to 11 a.m.) at one location. That enabled Professor Heyrovský to follow the progress of the research in the Institute and to keep in touch with the new work carried out in other parts of the world. In this period J. Heyrovský received numerous honors.

The scientific impact of Heyrovský's work was such that he was nominated several times for the Nobel Prize. At several occasions (1938, 1939, 1948) the nomination was unsuccessful because of geopolitical factors. However, on September 26, 1959 it was officially announced by the Czechoslovak radio that the Royal Academy of Science in Stockholm awarded Jaroslav Heyrovský the Nobel Prize for Chemistry. The vice-president of the Czechoslovak Academy of Sciences, V. Laufberger (a physiologist), and the Chairman of the Chemistry Division of the Academy, R. Brdička, congratulated Professor Heyrovský. Later, on December 10 in Stockholm, J. Heyrovský received the Prize from the hands of the King of Sweden.

Professor Heyrovský was naturally very happy about the appreciation of his life's work as manifested by the Nobel Prize. Unfortunately, the recognition came late in his life when poor health (circulatory and digestive problems) limited his creativity and energy, even though his reasoning remained logical and piercing. He demonstrated his capability repeatedly by his provoking questions at seminars, leading often to the heart of a complex problem.

The Nobel Prize award was very well deserved. Heyrovský was a discoverer who was scientifically well trained at the time when the opportunity of the discovery occurred. His power of observation and detection of new phenomena was remarkable, and he had the ability to sort out fundamental from peripheral information. One of his collaborators compared him to an extraordinary mushroom picker who is able to find a fine mushroom even on a highway. He soon realized both the theoretical and practical possibilities offered by the discovered technique and with all his energy tried to make these a reality. He found collaborators who were able to deal with the mathematical aspects, but he considered the theory useful only when it was shown to be in agreement with experiments and that it could lead to the design of new experiments. He mistrusted abstract theorizing, which to him seemed distant from experiments. He always favored the application of polarography in analysis, for solution of practical problems. He spent all his adult life fostering the growth of polarography in all its aspects. He did this by lectures, participation at meetings, visits to foreign centers of research, invitation of guest-workers from all over the world into his laboratories, and by publication of original papers, reviews and monographs. He was an outstanding teacher, predominantly at the graduate level. His personality made a deep impression on students in spite (or because?) of his quiet voice and he could generate great enthusiasm about polarography. He was a conscientious supervisor who visited all the research laboratories at least once a day and showed keen interest in the work in progress.

Professor Heyrovský always worked very intensely. His working day in the laboratory always was from 8 a.m. to 7 p.m., followed in his younger years by working at home during the evening. In his late years he allowed himself a short nap after lunch. He always spent weekends in the laboratories and he insisted that weekends were the only time when he could be certain not to be disturbed during work.

Not only did he work hard, but he expected his co-workers to follow suit. At the University, discussion of research projects was sometimes arranged on Saturday afternoon; at the Institute he could be seen with his pocketwatch in hand, standing a few minutes past 8 on the staircase and watching the late-comers arrive. He had the belief that the daytime in the laboratory is for experimental work and the evaluation and reading should be done in the evenings. He hated dust on the instruments ("you have to brush it every morning, like your teeth"), reading of newspapers in the laboratory, and in particular smoking. The smokers in the Institute had to go out of the building, into the garden, to smoke. Even then occasionally they had to bear some sarcastic remarks.

However, while Professor Heyrovský expected some sacrifice from his co-workers, he was himself ready to give up most of his early interests for polarography. Once a pianist and a member of a student chamber orchestra, later he was only able to listen to music. He was fond of attending the opera and knew lengthy parts of many of the operas by heart. At one time a well-known reviewer of books, when he became enchanted with polarography he hardly found time to read novels. Only when he wished to brush-up his knowledge of languages, such as before a trip abroad, did he read crime stories. However, during the 1960s he again found more time for reading and often returned to the books, which impressed him in childhood. In his youth he had, with his father, made several unforgettable tours in the high Alps. Always interested in sports, a soccer and tennis player, skier and swimmer, Heyrovský never missed making the kick-off at the traditional soccer matches between the Institute of Polarography and the Institute of Physical Chemistry (in the early days at the Charles University these matches took place between his students and those of the physicist Professor Dolejšek). In the garden of the Institute in Vlašská Street he rarely forgot to feed the squirrels.

Heyrovský's life was possibly unique in the single-minded devotion with which he pursued the subject of polarography and later applied it to numerous problems in pure and applied chemistry. Although this method attracted the attention of a large number of workers in many countries, he remained the center of these developments and continued to exert a profound influence on them, not only because of his scientific eminence but by the force of his personality, which made an unforgettable impression on the many scientists who had the good fortune to be in contact or to work with him at some time in their careers. He taught his students and coworkers by example more than most of them realized — mainly that the goal of research is not in pursuing a career, but in seeking the scientific truth.

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