Fifty years ago, in April 1955, Walsh published his
paper “The application of atomic absorption spectra to
chemical analysis” in *Spectrochimica Acta* [1] (see
Fig. 1). This paper marked the official birth of a new
method of instrumental analysis: atomic absorption
spectrometry (AAS). Before presenting the history of
the discovery and evolution of atomic absorption spec-
trometry, which I gladly had the honor of considering in
this work, let me briefly inform the reader about the
author of this method.

Alan Walsh graduated from the world-famous (due
to the discoveries of Rutherford, Bohr, Moseley, and
Bragg) Manchester University in 1938, and, after the
beginning of World War II, moved to London and
started his work at the Spectrochemical Laboratory of
the British Non-Ferrous Metals Research Association.
He was engaged in the development of atomic emission
spectroscopy and its application to the analysis of met-
als and alloys, and particularly to the development of a
universal spark generator for spectrographic analysis.
This generator was then produced by Hilger Crystals
Company.

In 1946, Walsh decided to apply for the position of
the head of Spectrochemical Division of the Australia
Commonwealth Scientific and Industrial Research
Organization (CSIRO). After the second interview (the
first was not successful, because the official interview-
ing the applicants doubted about the Walsh’s leadership
abilities), he moved to Melbourne. Among the areas of
his research in those years were Raman and IR spec-

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**The application of atomic absorption spectra to
chemical analysis**

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**Summary**—The theoretical factors governing the relationship between atomic absorption and
atomic concentration are examined and the experimental problems involved in recording atomic
absorption spectra are discussed. On the basis of the discussions, it is shown that such spectra
provide a promising method of chemical analysis with vital advantages over emission methods,
particularly from the viewpoint of absolute analysis. It is also suggested that the absorption
method offers the possibility of providing a simple means of isotopic analysis.

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Fig. 1. Alan Walsh’s paper marked the birth of atomic absorption spectrometry.
troscopy, on which he published around 20 papers between 1947 and 1953 [2].

FLAME ATOMIC ABSORPTION SPECTROMETRY

Having worked in atomic emission spectroscopy for six years and in molecular absorption spectroscopy for another six years, Walsh mused more and more on why the spectroscopic studies of molecules are usually based on measurements of absorbed radiation, whereas studies of atoms involve measurements of emitted radiation. Walsh recollected later [3] that on a Sunday morning in March 1952, while working in his garden, he suddenly realized that one should not ignore atomic absorption spectra. Moreover, their use is often preferred over the use of emission spectra. The next morning, Walsh performed his first experiments. Using a sodium discharge lamp as a light source and a town-gas flame for atomizing a sodium-containing solution, he obtained the result he wanted. Deeply excited, he said to his colleague John Willis, who also worked in IR spectroscopy: “Look, that’s atomic absorption!”

“So what?” was Willis’s answer. His reaction foreboded the indifference of researchers to Walsh’s project in the coming years. This actually happened. Neither his applications to a number of optical companies in Great Britain and United States with proposals to commercially introduce his project (1953), nor the demonstration of a laboratory model of an atomic absorption spectrometer at an exhibition of research instruments in Melbourne in March 1954 (Fig. 2) awakened any interest in the proposed method. Strictly speaking, this was not so. An attempt at commercially producing an atomic absorption spectrometer was made by the Hilger and Watts Company. This company got an exclusive license and produced a small lot of instruments in 1956–1958. Unfortunately, the manufactured model was assembled on the basis of a standard UV spectrophotometer without signal modulation, as was recommended by Walsh in [1]. Because of the superposition of flame radiation, high-temperature flames (acetylene–air among them) could not be used with this instrument. As a result, the idea of an atomic absorption spectrometer had been more damaged than popularized. In 1958, the CSIRO Company had to revoke the license.

Not only Walsh’s first paper [1] but his subsequent publications with colleagues [4–6], describing his experimental results, have long remained little noticed. J.P. Shelton, Walsh’s co-author in a number of papers, recollected that AAS was taken more like a scientific curiosity rather than an analytical technique for practical application. It seems that the only exception was paper [1] arousing enthusiasm in the author of this paper in mid-1956, when he performed his first experiments in atomic absorption spectrometry using a graphite furnace instead of a flame. These experiments, which formed the basis of electrothermal atomic absorption spectrometry (ET AAS), are closely related
to the further history of AAS and will be considered below.

