Editorial

The Centenary of the Invention of Chromatography

by Leslie S. Ettre

In the second part of the 19th century, at the dawn of modern science, associations were formed by those who were interested in exploring nature and learning about the newest achievements in science. These associations originated in Germany, but also existed in other countries, among them in Russia; their name represented an adaptation of the German Gesellschaft für Naturforscher (i.e., association encompassing people interested in the exploration of nature). These groups held frequent meetings, with lectures and discussions, and some even had their own publications (the predecessors of modern scientific journals). Among other places, such a group existed in Warsaw, in the Grand Duchy of Poland, then part of the Russian Empire.

One hundred years ago, at the March 21, 1903, meeting of this local association, a young assistant at the Botanical Institute of Warsaw University presented a paper, "On a New Category of Adsorption Phenomena and Their Application in Biochemical Analysis". For those in attendance, this lecture did not mean too much; they did not realize that it represented the start of a method that eventually changed the way analysis is carried out in laboratories. The young assistant presenting the paper was M.S. Tswett, and the technique that grew out of the reported preliminary investigations is chromatography. Therefore, this year we celebrate the centenary of its invention.

Much had been published on the life and activities of Tswett, and I do not want to repeat this information. What we should rather emphasize on this occasion is the importance of Tswett's concept, radically different than the prevailing philosophy of how natural substances were investigated 100 years ago. At that time, the key words were isolation and crystallization: isolation of a single substance from an excess quantity of material and then purifying it through crystallization. For example, when Richard Willstätter was investigating plant chlorophylls, large quantities of dried poison ivy had to be worked up first. When finally a sufficient quantity of the raw substance was isolated, it was further purified by selective extraction and crystallization, and then it was studied by carrying out various chemical reactions with the compound. Tswett was the first to point out that it is not enough to isolate one single substance. One must study all of the compounds present in order to see their interaction, and in their study, one should have the individual substances as close to their native form as possible; chemical manipulations and derivative forming may alter the original substances present in nature. Tswett also demonstrated that chromatography (the method he described for the first time in this lecture) can provide separated substances that are at least as pure as the classical methods of extraction and crystallization. This belief represented a radical change in the philosophy of organic-biochemical research, and it took 30 years until it was

generally accepted. This Tswettonian concept—to use the expression of Professor Csaba Horváth—places his contributions to science on the same level as those of Lavoisier and Bunsen, the two founders of modern chemistry.

In his work, Tswett used liquid adsorption chromatography in columns. In the decades following his activities, his technique had been extended to other variants such as partition chromatography, gas chromatography, and electrochromatography, and besides columns separation is also carried out on paper or thin-layer plates. In this way, Tswett became the father of a large family of separation methods we characterize today as differential migration processes. Today, there is practically no chemical or biochemical laboratory in the world that does not use of some form of chromatography. In the 100 years since its invention, it became the most widely used laboratory technique. In addition, scale-up versions also find use in preparative/process scale applications.

Unfortunately, Tswett could not enjoy the merits of his invention. Educated in Switzerland, he could never fully implement his knowledge in Russia, the country of his ancestry. His short life was characterized by a constant struggle to obtain a decent position, suitable conditions of life and work, and acceptance of his results by his peers, but in vain. He dreamt of a permanent and stable position that was worthy of his knowledge, one in which he could establish a laboratory and create a scientific school of his own. Instead, he would occupy only relatively minor positions, and in the last years of his life he was forced to wander from place to place. He died in the prime of his life, in 1919, without being able to achieve these goals. His achievements were recognized only decades after his death.

We generally attribute the name "chromatography" to two Greek words, χρομα *(chroma) and* γραφειη *(graphein), together meaning "color writing". This explanation is, however, pure speculation. Tswett, who first used this expression, never stated this meaning. At the same time, there is another explanation. The meaning of Tswett's name in Russian,* цвет*, is "color"; thus we may interpret the meaning of chromatography as "Tswett's writing". Every time we speak of chromatography, we refer to him, and the name of our journal also commemorates his activities: in these ways, we perpetually honor the creator of chromatography.*