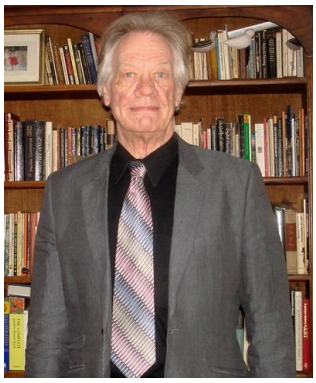
2011 JARI Medal – Laureate's "lecture"



I would like to thank Elsevier and the journal *JARI*[i], its publisher and editors, and, of course, Dr. Brian Zimmerman, who undoubtedly put them up to honoring me in this way.

This is the 10th time in the past 31 years that this medal has been awarded.[ii] Alas, throughout most of my career I always saw myself as this young, boyishly charming, scientist, surrounded by all these old people who I thought at the time knew less than me. Now, I suppose all of you young men and women out there are now looking at me and you are probably thinking the same thing. I know that I've often been accused of being a little arrogant and perhaps not easy to get along with at times. Today, I stand here truly humbled by this honor. Honored and humbled by being put in the company of previous awardees.

You may better appreciate the distinction that I feel if I briefly mention a few of the previous medal winners. I have personally known and have been closely associated with five of these past nine awardees.

Alfred Wolf was a father of the nuclear chemistry end of nuclear medicine. I met Al while working at Brookhaven[iii] shortly after receiving my doctorate. It was the early 1970s and an exciting time to be doing nuclear reaction studies, which called for rapid radiochemical separations and subsequent spectrometry. At that time, Al led a large and active research group in the relatively new and burgeoning field of nuclear medicine. The group was well known as the "Wolf Pack" with a large number of postdoctoral fellows and students, and Al tried to recruit me into it. I suppose he thought that my radiochemistry experience might be useful to him for the synthesis and labeling of radiopharmaceuticals and that my knowledge of nuclear reaction mechanisms, based on my own research, might be useful for the production of those exotic nuclides like ^{123}I, ^{178}Ta, and even easy things like ^{18}F that were beginning to be used in medicine. I declined. Maybe I thought that nuclear medicine didn't have much of a future!

The legendary Wilfred Mann was the founding editor of *JARI* and was one of the prime movers in organizing ICRM[iv] and this very series of biennial meetings of the world's radionuclidic metrologists. Dr. Mann largely built the Radioactivity Group at NBS (before we were known as NIST)[v] into the world class laboratory that it became. He had the wisdom to hire me 37 years ago. My job was to start up a radiopharmaceutical standards program. I hadn't changed my mind about nuclear medicine, but thought I'd like doing metrology. I had a few different jobs and re-incarnations at the laboratory over the years, but I've more or less been doing standards development since then.

Bill McLaughlin, another colleague and friend, was a fellow opera and art lover. He is probably the most well-known of the NIST ambassadors. Despite his hundreds of publications on his seminal work on radiochromic dye dosimetry and radiation processing, Bill knew how to take the time to enjoy life to its fullest and advised me at an early age to do just that. I did.

Now, I am sure that all of you will recognize the name John Hubble, and you have probably directly used the product of his career, those innumerable computations, evaluations, and compilations of photon cross sections and attenuation (energy absorption) coefficients. He too was of another generation. A kind and humble, gentleman scholar, who I often bumped into at the laboratory at the strangest hours – evenings and weekends – with both us inquiring as to why we were there. I once asked John for a fluorescence yield, having found two somewhat conflicting values, and within hours he sought me out with a newly evaluated value accompanied by a complete data printout of every piece of experimental and theoretical work on that value. I was often reluctant to ever again ask him for a reference value knowing how much dedication and effort he'd put into it.

And even those of you who may never have been fortunate enough to have met Jörg Müller from BIPM[vi], you certainly know of him and his contributions to radionuclidic metrology. He was the only true Renaissance man I met in my life. We didn't always agree on philosophies or the relative merits of French and America music, art, and literature, but the treatment of measurement uncertainties always made more sense over a bottle of wine with him. It is a little odd that a journal chose to honor Jörg and I since he, much like myself, never quite met a journal referee or editor that we agreed with or much liked. I exclude, of course, the *JARI* Editor-in Chief and my good friend and colleague, who my children still refer to as "the young Dr. Zimmerman."

On reflection on these five previous awardees, I am unnerved at even considering myself to be in the ranks with these productive scientists and great men. Although I was beside them at times, I largely stood on their shoulders for inspiration, and stand humbly in their shadows.

I would in passing like to acknowledge a few others who were substantial contributors to the good metrologist I like to think I became. I started in this business in 1968 at Georgia Tech[vii] synthesizing Fe-55 labeled ferrocene for precise measurements of the L/M electron capture ratios by multi-wire proportional counting. I did this at the knee of Professor R.W. Fink, who was perhaps the most demanding and exacting metrologist I ever worked with in my life. He was a "nuclear chemist' and the first to explain to me how a good chemist could learn to do nuclear physics and a few calculations, but a physicist wasn't likely to ever do chemistry – and both are needed in our work. The Manhatten-Project-era radiochemist Herb Clark at RPI[viii] was an inspiration to me as a great and wise teacher. He became my friend and taught me much more than science. He exhibited gentlemanly old-world manners, alongside a wry sense of humor, and he possessed a social conscience that is often rarely found in scientists. Angela Li-Scholz, Editor Emerita of *Atomic Data and Nuclear Data Tables*, more than anyone took me under her caring wings as a young man

and gave me scientific maturity. She's the one who taught me to do the experiment completely in my head before going into the lab to "tinker."