Despite the indifference of researchers, Walsh and his colleagues were not only able to develop reliable sealed hollow-cathode lamps [5], but also to arrange for the production of simple do-it-yourself instruments (see Fig. 3) at a number of small companies in Australia. Between 1958 and 1962, about 30 laboratories in Australia were equipped with AAS instruments. However, as an instrumental method of analysis, AAS was universally (mainly in the United States and Europe) accepted only in 1963, when Perkin-Elmer manufactured the first specialized flame atomic absorption spectrophotometer (model 303), designed by Kahn and Slavin [7].

This important period in the history of atomic absorption spectrometry was preceded by a curious event. When visiting Perkin-Elmer in the United States in 1962, Walsh spoke about the successful expansion of AAS in Australia. After Walsh’s speech, Chester Nimitz, Vice President of Perkin-Elmer asked: “If this god-dam technique is as useful as you say it is, why isn’t it being used right here in the United States?” Walsh’s reply was as follows: “We have to face up to the fact that, in many things, the United States in an underdeveloped country!” The decision on the commercial production of this instrument was taken immediately.

Within the next years, some other companies also started the production of instruments; the total number of AA spectrometers steadily increased and exceeded the threshold of 2000 instruments per year in 1966. The proposal for a high-temperature acetylene–nitrous oxide flame by Walsh’s colleagues Amos and Willis in 1965 [8] favored the further expansion of AA spectrometers. The optical and electronic systems of AA spectrometers have now been significantly improved, and the analytical procedure has been automated. A specialized journal Atomic Absorption Newsletter, edited by W. Slavin, has been published since 1962. In view of the expanding application of AAS, Willis expressed his “apprehension” that, by the end of the 20th century, the whole surface of the Earth might be covered with AA spectrophotometers. However, this “catastrophe” did not come.

Moreover, interest in flame AAS had declined by the end of 1960s. In his basic review “Atomic absorption spectrometry–stagnant or pregnant?” [9], Walsh wrote that the main problem with flames, i.e., the incomplete atomization of samples, still remained unsolved: “I remain convinced that the best means of extending the range of application of atomic absorption methods of analysis is by developing new methods of atomization. In the first place, so-called flameless methods of atomization, based on developments of the L’vov furnace, have in the last two years become of rapidly increasing importance, and their full potentialities have by no means been fully exploited.”

ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY

The history of the development of ET AAS is very similar to the history of flame AAS. The author of this paper graduated from Leningrad State University in 1954, having spent two years at the Department of Physics and three and a half years, at the Department of Chemistry. (For the sake of convenience, the first person is used below.) Having started my work at the State Institute of Applied Chemistry in Leningrad in 1955 as a senior researcher, I was for many years engaged in the spectrochemical analysis of materials labeled with...
radioactive and stable isotopes. Writing abstracts of papers in the abstract journal Khimiya (Chemistry), I accidentally came across Walsh’s paper [1] at the end of 1955. The possibility of developing an absolute analytical method that required no certified reference materials, about which Walsh wrote in [1], seemed to me very attractive, and I decided to pursue this problem in my free time. During my summer vacation in 1956, when the other researchers of our laboratory were gone, I seized the opportunity of making the first experiments on the visual observation of atomic absorption at the D-line of sodium. This was done using a dismountable hollow-cathode tube that I assembled for isotope analysis, a tubular graphite furnace heated on a stand for the fractional distillation of volatile impurities from non-volatile matrices, and a glass-prism monochromator. The gradual decay of the bright sodium line while increasing the temperature of the furnace, right down to its complete disappearance, was so terrific that had a decisive effect on my scientific interests and, in many respects, my life for many years.

As in the case of Walsh, the reaction of the researchers of our spectral laboratory was far from optimistic. Even G.I. Kibisov, the well-known Russian specialist in spectrochemical analysis who first supervised my scientific research at the institute, repeatedly expressed his concern about my “risky” enthusiasm.

Nevertheless, I was able to assemble a rather cumbersome laboratory setup for quantitative measurements. I consciously selected an isothermal furnace (graphite cuvette) as an atomizer, which is evident from the record in my laboratory journal (see Fig. 4). It was easy to understand that measuring the absolute value of an analytical signal in AAS was only the first condition of absolute analysis. Another problem that was not considered by Walsh in [1] was the need in an atomization technique to ensure the complete vaporization of a sample, atomizing and holding it within a limited furnace volume (like in a cell in molecular absorption spectrometry). I tried to persuade myself that solving this problem would suffice for a candidate’s dissertation.

