

# Gerry Downey: an authentic spectroscopist

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This year has seen the retirement of Gerry Downey from active service with the Irish National Agriculture and Food Research Institute, Teagasc<sup>1</sup> in Dublin. As one of Europe's leading innovative spectroscopic chemometricians and a great positive personality to have as a project partner, we thought it appropriate to dedicate a column to Gerry's career, however embarrassed he may be about the idea!

## Background

**Gerry, you graduated from Queen's University Belfast in 1972 so you studied Biochemistry right through the worst time of the troubles in Northern Ireland and the introduction of direct rule from London. How much did this experience effect your decisions to move south of the border to Galway to start your PhD and your later career move to Dublin?**

That was a very difficult period for everyone, particularly in Belfast, although arguably the worst period of the Troubles came a few years later. Anyway, yes it did play a role in my move south of the border to Galway in the Republic of Ireland but it wasn't the only reason. A desire to get away from the entrenched bigotry and discrimination that was still present in everyday life was perhaps the main reason. Thankfully things are much better now after the Good Friday Agreement, but many political arguments in the North remain circular and "what-aboutery" is still a disappointing feature of public discourse. Having moved to Galway and getting married to a Belfast woman (Geryllyn, who I met when I was

16) during my time there, I focussed on employment opportunities in both Northern Ireland and the Republic. Opportunities arose in the Republic when I moved briefly to Cork and then to Dublin. By that stage, we had children and even though we both had close family and friendship relationships with Belfast, we were reluctant to move our children back up given that violence was still a daily reality there. So, in the end, we remained in Dublin and, though we still consider ourselves as Belfast people, we have been happy here in Dublin. At that point I worked for An Foras Talúntais (a precursor of Teagasc) while Geryllyn was an occupational physiotherapist with Aer Lingus.

**I've experienced many of the ups and downs of relocating to another country when work calls, but what were the best and worst experiences you had in relocating?**

That is a difficult question to answer because I am not sure we encountered very many difficulties. I suppose the biggest thing would be the general outlook of people in the Republic as compared to the North. Here, life is generally much more relaxed and that applies to also to operational efficiencies in the public sector; but I have to say that this country has changed dramatically in the last 20–30 years and I can say that levels of business performance and general professionalism equal or even surpass those in the North. Perhaps the best experience we had was when a local woman in Dublin became a housekeeper and third granny to our kids while

we worked—this was before the days of organised childcare. Mrs Browne never missed a day's work in over 30 years with us and she was a rock for us and the kids. Ironically, she died just a few days ago but all our children were happy to play a role in her funeral mass.

**Biochemist to spectroscopist to top chemometrician—how come?**

**After moving to Galway to start your PhD you joined An Foras Talúntais (Agricultural Research Institute) in Dublin at a critical time for the cereals industry with major changes in the way farmers were to be paid and the value of their crops calculated?**

In fact, while I moved from Belfast to Galway to work towards a PhD, I never obtained one from that university—personal difficulties between myself and my supervisor made it a fraught time for me. But you are correct about the cereals industry. Just at that time there had been a major swing in Ireland and the rest of Europe in the cultivation of wheat. Winter wheat varieties were increasingly being grown because of the better yields associated with them, but this was problematic from the flour millers' point of view because most winter-sown varieties were not of bread-making quality. The milling industry had no test which could discriminate between winter- and spring-sown crops at grain intakes, nor had the merchants who made the purchase decision in the first instance. However, it was known that these wheat types differed in their protein content so measurement

# TONY DAVIES COLUMN

of this constituent was the only way to achieve segregation of feed from bread quality wheats.

**This led directly to your role in establishing NIR spectroscopy and multivariate data analysis as a trusted tool responsible for the financial success of an entire agro-industrial sector replacing the old Kjeldahl methodology that had been trusted since 1883!<sup>2</sup> How scary was that project to work on knowing the consequences of failure?**