There are many past and present colleagues at NBS/ NIST and at other laboratories around the world who have taught me, helped me, and entertained me throughout the years. Some are even junior to me, or at least not as old. Nearly all were highly-valued collaborators and were often my principal devil's advocates. The list of these colleagues and friends are too numerable to even attempt to name them all. Yet, I would be remiss to at least not acknowledge in passing the most significant: Lucy Cavallo, Robin Hutchinson, Philippe Cassette, Bert Coursey, Brian Zimmerman, and Ryan Fitzgerald. I also must thank all of my bosses over the many years. I always gave them a really hard time of it, and appreciate that they still put up with me and supported me. And, of course, I must also thank my family; Biba, Arthur, and Sophie -- who also put up with my ways. I would not be who I am today without them.

Brian mentioned a few of my meager contributions to the field of Radiation Physics in his introductory remarks. A few years ago, as part of a self-promotion exercise, I prepared a list of my major career contributions and the things I was most proud of. There were a few novel things in the list. These include:
(i) establishing one of the first and hallmark quality assurance programs for radioactivity in the world, which is still an ongoing 30+ year radiopharmaceutical standards program; (ii) developing most of the laboratory procedures for this program that are largely still in use today for routine operations, and which have since been disseminated to many other laboratories; (iii) devising some uncertainty and data reporting practices that still survive; (iv) designing and performing the first (and ever) remote in-situ marine–atmospheric radon calibration and measurement comparison in Bermuda, using standard additions at ambient concentration levels, which was used to test the efficacy of global transport models; or (v) the digestive assays of brachytherapy sources, which provided the necessary linkage between source calculations and dosimetric measurements; or (vi) my development of the radon emanation capsules, as well as some other cute and useful transfer standards; and (vii) I suppose the importance of doing a few primary standardizations and international measurement comparisons along the way.

And, lest we forget that I spent a decade endlessly talking about measurement errors and uncertainties, and what we should do with them. I smile inside whenever I recall the wit and wisdom of Jörg Müller's words "Errors are what our mothers tried to teach us to avoid; Uncertainties are all around us and we must deal with them."

A few projects were very close to my heart, such as working on a quantitative mock-soil spiking procedure that had a verifiable matrix recovery "yield", corresponding to and unaccounted-for loss of 34 grains of sand out of 2.7 million; or performing the "said-to-be-impossible" verifications of the serial dilutions used to prepare the ^{36}Cl/Cl AMS[ix] standards, requiring ^{36}Cl measurements at very low activity concentrations (< 0.04 Bq $\bullet g^{-1}$) and high salt content (> 150 mg NaCl per g of solution). These were exercises in true metrology at its best.

Yet, most items on my list seemed fairly mundane compared to the contributions of many of my peers. By the time I finished my career cataloging exercise, however, I realized that I had overlooked perhaps my greatest contribution. I have come to believe that my significance lies in what I personally gave to a few of the younger and brighter scientists that I had the pleasure to meet and "train", and hopefully nurture and inspire over the years. I tried to place my outlook and my ways of working into the capable hands of youngsters like Brian Zimmerman, Zhichoa Lin, Lizbeth Laureano-Perez, and Ryan Fitzgerald. They are the future of our discipline. I hope I was a good role model, and a helpful and supportive mentor. I wanted to show them what metrology at its best was all about and also how to have a really good time while doing so.

Ronald Collé
Radioactivity Group
Radiation and Biomolecular Physics Division
Physics Measurement Laboratory
National Institute of Standards and technology
Gaithersburg, MD 20899-8462 USA

Addendum
All good metrologists, working from some explicit model, should measure, analyze, and predict the observable events that they are concerned with. This leads to true understanding. I sincerely hope that my selection for this honor is not a portent of upcoming events and timing since I still view myself as that young guy surrounded by a lot of old people who know a hell of a lot less than me. The five awardees that I mentioned here received their medals at age (70.6 ± 4.4) years, and with the exception of John Hubble who received the JARI medal posthumously, the other four awardees had unfortunately passed away within (12.5 ± 1.0) years after getting the medal. The uncertainty intervals given here are standard deviations of means with ν = 4 and ν = 3 degrees of freedom, respectively, as based on a type-A assessment with a coverage factor of k = 1. The 99 % confidence intervals (α = 0.01), with Student-t values of $t(\nu=4) = 4.604$ and $t(\nu=3) = 5.841$ are 71 ± 11) years and (12.5 ± 6.1) years. With this in mind, I hope you will be able to invite me back at ICRM2025 (the 25th International Conference on Radionuclide Metrology and Its Applications) in the year 2025 to give a plenary lecture.

---

[i] Applied Radiation and Isotopes (JARI), Elsevier, Amsterdam.

[ii] Previous JARI Medal awardees were: David Bradley (2009); John Hubbell (2007); Richard H. Pratt (2006); W L McLaughlin (1995); Jörg W Müller (1992); Syed M Quaim (1990); Wilfred B Mann (1988); Alfred P Wolf (1986); K H Purser, A E Litherland, and H E Gove (1980).

[iii] Brookhaven National Laboratory, Upton, Long Island, NY, USA

[iv] International Committee for Radionuclide Metrology.

[v] National Institute of Standards and Technology (NIST), known between 1901 and 1988 as the National Bureau of Standards (NBS), is the measurement standards and metrology laboratory for the USA.

[vi] Bureau International des Poids et Mesures, Sevres, France.

[vii] Georgia Institute of Technology, Atlanta, GA, USA.

[viii] Rensselaer Polytechnic Institute, Troy, NY, USA.

[ix] Accelerator Mass Spectrometry.