

György Inzelt

Patent No. 2,058,761—or the beginning of electrochemical instrumentation

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Editorial

About 40 years ago, when I started my studies at the Eötvös Loránd University, Budapest, there were several instruments (e.g. pH meter, polarograph, spectrophotometers) even in the students' laboratories. Nevertheless, we had to assemble devices—we were told for educational reasons—and applied those to measure, e.g., cell potentials, electrolysis (polarography). We had to utilise our eyes as detectors of light intensity although in these cases we already used commercially available Pulfrich visual photometers or polarimeters. I really hated the determination of electromotive force by compensation technique à la Poggendorf and later by using bridge circuits for measurements of electrochemical cell impedances. Today, students and researchers that employ computer-assisted instruments for the control of the measurements and for the acquisition of the data probably do not miss these experiences. My students are smiling sympathetically when I show them the old “Kohlrausch-Walze” that I inherited from my late Professor T. Erdey-Grúz, which is now in our small chemistry museum, or my X-Y recorder, and I try to explain them how happy I was 25 years ago when I could buy it. The revolution in instrumentation caused by the personal computer that started about 15 years ago led to a really new age regarding laboratory techniques. I do not feel nostalgic for the India ink, either, that I used to draw my figures. The computer programs almost automatically construct the figures, one can send the manuscript electronically which sped up the time of publication.

Nowadays, one can buy many things that were impossible to get in the time of our grandparents. We

got accustomed to taking medicines which are the products of chemical industry or watching distant events on colour television or to talk to everybody from practically everywhere by the help of a mobile, cellular phone. We seldom think of the inventors and scientists whose work made all these developments possible. It seems strange that there were times when no laboratory instruments were available commercially; and it was not long ago, either.

Seventy years ago, a 34-year-old scientist, in order to make the work of his former classmate easier, constructed an instrument: The inventor obtained a patent for his “Apparatus for Testing Acidity” (US Patent No. 2,058,761). Although originally designed to measure the acidity level in lemon juice, the instrument, which was later called a pH meter, quickly became a ubiquitous tool in chemical laboratories. Why did this invention change the world of both laboratory research and routine analysis? Earlier the chemists had to build their measuring apparatus from components which required a fair knowledge of electrical circuits and devices. This new conception utilising the vacuum-tube technology made the construction of an integrated instrument possible where all the electronics were placed in a box, the electrodes could be connected easily and reading the data from the display of the built-in meter was an easy thing. It did not require a deep understanding of electronics to operate, i.e. practically everyone could handle such an instrument. (That is the bright side of this technological breakthrough. The drawback is that the instruments always display certain values, and it needs expertise to realize the possible errors.) By using a vacuum-tube amplifier—that was invented in 1906 by Lee De Forest—the precise detection of very small currents and potential differences became possible even in systems of high resistance.

It is strange, but the name of the inventor practically sank into oblivion. In the 1960s, there were already so many firms that produced pH meters that nobody cared who fabricated the first one. I encountered his name in connection with his other invention, since in my

G. Inzelt
Dept. of Physical Chemistry,
Eötvös Loránd University, P.O. Box 32,
1518 Budapest, Hungary
E-mail: inzeltgy@para.chem.elte.hu

“Instrumental Analysis” textbook there were descriptions of spectrophotometers and a remark that the first modern spectrophotometer was developed by him in 1941. I was also unaware that the Helipot, the excellent helical potentiometer was also his invention.

The impact of the creation of precise, sensitive, portable, easy-to-use instruments cannot be overestimated. They have been playing a crucial role in the rapid development of research but also in the mass production of chemicals including medicines, the quality control of foods and drinks, the safety or even the mere existence of high-flying aircrafts or nuclear power plants, mentioning only a few areas from the almost infinite varieties.

After 1947 the transistor replaced the vacuum-tube amplifiers and newer and newer generations of instruments have appeared in which the new inventions such as integrated circuits (1958), microchips (1959) and personal computers (1981) were utilised. Although the new stars outshine the old ones, it is proper and also instructive to remember the beginning and the inventor whose work opened up new vistas and made our work much convenient.

The name of the inventor of the first pH meter (and also many other instruments) was Arnold Orville Beckman. He died on May 18, 2004 at the age of 104.