THE NAMES BEHIND THE DENVER CONFERENCE AWARDS

THE BIRKS AWARD IN X-RAY SPECTROMETRY

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ABSTRACT

The Birks Award in X-ray Spectrometry was established by the Denver X-ray Conference in honor of Laverne Stanfield (Verne) Birks, Jr. to pay tribute to scientists who have made significant contributions to the practice of X-ray spectrometry.

INTRODUCTION

The Birks Award in X-ray Spectrometry was created by the Denver X-ray Conference in honor of Laverne Stanfield (Verne) Birks, Jr. and his contributions to the field. The Award is presented in alternate years at the beginning of the Plenary Session of the Conference, the awardee being chosen by a committee made up of previous awardees, the chairman of which is the most recent.

VERNE BIRKS AND HIS CONTRIBUTIONS

I could discuss his growing up in Rockford, IL, or his attendance at the University of Illinois, where the Physics Department almost decided not to give him his degree because he had taken a course in X-rays from Professor Clark who was in the *Chemistry* Department, or his service as a Naval Officer at NRL during WW II, or his graduate work leading to a Masters Degree in Physics from the University of Maryland while continuing at NRL as a civilian.

But I will not dwell on these subjects but rather tell you a few of the contributions he made to the fields of X-ray analysis, X-ray Fluorescence (XRF), X-ray Diffraction (XRD), and Electron Probe Microanalysis (EPMA).

It was in the mid-1940's, when he was first working as a civilian at NRL after his military service, and with Herbert Friedman, that they noticed a high background fog on some Debye-Scherrer XRD films taken using a copper tube, performing X-ray diffraction studies of steel specimens. Since they knew that copper radiation was just the right energy to excite iron to give off its fluorescence efficiently and remembered some previous work[1] applying X-ray excitation as an elemental analytical tool, they decided they could apply some present-day (for the time) technology to advance the application. They took advantage of two previously studied components, the sealed X-ray tube for excitation suggested by de Broglie, and the Geiger-Müller tube for detection as used by Jönsson, to construct what has become the conventional basic geometry, even today, for a wavelength dispersive X-ray fluorescence analyzer, adapting the

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XRD instrument used for aligning quartz crystals[3]. Thus began an illustrious career in X-ray emission, to enhance the reputation he had gained after working in X-ray diffraction for only a few years.

It was when Herb Friedman moved on to work in Space Science, specifically X-ray astronomy, that Verne became the Head of what was then called the X-ray Optics Branch at NRL, leading a team of between six and ten physicists, chemists, and one mathematician. The difficulty with the humidity-sensitive NaCl crystal used in that first instrument led Verne to begin a study of crystal diffraction for the dispersive element, which went on for many years, including the determination of the how the efficiency of LiF varied with the surface treatment, and how it compared with pyrolytic graphite[2], as well as what long spacing crystals might be effective for the dispersion of long wavelength radiation[4]. After deciding that a helium atmosphere was too difficult to maintain sufficiently stable for the analysis of the low atomic number elements, the obvious alternative was vacuum, and such a device was assembled[5]. It was several years before such a commercial vacuum instrument was available.

One of the important parameters determining the intensity of the X-rays emitted from an element is the excitation efficiency. After making measurements of the K-line intensity emitted by atomic numbers 22 to 47 when excited by primary wavelengths between 0.3 Ä and the K-absorption edge of each element, using a proportional counter to measure both the primary and secondary intensity, it seemed only natural to compare these results with similar measurements using electrons and protons as the excitation quanta[6]. This activity was a significant contribution to what we know now as proton induced X-ray emission (PIXE) and electron probe microanalysis (EPMA). The ability of the proportional counter to discriminate among different energies, used to advantage in those measurements, was the inspiration for what we now know as energy dispersion X-ray fluorescence (EDXRF), and was advanced further by what I believe was the first application of a multichannel analyzer to X-ray analysis[7]. Of course, it was the development of the solid state detector by the Nuclear Physics community that made EDXRF into the present day technique that we all know and love.

The development of EPMA in France by Castaing, led a few researchers around the world, only about a half dozen in the beginning, to construct similar, but not identical, instruments to investigate the potential of such a device. Verne, along with Ed Brooks, designed and built at NRL one of the first[8]. They were able to demonstrate how valuable it could be to measure the elemental composition of volumes on the surface of a specimen as small as a cubic micrometer. Because it was difficult to find multielement standards with the level of homogeneity necessary, mathematical techniques were needed to quantify the measurements. By the mid-1960's, many workers worldwide were examining a wide variety of calculational techniques, while Verne had used empirical methods from the beginning, using what he called an “Intensity Function”, related to the product of the absorption coefficient and the cosecant of the take-off angle[9]. As time moved on, several more sophisticated mathematical approaches were developed, including Monte Carlo and electron transport. Dennis Brown was lured away from USC to apply his electron transport technique, first applied to those types of measurements, to more widely applicable schemes, including the calculation of X-ray tube spectra. These parameters were needed for comparison with the measurements which had been made for use in the Fundamental Parameter method of converting X-ray fluorescence intensities to elemental composition of

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unknown samples using the NRLXRF computer program. It thus became possible to use any geometrical arrangement and experimental operating condition desirable for the analysis, not limited to the few for which spectral measurements were available. Further development produced simplified calculations for incorporation within NRLXRF.

It became obvious that the concern for the environment was ignoring the potential for using XRF to analyze pollution specimens. Verne made arrangements to meet with a representative of the United States Environmental Protection Agency (EPA) at the Clean Air Conference held in Washington, and convinced him that NRL could provide contractual services to investigate the application of XRF to the kind of particulate specimens which were collected out of mobile and stationary sources[10]. At the same time, another part of the EPA was investigating application to ambient air. This initial effort led NRL to many years of collaboration with that agency, and resulted in the establishment of an XRF laboratory for EPA in North Carolina. Other efforts with the EPA were also expended to analyze water pollution, determine the chemical state of sulfur, develop a special XRD technique for asbestos, and to build for that agency two portable WDXRF instruments for use in the field.

These few words only touch on the technical accomplishments of Verne Birks. This discourse could go on for a long time to detail all of his successes, but within this short discussion, I have attempted to present a cross-section of those achievements. Perhaps some of the best testimonies to his stature include his election as the first president of the Electron Probe Analysis Society of America (now known as the Microbeam Analysis Society) which has created an award in his name, and his being granted an honorary doctorate at the celebration of the 175th anniversary of the Technical University of Vienna.

I would like to close by mentioning my satisfaction at having the opportunity to work with him for about 15 years until he retired, and for several years after that as he kept a part-time involvement with the organization which he had led for three decades. I cannot forget to acknowledge the other members of the X-ray Optics Branch who contributed much over the years to the success that the organization enjoyed. To say that Verne taught me much of what I know is small tribute, but, in fact, goes back to the late 1950's, when I first began to be seriously involved with X-ray analysis and I obtained a copy of his first book, *X-ray Spectrochemical Analysis*. Verne Birks passed away on September 6th, 1991.

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