Using the assembled setup (see Fig. 5), I was able to demonstrate the obvious advantages of graphite cuvettes over flames in sensitivity, the range of analytes (the C2H2–N2O flame was still unknown), and even the possibility of absolute analysis. These results were presented at the All-Union Congress on Spectroscopy held in Moscow in October 1958 and published in 1959 in Inzhenerno-fizicheskii zhurnal [10, 11]. However, analytical spectroscopists still showed little or no interest in the new method. According to the data from the Institute of Scientific Information (ISI) in Philadelphia, papers [10, 11] were cited only three times for the six years between 1960 and 1965. This can partly be explained by the low availability of the journal to analytical spectroscopists. Paper [12], published in 1961 in Spectrochimica Acta, was cited a little bit more often (11 times for four years). Nevertheless, even leading Russian spectroscopists (Prokof’ev, Zaidel’, Mandel’shtam, Nedler, and others) were relatively unrealistic (more likely critical) when talking about the prospects of the new method. I was only able to defend my candidate’s dissertation six years after starting my research, and then with difficulty.

The research was hindered not only because of the lack of moral support from the scientific community, but also because I had to work alone for ten years, without any help from other researchers (the “initiative” topic did suit the official plans of our institute). I had to do everything myself, from constructing chambers for graphite cuvettes to turning graphite components (furnaces, contacts, electrodes) on a lathe. In addition, the State Institute of Applied Chemistry, where rocket fuels were studied for the defense industry, was a closed-door institution (especially for foreigners). Faced with dismissal or tough sanctions, the researchers of our
institution could not go abroad, meet or correspond with foreign scientists, publish papers abroad without official permission of the ministry, and so on. This also hindered traffic in ideas and the progress of the method.

In spite of this, I could significantly improve the equipment and analytical procedure over the next decade. I first used electrodeless discharge lamps in AAS for a large group of volatile elements, proposed and used pyrolytic graphite in furnace coatings, and elevated argon pressure in the atomizer. The arc heating of the electrodes with the sample was replaced by simple ohmic heating, and a method for measuring time-integrated absorption (pulse area) was proposed and substantiated. The automatic correction for nonselective spectral interferences using a deuterium lamp was implemented in ET AAS for the first time. These improvements were described in a series of papers [13], monograph [14], and its English translation [15]. They were also implemented in the design of a laboratory AA spectrometer with a graphite cuvette (see Fig. 6).

However, only two researchers in Russia expressed any interest in the new method. They were G.I. Nikolaev (Prometei Central Research Institute, Leningrad) and E.M. Sedykh (Research Institute of Vacuum-Tube Glasses, Moscow). Nikolaev not only convincingly demonstrated the analytical potentialities of ET AAS, but also developed a new line of research dealing with the study of the thermochemical properties of metals and alloys [16]. Sedykh’s attempts to use the proposed technique for analyzing glasses were less successful because the equipment was too cumbersome and unreliable, and the analytical procedure was rather complex.

The publication of the paper by Hans Massmann [17] from the Institute of Spectrochemistry and Applied Spectroscopy in Dortmund in 1966 was an important milestone in the further development of ET AAS. Note that his interest in ET atomizers had appeared under unusual circumstances. After World War II, he spent several years in a prisoner-of-war camp near Moscow, where he learned Russian. After returning to Germany, he was able to read my first publications [11, 12] in Russian earlier than the other researchers in the West. Being a more practical person than his predecessors, Massmann significantly simplified both the design of the furnace and the analytical procedure by replacing sample vaporization into an isothermal furnace using an additional electrode with its vaporization from the furnace wall while heating the furnace. This “modernization” of the graphite furnace proved fatal to the electrothermal atomizer.

It was quite natural that I wanted to know Massmann better. As sometimes happens, this became possible. In 1967, the first conference on atomic absorption spectroscopy was organized in Prague on the initiative of the well-known Czech analytical spectroscopist Ivan Rubeska. I was invited to this conference as a speaker, and our ministry surprisingly did not forbid my participation in the conference, as it did earlier in the case of an international conference on isotopes held in Leipzig in 1963. (By that time, I had already published more than ten papers on isotopes [13], and these were noticed by the specialists.) However, because secrecy was required (!), I had to go to Prague as a representative of the Commission on Spectroscopy of the Academy of Sciences of the USSR rather than of my institute.

