Celebrating the 75th Anniversary of the ACS Division of Analytical Chemistry: A Special Collection of the Most Highly Cited Analytical Chemistry Papers Published between 1938 and 2...

ARTICLE *in* ANALYTICAL CHEMISTRY · MAY 2013

Impact Factor: 5.64 · DOI: 10.1021/ac401048d · Source: PubMed

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Editorial

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Celebrating the 75th Anniversary of the ACS Division of Analytical Chemistry: A Special Collection of the Most Highly Cited Analytical Chemistry Papers Published between 1938 and 2012

The year 2013 marks the 75th anniversary of the founding of the ACS Division of Analytical Chemistry. The Journal and the Division have been integrally linked over their history and together share a common mission to promote the field of analytical chemistry as a critical scientific endeavor. We present a virtual issue of the most highly cited papers published in *Analytical Chemistry* between 1938 and 2012 that recognizes this shared history of promoting key scientific discoveries and achievements in our field.

As described in a recent article by Roland Hirsch recounting the history of the ACS Division of Analytical Chemistry (DOI: 10.1021/ac4002386), the journal *Analytical Chemistry* grew out of the *Analytical Edition of Industrial and Engineering Chemistry*, founded in 1929, and then was established as a monthly supplement to *I&EC* in 1937. In 1942, Walter J. Murphy became the editor of the *Analytical Edition* and expanded the scope of the journal beyond its prior emphasis on analytical methods and news by inviting research papers, especially those describing new instrumental techniques. *Analytical Chemistry* was introduced in 1947 as an independent journal and quickly grew to be the flagship of our field. The Division was first established as the Microchemical Section of the Division of Physical and Inorganic Chemistry and was recognized as an independent Division of Microchemistry in 1938. In 1949, the name of the Division was changed to the Division of Analytical Chemistry, recognizing the expansion of the field beyond microchemical analysis to include a broad range of techniques and approaches for quantitative and qualitative chemical measurements.

How has the field of analytical chemistry changed over the lifetime of the Division? Here we highlight a collection of papers from *Industrial and Engineering Chemistry, Analytical Edition* (1938−1946) and *Analytical Chemistry* (1947−2012). In creating this virtual issue, we initially selected the 75 most highly cited papers published in the Journal since its founding. We quickly realized that this approach weights the results toward papers published early in this period, and many of the papers that are currently impacting the science of analytical chemistry have not yet reached sufficient citations to overcome this historical bias. Instead we decided to include the single most highly cited paper published in each of the past 75 years. The papers in this collection were identified using the number of citations listed in the Web of Science on February 18, 2013, and the number of citations follows the listing for each paper. A caveat to this approach is that the papers identified as the "most highly cited" published in recent years may not stand the test of time. For example, the most highly cited paper from 2012 had only 20 citations at the time this analysis was performed. Even with this limitation, we feel that the papers in this list mark many of the most significant developments in analytical chemistry over the past 75 years and show how the field has progressed over its history.

In compiling this special collection, we considered only research papers. For many years, the Journal also published A-page articles, now called Features, which provided introductions to an important analytical approach, application, or technique. In 1973, 1983, and 1991, an A-page article was the most highly cited *Analytical Chemistry* publication. Although these articles are not included in this special collection, we list them here: "Simplex optimization of variables in analytical chemistry" by S. N. Deming and S. L. Morgan (*Anal. Chem.* **1973**, *45* (3) A278−279); "Limit of detection" by G. L. Long and J. D. Winefordner (*Anal. Chem.* **1983**, *55* (7), A712−724; and "Matrix-assisted laser-desorption ionization mass-spectrometry of biopolymers" (*Anal. Chem.* **1991**, *63* (24), A1193−1202) by F. Hillenkamp, M. Karas, R. C. Beavis, and B. T. Chait.

Several trends are discernible. Manuscripts in *Analytical Chemistry* have been more highly cited than those published in the *Analytical Edition of International and Engineering Chemistry*, in part because of the age of those papers and the association of our field with the name "analytical chemistry." Perhaps the change in scope of the Journal that accompanied its evolution, and that led to the name change, contributed to the publication of papers relevant to fields beyond the specialty of analytical chemistry. Indeed it is this aspect of analytical chemistry that ensures its continued vitality as an area of scientific research.