As we all know, Kjeldahl was the reference protein measurement at that time and it was quite unsuitable owing to its complex nature, requirement for laboratory staff and general slow speed. Luckily, NIR (near infrared) spectroscopy emerged just at that time and it was viewed as being the only real solution to this testing need. Replacing it was a very daunting task but I was far from alone in achieving this goal. At that time, the Irish Flour Millers Association had very competent technical people working in the flour mills and they, in combination with Technicon, devised an elegant and effective experimental exercise to develop calibrations and to demonstrate the transferability of these calibrations to similar instrument and wheat grinder combinations. To be honest, I was only an observer in this work. I became involved at the behest of the Irish Farmers' Association who, while understanding the requirement for the test, wanted assurance that it was working effectively and did not unfairly penalise any of their members. So I had to devise a mechanism for checking both the operation and performance of the equipment, instruments and calibrations during the harvest over the first three years of its operation. This was paid for by both the milling and farming organisations; once they were both happy, they withdrew funding and grain merchants paid for that service on an individual basis for the next 20 years. Thankfully, there were no major problems with either calibrations or instruments apart from routine maintenance of the latter and occasional bias adjustments of the former.

**In the past you have hinted of some stories about mice and water at this time—what was all that about?**

One of the really valuable lessons I have learned during my work with the cereals industry and NIR spectroscopy is that there is no substitute for actually going out to the site where measurements are being taken to fully understand the issues which can arise when a laboratory method is transferred to the real world. In this case, I visited the grain merchants (around 40 premises at the high point of the harvest monitoring exercise). These were rough and ready places at which the person doing the rapid grain testing was also the forklift driver or a summer student earning some holiday pay. They all understood fully what they needed to do (we also trained them) but the equipment was generally used during the harvest and then put away somewhere until the following year. In one instance, we were present when a NIR instrument was removed from its storage in an apparently safe place under a bench in the makeshift laboratory and found to be full of water having been placed under a tap which, unknown to the company owner, had a small but significant leak over the winter!! In another location, the grinder operator (we used a Kamas grinder—big and bulky with a metal mesh but effective) complained of difficulty in getting the correct grind and we opened it to find that a poor unfortunate mouse had made a home for itself there unaware of the hazards involved in residing in a grinder. You can imagine how unhappy the operator was when we pointed out the mess inside the grinder which he had to clean up!!

**This early encounter with the interface between analytical spectroscopy and high-value agro-industrial production clearly inspired you to carry on work in this area, expanding into food quality, food authenticity and adulteration, in fact the food fraud topic in general—well before the European Union decided this needed to be a priority! Even as late as 2013 European Parliament motion<sup>3</sup> seems still to have been bemoaning**

**the lack of concrete action in fields which you had identified as being of particular concern and been researching for many years. Table 1 shows their citation of the work of Spink and Moyer showing the Top Ten products that are most at risk of food fraud.<sup>4</sup>**

**I think I am right to say you have published food quality spectroscopic analytical research on most of the systems identified. Which matrix did you find the most challenging and why?**

It is true that we have examined many authenticity issues, although we did not do any work on tea, spices, organic foods or wine. It is also important to remember that since I worked for a publicly-funded organisation, all my research was aimed at demonstrating the potential of vibrational spectroscopy to address authenticity issues rather than to develop robust and accurate predictive models. For most of the foods that we studied, the greatest challenge was always to obtain representative sample sets collected over a number of years and with provenance that we could be sure of. In this context, work we did on honey and fruit purées was possibly the most satisfying. We received good national funding for this work and were able to obtain large sample sets from producers on the island of Ireland which we could trust. Maybe the most difficult, but also

**Table 1.** Is based on Spink *et al.*<sup>4</sup> and information from retail and branch organisations.<sup>5</sup>

1	Olive oil
2	Fish
3	Organic foods
4	Milk
5	Grains
6	Honey and maple syrup
7	Coffee and tea
8	Spices (such as saffron and chilli powder)
9	Wine
10	Certain fruit juices

# TONY DAVIES COLUMN

interesting, was some work in which we collaborated with a large team assembled by the United States Pharmacopeia (USP) which wanted to investigate non-targeted methods for detection of adulterants in milk powders. The focus was on melamine adulteration of course and it turned out that the way in which melamine was incorporated into the powder had a significant effect on our ability to detect it. This work is being published soon and it highlights another apparently trivial but crucial issue that we have now learned to address early in our work—what really is the issue that we are trying to address? In authenticity studies it is very easy to conflate problems especially those dealing with geographic provenance and the problem one is trying to solve may in fact mask other issues of quality which need to be well thought out and tackled using rigorous experimental designs.