In Prague, I was able to meet not only Massmann, but also some other well-known specialists in spectroscopy (in particular, Alkemade and Fassel). However, my acquaintance with Walter Slavin, head of the AAS
Division of Perkin-Elmer (Fig. 7), was of the greatest importance. His suggestion to collaborate on the commercial production of electrothermal atomizers seemed to me very attractive. However, any contacts (with US researchers!) in the midst of the cold war could have disastrous consequences for both me and my scientific carrier. Therefore, after thinking about it for a while, I proposed that Massmann’s design of the electrothermal atomizer be used as a prototype of a commercial atomizer. I pointed to the simplicity of the analytical procedure and the possibility of dosing large volumes of sample solutions (including organic solutions) into the furnace.

Slavin later wrote in [18] that he went from Prague to the branch enterprise at Bodenseewerk in South Germany and, after discussing the project for a week, argued that his colleagues accept Massmann’s furnace as a model. Bernhard Welz, who had begun his work in the company not long before (and had participated in the conference in Prague), was sent to Dortmund. With his assistance, the first commercial electrothermal HGA-70 atomizer was put on the market of AA spectrometers in 1970 [19]. This device was supplied as a supplement to the flame AA spectrometer. Almost 15 years had passed since I had conducted my first experiments in 1956!

The laboratory tests of the atomizer substantiated that it greatly increased sensitivity as compared to flames and stimulated the interest of analysts in this method. However, the euphoria of this advantage soon changed to disappointment. The matrix effects were so pronounced that quantitative analysis remained an open question. Here is a typical reaction of one analyst [20]: “It has been apparent for some time that the greatest barrier to the acceptance of flameless atomization as a normal tool in AAS is its susceptibility to matrix interferences.” I felt uncomfortable over the growing distrust of the development of ET AAS. In any case, I was wholly responsible for the situation, having recommended Slavin the evidently flawed idea of a nonisothermal furnace as a prototype for a commercial atomizer.
At the beginning of 1975, I was offered the position of the Head of the Department of Analytical Chemistry at the Leningrad Polytechnical Institute. Among the advantages of the new position was relative freedom from the secrecy limitations at the Institute of Applied Chemistry. I seized the opportunity and bargained for collaboration with the Perkin-Elmer Company. By the middle of 1976, our department had received the necessary research equipment, a Model 603 spectrophotometer and an HGA-76 atomizer. (In return, our department was obligated to organize joint workshops on theoretical and applied problems in AAS. These workshops were attended by many Russian and foreign researchers (see Fig. 8.) Together with my graduate students, I turned to searching for methods that allowed the elimination or even reduction of the effect of nonisothermal furnace conditions on the results of analysis. Of the several methods tested (graphite probes for introducing samples into the furnace by analogy with graphite cuvettes, pulse heating of the furnace with a capacitance power supply, and sample vaporization from a pyrolytic graphite support at the furnace’s center), the last was found to be the simplest and most efficient.

The results of this research were presented at the 6th International Conference on Atomic Spectroscopy in Philadelphia at the end of 1976 and at the Perkin-Elmer workshop [21]. Slavin’s response was quick and sure. The last method, which was named the L’vov Platform, was implemented by the company in 1978. The reputation of commercial electrothermal atomizers as a reliable method of AAS analysis was restored!

The furnace with the platform provided Slavin with the basis for the development of the Stabilized Temper-
calculated and experimental values of physical parameters, the correlation between the calculations of the calculation model and errors in the values atomization conditions. With regard to the approximations of the calculation model and errors in the values of physical parameters, the correlation between the calculated and experimental values of $m_0$ was found to be better than satisfactory. The average value of the $m_0$ (calcd.) : $m_0$ (exp.) ratio for a group of 32 elements was $0.85 \pm 0.10$. One can hardly find an instrumental method of analysis (at least among optical and mass spectrometry techniques) for which the theoretical interpretation of the analytical signal is so reliable.

Unfortunately, uncontrolled changes in the atomization conditions (the age of the furnace and the quality of the pyrolytic coating) and the radiation of the light source (lamp type and age, the conditions of its operation, and spectral slit width) do not allow the absolute or even the similar calibration of all instruments of the same type in routine analyses. Nevertheless, within one laboratory or a single atomic absorption spectrophotometer under completely reproducible (although not optimum) measurement conditions, calibration can be relatively stable in time. Along with the elimination of matrix interferences ensured in STPF systems, this property earned the trust of analysts for ET AAS.