It also is not too surprising that methods for chemical derivatization feature prominently in the list of highly cited papers, especially those from the early years. Papers published early on focus on derivatization for colorimetric determinations of tryptophan (1948), inorganic phosphate (1949), NO_2 (1954), sugars of various types (1950, 1953, 1956, and 1959), and iron (1970). In fact, the most highly cited paper in this collection is "Colorimetric method for determination of sugars and related substances" by Dubois et al. in 1956, which has received 23 713 citations thus far. The 1971 paper by M. Roth, "Fluorescence reaction for amino acids", was another important scientific achievement.

The rising prominence of instrumental methods is also obvious from this list, including infrared spectroscopy (1952, 1978), thermal analysis (1957), and XPS (1977). Papers related to separations are also prominent, including paper chromatography (1951), and derivatization methods for gas chromatography (1959, 1960, and 1961). The paper by J. R. Whitaker, "Determination of molecular weights of proteins by gel filtration on sephadex" published in 1963, illustrates an early analytical chemistry contribution foreshadowing the molecular biology and proteomics revolutions. Ion-exchange chromatography with electrochemical detection was the topic of the most highly cited paper in 1979. Another landmark publication was the first report of capillary electrophoresis by Jorgenson and

Published: May 7, 2013

dx.doi.org/10.1021/ac401048d | *Anal. Chem.* 2013, 85, 4201−4202

Lukacs in 1981. Several highly cited papers grew from this initial report, including two publications by Terabe et al. describing micellar electrokinetic chromatography, which were the most highly cited papers for 1984 and 1985, and in a 1986 paper by Lauer and McManigill, "Capillary zone electrophoresis of proteins in untreated fused-silica tubing". The most highly cited article in 1992, "Capillary electrophoresis and sample injection systems integrated on a planar glass chip", helped launch the lab-on-a-chip revolution. The most highly cited papers of 1998, 2006, and 2008 also report innovations in microfluidic devices.

Electrochemistry is another area that is prominent among the most highly cited papers. The 1965 paper by R. S. Nicholson describes the "Theory and application of cyclic voltammetry for measurement of electrode reaction kinetics". In 1980, "Rotating-ring-disk enzyme electrode for biocatalysis kinetic-studies and characterization of the immobilized enzyme layer" by Kamin and Wilson laid much of the groundwork for enzyme-based biosensors. This theme reoccurs in 2009 using a graphene-based biosensor, again using glucose oxidase. Another landmark paper by Bard et al. describing the new technique of scanning electrochemical microscopy was the most highly cited paper of 1989.

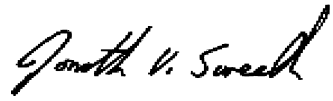
Methods for data analysis and chemometrics are also prominent in this list, beginning with the 1964 landmark paper "Smoothing + differentiation of data by simplified least-squares procedures" by A. Savitzky and M. J. E. Golay. Other highly cited papers discuss methods for smoothing and least-squares (1972), SIMPLEX optimization (1974), and derivative spectroscopy (1976).

More recently, advances in proteomics have been driven by innovations in the analysis of mass spectrometry data, the topics of the most highly cited papers published each year during the period of 2000−2004. Indeed, new mass spectrometry techniques feature prominently in the most highly cited papers of the past 25 years. HPLC coupled with atmospheric pressure ionization mass spectrometry was reported in 1987, followed by "Laser desorption ionization of proteins with molecular masses exceeding 10 000 Da" by Karas and Hillenkamp in 1988. In 1994, the most highly cited paper by Mann and Wilm introduced peptide sequence tags, and in 1996, the sequencing of proteins from silver-stained polyacrylamide gels was reported. In 1997, Caprioli et al. described the use of MALDI-TOF mass spectrometry for biological imaging, and in 1999, Clauser et al. discussed the role of accurate mass measurements in protein identification strategies and database searching. Electron capture dissociation of protein cations was the most highly cited paper of 2000, and a new ion source (DART) for ambient mass spectrometry measurements was reported in 2005.

While space limitations prohibit a discussion of each of the most highly cited *Analytical Chemistry* papers of the past 75 years, we have tried to highlight the most significant trends and encourage you to browse the virtual issue. We eagerly look forward to coming developments in the next 25 years. Future discoveries will continue to open up new fields within analytical chemistry and enable important scientific discoveries in far-reaching fields, including biology, medicine, materials, and the environment.

We hope you enjoy perusing the articles as much as we enjoyed compiling the collection.

Cynthia K. Larive,[†] 2013 Chair ACS Division of Analytical Chemistry



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dx.doi.org/10.1021/ac401048d | *Anal. Chem.* 2013, 85, 4201−4202