**Your skills have made you a popular partner in international projects, especially funded through the European Union—in fact that is how we first met many years ago in Paris, I was surprised that you have collaborated with the USP in Washington, DC.**

**How did that come about?**

Thank you for the praise but it has always been important to me to make and retain strong working relationships with international partners. In a small island off the west of Europe, it has historically not been easy to work at or near the forefront of science, but membership of the EU and access to competitive funding has enabled me to join groups of excellent scientists who are not only expert in their field but have, in my experience, always been ready and willing to help people like me to understand the tools, especially in chemometrics, that they use. Such collaborations have always been rewarding on a personal level too and I count myself lucky that I can probably lift the phone and ask for help from most of the global leaders in vibrational spectroscopy and chemometrics. The USP collaboration has been interesting and it really originated in a telephone call from a senior staffer in that organ-

isation. As I mentioned above, they were involved in research into methods for non-targeted adulteration in milk powders with the long-term goal of developing and demonstrating appropriate techniques and then supplying standards to support them. They had developed a really large team looking at techniques ranging from dye-binding to nuclear magnetic resonance and including NIR spectroscopy. Having assembled a small sub-group of people to produce samples and NIR data, they were looking for help in interpreting the data and ensuring their interpretations were valid. For no specific reason that I know of, they contacted me, had an extended telephone call to discuss my work and some of theirs and then followed up with an invitation to join the collaboration. It has been really interesting to work with a group like this that has considerable firepower to bring to an analytical problem and a global reach. The work continues although given my retirement my involvement is reduced slightly.

**... and how did it compare with working on multi-lateral EU projects?**

I suppose that the biggest difference was that regular travel to meetings and other laboratories was a constant and, in my view, critical feature of the EU collaborations. Right from the beginning when we were involved in what were called EU Concerted Actions which had money for meetings and training but none for research, the value of the scientific exchanges facilitated by this money was incalculable. Actually, most of the people I go to for help and advice were involved in the very first Concerted Action dealing with spectroscopic analysis of food—QUEST. Effectively coordinated by our good friend Chris Scotter of what was then called Campden Food Research Institute, this project laid the basis for many subsequent research partnerships which were successful in obtaining EU funds. On a personal level, the EU projects were learning experiences in the broadest sense in which we all learned to understand the different dynamics behind the different national positions around the research

table and hopefully developed tools to allow us to operate as effective teams by bringing the different strengths of partners from a now very expanded pool of countries. The final EU bonus was of course that there was always money available in these projects which was to be used for training; this allowed me to spend time in laboratories such as that of Dominique Bertrand in Nantes which was a very effective way to learn first-hand about chemometrics.

## Tomas Hirschfeld Award

**This dedication, to what was clearly becoming a very important field for us all, led in 2007 to the International Committee for Near Infrared Spectroscopy honouring you with the prestigious Tomas B. Hirschfeld Award for your application of NIR spectroscopy to the qualitative analysis of foodstuffs.<sup>5</sup> Apart from the American Chemical Society's *Chemical and Engineering News* not being able to distinguish between Dublin and Belfast,<sup>6</sup> how did this honour affect you and your work?**

That was indeed a very nice moment and I think it is important to recognise that we all appreciate a pat on the back from our peers no matter what age we are. For me it was a very important milestone professionally as it represented a validation of my research efforts by the global body representing NIR spectroscopists at a time when such recognition was not so forthcoming nationally and funding to continue my endeavours was getting harder to come by. Given my subsequent exposure to American scientific societies in a different field, I have come to appreciate their focus on rewarding achievement in a particular field as a way of recognising scientific excellence outside an institutional setting. Of course, having the award probably helps to some degree in obtaining research funding although I cannot be sure of that.

## Collaboration with the University College Dublin

**Clearly your work hasn't only attracted the attention of the agro-industrial food sector as you were honoured**



Gerry Downey receiving the 2007 Tomas Hirschfeld Award.

with a DSc by your alma mater, Queen's University Belfast in 2005, and after a number of joint research publications you became adjunct Professor supporting research in the UCD School of Biosystems and Food Engineering at UCD in 2009. How would you compare the work at UCD to the daily schedule at Teagasc?