As in flame AAS, progress in ET AAS for the last 20 years of the 20th century was not great. I can hardly remember anything other than isothermal furnaces with transverse heating and the use of suspensions for the direct analysis of solid (powdered) substances. There were once again symptoms of stagnation in AAS. In the late 1980s, one of the leading spectral analysts G. Hiftje, while noticing a decrease in the number of publications in AAS, wrote in [25]: “If current trends continue, I would not be surprised to see the removal of commercial AAS instruments from the marketplace by the year 2000.” Nevertheless, AAS remained one of the leading instrumental methods, particularly in comparison to the most impressive and popular techniques based on inductively coupled plasma mass spectrometry (ICP MS). In spite of its obvious advantages in detection limits, rapidity, and the possibility of multielement analysis (including isotope analysis), the latter method remains very expensive from the viewpoint of equipment cost and current expenses and is relatively complex in operation. (We can hardly imagine that this method could be used, for example, in clinics or at city water laboratories.) In addition, the method is not free from serious matrix interferences, particularly in the analysis of complex and highly concentrated solutions.

### A NEW CENTURY AND A NEW REVOLUTION?

The end of the 20th century was marked by the publication of a special issue of Spectrochimica Acta in the memory of Sir Alan Walsh. The issue was a collection of brilliant articles written by many active participants of the AAS project. Among these was an excellent review of the indubitable leader in the state-of-the-art AAS Bernhard Welz. “Atomic absorption spectrometry—pregnant again after 45 years” [26]. While considering the prospects for the further development of AAS, Welz noted the following three main lines of development: (1) the use of diode lasers as light sources, (2) solid sampling for ET AAS, and (3) the development of continuum-source AAS.

#### Semiconductor diode lasers (SDL). These devices, which have found wide application in telecommunications systems, CD players, laser printers, and even laser pointers, possess a number of properties for which they are very attractive for spectrochemical analysis, including AAS. First, they emit energy several orders of magnitude greater than conventional light sources and possess an amazing stability. This makes semiconductor diode lasers key devices in measuring low absorption signals. Second, the spectral width of the emitted radiation is two orders of magnitude narrower than the widths of absorption lines in flames and furnaces. This opens up possibilities for extending their dynamic range by measuring absorption at line wings. Third, the possibility of wavelength modulation allows corrections to be introduced for nonselective interferences.

The main limitation of commercial semiconductor diode lasers today is that their spectral region is restricted to 630 nm. Therefore, even with frequency doubling, these devices cannot be used in the region shorter than 315 nm. Nevertheless, the authors of [27] supposed that SDLs could be used for the development of simple and inexpensive (without the use of monochromators) analyzers for determining some metals (e.g., Al and Cr) and some nonmetals (in particular, S, Cl, and inert gases) that possess highly populated excited energy levels.

#### Solid sampling for ET AAS. Although the direct introduction of solid samples into graphite furnaces was used even in the 1960s [14], progress in the instrumentation and automation of the dosing process has until recently been limited to demonstration experiments. However, there is interest in such devices due to...
the growing production of high-technology materials (heat-resistant metals and alloys, semiconducting ceramics, and so on). All of these materials are highly pure and difficult to dissolve. According to the data of Hornung and Krivan [28], by excluding dissolution and increasing sample mass to several dozens milligrams, one can lower the detection limit for the majority of elements by one or two orders of magnitude in comparison to the most efficient ET AAS method for analyzing suspensions. In one analysis of tantalum and tungsten powders, the detection limits were as low as 0.01–0.1 ng/g. It is important that the use of the STPF technique allows one to use aqueous analyte solutions in analyzing solid samples. In the works by Krivan and his colleagues, the direct dosing of solid samples was implemented on a completely automated (including the weighing step) device manufactured by Analytik Jena AG.

**Continuum spectrum sources.** The greatest prospects for AAS in the future centre around continuum spectrum sources (CSSs). For the last 50 years, AAS has been based on the use of line sources (hollow cathode lamps and electrodeless discharge lamps). On the one hand, this has ensured absorption measurements at the center of the absorption line (even using low-resolution monochromators), a dynamic range of two to three orders of magnitude, and a low limit of the absorption signal. On the other hand, this made AAS a single-element method of analysis. For many years, the construction of spectral instruments characterized by high resolution over the spectral region seemed improbable.

A breakthrough was made only recently in the development of not only a corresponding polychromator but also of a powerful CSS (xenon arc lamp) and a two-dimensional solid-state detector. The combination of these technological achievements provides an opportunity for changing AAS into a multielement analytical method. It has now been shown, using the example of a linear detector with a resolution of about 2 nm/pixel, that atomic absorption can be measured not only at the center but also at the wings of the absorption line, which extends the dynamic range (in concentrations or masses) by five to six orders of magnitude. In this case, the detection limits for absorption signals are even lower than those attained with line sources [29].

As before, the time necessary for the implementation of the new potentials in corresponding commercially produced instruments will depend on whether the instrument-making companies are ready to use the above technological achievements, and on the policies of company management.

**CONCLUSIONS**

Considering the history of the discovery and development of AAS for the past 50 years, one cannot but admire the simplicity and even obviousness of its basic ideas. In [3], Walsh wrote about this with his usual modesty and wit: "My development of the atomic absorption spectrophotometer originated in one sublime moment during which I was able to avoid being stupid." He characterized the idea of an electrothermal atomizer in the same way [30]: "The essence of his (L’vov’s) idea is to completely vaporize a small analysis sample and to measure the transient absorption signal. In retrospect this ingenious idea may appear simple and almost obvious. But I am sure that many other spectroscopists had considered, as I had, the possibilities of furnace atomization and failed to see how it could be used because we thought only in terms of steady-state systems."

On the other hand, it is surprising how difficult it was to persuade the colleagues and the scientific community that these simple ideas were attractive and deserved to be implemented as an industrial technology. The gap between the birth of the idea and its introduction into analytical practice was 10 years for flame AAS and 15 years for ET AAS.

Walsh’s great contribution was that he not only reverted to the idea of AA analysis put forward by Kirchhoff and Bunsen a century ago [31] but worked patiently for many years to implement the idea. In this respect, his contribution far beyond that of Cornelius Alkemade, who published his work with the description of a flame AA photometer as early as 1955 [32],

![Fig. 9. Sir Alan Walsh (1916–1998).](image-url)
virtually simultaneously with the work of Alan Walsh [1]. In 1980, while comparing his first work with Walsh’s research, Alkemade wrote in [33]: “The historical development of AAS since 1955 shows that the mere proposal and demonstration of a new method is not sufficient to effect its actual application in analysis. The birth of a new idea alone does not automatically lead to its acceptance as a member of an established family. An adequate follow-up, including the propagation of the idea, the optimization of the necessary equipment and its trying-out in practice are at least as important as the birth. In this respect, the efforts that have been made at the CSIRO, for example, to construct simple, practical hollow-cathode lamp for various elements have been a decisive factor in the success of AAS… In regard to the last point, nobody will hesitate to acknowledge Sir Alan Walsh as the “Father of AAS.” My real (but late) “discovery” in this time was mainly my realization that the absorption flame photometer described in our 1955 paper was an important invention—important, but thanks to the pioneering work of Walsh and his associates.”

Alan Walsh (Fig. 9) was given many distinctions and awards. He was elected an Honorary Member of the Society of Analytical Chemistry of Great Britain and Japan Society for Analytical Chemistry. He was also a member of the Royal Society of London, the Australian Academy of Science, and the Royal Swedish Academy of Sciences. He was awarded Talanta Gold Medal, the Royal Medal of the Royal Society of London, the Robert Boyle Medal of the Royal Society of Chemistry (London), and the Karolinska Institute Medal (Sweden). He also won the Maurice Hasler Award of the American Society of Applied Spectroscopy (SAS) and the XXVII Colloquium Spectroscopicum Internationale (CSI) Award. In 1977, Walsh was made a knight and awarded the title of Sir Alan.

However, the attempts of many scientists to nominate Alan Walsh for the Nobel Prize in chemistry failed. (A grievous mistake of the Nobel Committee!) To a certain extent, this could have been due to intellectual snobbery; Walsh wrote in [34] that this “results in many scientists believing that any type of scientific activity which has some real bearing on industry or commerce is intellectually and socially inferior to the so-called pure research.”

However, there is no doubt that the analytical community will consider AAS, the discovery of which is associated with the name of Sir Alan Walsh, to be one of the most brilliant achievements of the 20th century in instrumental analysis. The pioneering contributions of Walsh and L’vov, Slavin, and Koirtyohann to the development of atomic absorption analysis [35–38] were marked with panache at the annual 1991 James Waters Symposium (Fig. 10).

I was lucky not only to participate in this fascinating project for almost 50 years but also to find many new friends, among whom I can happily mention the names of Alan Walsh, Walter Slavin, and Bernhard Welz, outstanding gentlemen and true giants of atomic absorption spectroscopy.

REFERENCES