Well I think that the two are quite different and there are pros and cons associated with each. One advantage of



Gerry Downey with his parents after receiving a DSc at Queen's University, Belfast.

working in Teagasc is that one is a full-time researcher with no distractions associated with lecture schedules and examinations which are the essence of working in a university. Of course, how much full-time research is actually full-time nowadays with the incessant grant application and reporting requirements associated with the job is a moot point, but I suppose this problem affects both research institutes and academia. The potential downside of working in an applied institute as opposed to a university is that one's freedom to explore scientific problems that are not directly associated with the agriculture and food industries in one's country can be a significant issue, but one that I have had to cope with for many years. Looking objectively at the Irish food industry, it is not at all evident at first glance why work on the authenticity of olive oil is of relevance! For me also there is the question of scholarship or the advancement of science as an end in itself. I know that this is under pressure in many of our universities now as education becomes a commodity to be bought and sold in the marketplace but I do still believe that science as an end in itself to describe and understand the universe which we inhabit still has a place in academic institutions.



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## Workplace values

**On a different topic, many scientists are often so buried in their work that they fail to see—or want to see—the societal issues around them. You are not one of these people and if I remember rightly have involved yourself in the support of fellow colleagues in the workplace?**

I have always been involved in my trade union and served as an officer for several years. I have also been significantly involved in the introduction of a bullying and harassment policy for Teagasc and have acted as a mentor to research students on my campus and as a support to staff who find themselves bullied or otherwise badly treated in the workplace. While never being a rabid socialist, I have always felt the need to have some mechanism or mechanisms in the workplace to, at the very least, articulate the concerns of temporary or permanent employees with the overall goal of making the workplace a better environment and therefore enhancing the performance and happiness of both the organisation and its staff. Working in the public sector, I think that these values are present in most organisations but that sometimes the management of these bodies need reminding of their responsibilities and the general advantages of working with staff rather than trying to solve issues by diktat. It is regrettable that as a result of the economic maelstrom in which we in Ireland have found ourselves that some of these attitudes have hardened and we have had to take backward steps in some of our industrial relations, but it is my hope that these losses will prove to be temporary. Probably because of my experience in Galway, I have always felt a particular responsibility to post-graduate students who have placed a lot of trust and time in a supervisor and a system in order to advance their career.

## Inheritance...

**Teagasc is known as a world-class facility in infrared and NIR spectroscopy specialising in multivariate data**

**analysis: hopefully you have left behind a strong successor to keep up this tradition?**

Ironically, perhaps, the answer to this is no! As an organisation Teagasc is perhaps not very good at succession planning but even without that I think it is fair to say that I operated as a lone wolf and that I probably was unable to convince my organisation of the merit in retaining expertise in this area. This also applies to the chemometric expertise which I have accumulated—despite banging a drum about the need to move from the default univariate analysis to multivariate exploration and modelling of data, I am not sure that the desirability of at least one person on the campus with this expertise will materialise.

## Advice for those entering their careers

**Finally, with I believe five children and several grandchildren you have clearly ensured your pension pot will remain filled, but what advice would you have for offspring or young graduates looking for help in making their first career steps? Is spectroscopy still the exciting place of opportunity to plant your career flag as it was when you left Galway?**

Wow, keeping the easy ones to the last Tony! First, the grandson tally is now five and GERALYN and I are hoping more than ever for a grand-daughter, but of course we have no say in these matters! On your main question, I have always thought of science as a vocation rather than a simple career choice. There has to be some connection between a student and the inherent beauty of scientific experimentation and theory as a way of understanding the world. And for that reason, if one exists then I would encourage some-one to follow this path. However, I think that a research career is something else. I have advised several students who asked about a PhD that the only reason I could see for doing it was to have a career in research; while it is true that people with PhD degrees can make it out of the technical side of

science-based companies, I feel that such a route is the exception rather than the rule. If financial success of executive power is the goal, then a science degree followed by a business qualification is always my suggestion.

Regarding spectroscopy, I still think that it is an exciting field of study. With the continued development of better, more accurate and stable instruments which may in the future obviate any need for calibration transfer and the improved performance of miniaturised equipment, I believe there is much excitement ahead. And let's not forget developments in chemometrics and general field of big data. I suppose the one risk is that, as in so many other scientific fields, the days of the specialist in any specific technology are fading rapidly as career paths are more diverse and scientists are increasingly called upon to use spectroscopic techniques as but one of a number of other techniques in their analytical armoury. But the world keeps on turning and change is more of a constant than ever before so our young scientists will, I have no doubt, rise to these challenges.

**Thanks Gerry, and sorry for embarrassing you!**

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