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Corrigendum to: Dedication to Professor Kevin Francesconi, father of organoarsenicals in the environment

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Unfortunately, an incorrect statement was included in the Foreword to the Special Issue dedicated to Professor Kevin Francesconi.

The statement that Professor Kevin Francesconi was one of the founding fathers of *Environmental Chemistry* is incorrect and we wish to correct this statement to read:

'His passion for good quality publications and environmental chemistry led to his serving as Editor-in-Chief of the very same journal in which this special issue is published in his honour.'

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Dedication to Professor Kevin Francesconi, father of organoarsenicals in the environment

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I am honoured to have been asked to organise a special issue for Professor Kevin A. Francesconi, a towering figure in environmental chemistry, who retired a few years ago from his leading role as Professor for Analytical Chemistry at the University of Graz in Austria.

Kevin would describe himself probably as an environmental chemist, although not only his publications but also his upbringing demonstrates that Kevin has all the hallmarks of a very versatile and gifted chemist. In fact, he is one of the most accomplished environmental chemists I know today. He started as an analytical chemist, became a natural product chemist and finally an organic chemist synthesising arsenic compounds. What seems a rollercoaster scientific career has been in fact very focused. At his heart, he has always been interested in natural products containing arsenic and their impact on human health and the environment. He has published so far more than 270 peer-reviewed publications and received more than 15 000 citations (h-index 64) with colleagues from all disciplines. He was Editor-in-Chief for this journal, the first entirely committed to environmental chemistry, between 2010 and 2020, after being on the editorial board for 6 years.

Kevin was born and brought up in Western Australia near Perth. After university, he started to work in 1975 as analytical chemist at the Western Australian Marine Research Laboratories, Perth, Australia. He did his Master and PhD alongside his friend John Edmonds and stayed in this research institution for more than 20 years until 1996. Then Kevin left his home country for Europe. In 1996, he was appointed as Associate Professor in Ecotoxicology, Southern Denmark University, Odense, Denmark, which illustrates impressively his thirst for doing something new, not only determining arsenic natural products but measuring their impact. In 2002, he moved to Austria; the near-namesake of his country of origin, but the one without kangaroos! He became full Professor of Analytical Chemistry and head of the research group *Trace Element Metabolomics*, and then the head of the Institute for Chemistry at University of Graz, Austria, where he retired in 2018.

Kevin's Master project was on organoarsenic compounds. Until then, there had only been evidence that arsenic can be methylated but larger organoarsenicals were unknown. His first paper, with his colleague John Edmonds, was on the development of an analytical method to determine exactly those methylarsenicals as traces in biological samples(Edmonds and Francesconi 1976).

When Kevin started working on the more complex nature of organoarsenicals, it was known that marine organisms contain high concentrations up to 100 mg/kg of arsenic in a molecular form, which was largely seen as non-toxic, and it was called *fish arsenic*. This mystery was solved when John Edmonds with Kevin and co-workers published their findings in 1977 (Edmonds *et al.* 1977). In a monumental effort, they were able to identify this fish arsenic as arsenobetaine, but not as one would do today using mass spectrometry, but by full isolation and purification of the natural compound generating a single crystal, which they characterised by X-ray diffraction and NMR and then compared with a synthetically generated standard of arsenobetaine. Although Kevin determined the fish arsenic in a crustacean (Western Rock Lobster), arsenobetaine was later established as the main organoarsenic compound in fish and shellfish. Hence, fish arsenic finally had a name: arsenobetaine. It was an inspiring effort (Fig. 1).

This marked the beginning of the entire research area of arsenic speciation analysis, which is pursued today by hundreds or even thousands of researchers worldwide. The success continued in 1982, when an even more complex arsenic containing sugar sulfate was isolated and determined from the kidney of a giant clam (Edmonds *et al.* 1982).

Fig. 1. Kevin A. Francesconi at the Western Australian Marine Research Laboratories in the 1970s.

For that, the team used 380 g kidney from which the arsenosugar was extracted by 2.4 L of methanol. A scale nobody would attempt nowadays for the characterisation of a novel arsenic compound. This shows how far the field of environmental analytical chemistry has evolved.

An entire new field of research was about to take off in the late 1980s with the development of novel analytical methodologies, the coupling of high-performance liquid chromatography (HPLC) directly with an arsenic-specific detector the inductively coupled plasma mass spectrometry, a method in which Kevin excelled. But without any molecular identification capabilities, no novel compounds could be identified. A whole generation of environmental analytical chemists interested in arsenic speciation relied (and still relies) on Kevin's talented hands (yes, Kevin was still active in the lab himself) to produce some complex organoarsenicals as standards, which were either isolated from marine organisms or synthesised (e.g. Guttenberger *et al.* 2017). The standards are still used today with availability of high-resolution electrospray mass spectrometry.

One mystery still needed to be solved around arsenic natural products and that was the occurrence of lipophilic arsenic in marine organisms, which Kevin tackled in Graz. Before he started this work, only one publication existed about the molecular nature of lipophilic arsenic compounds (Morita *et al.* 1981). Kevin identified many dozens of novel arsenolipids and defined different classes amongst the group of arsenolipids (García-Salgado *et al.* 2012; Glabonjat *et al.* 2019, 2022).

Besides his numerous achievements in the field of arsenic, he was also interested in the human metabolism of the essential trace element selenium, an area to which he immediately contributed significantly. After the discovery of selenosugars as major urinary selenium metabolites, he and his group were the first who succeeded in their chemical synthesis (Traar *et al.* 2004). This greatly facilitated his research into metabolic studies elucidating selenium's transformation in the human body, which he tackled using the novel HPLC mass spectrometry methods developed in his group (Kuehnelt *et al.* 2006). Although coming from an analytical chemistry perspective, he was always eager to see these methods applied for solving bigger research questions in the field of human health together with scientists from other scientific disciplines. An analytical method allowed the determination of the urinary selenium metabolite, TMSe (trimethylselenonium), at the sub µg Se/L level (Kuehnelt *et al.* 2006). TMSe built the basis for the discovery of a genetic single nucleotide polymorphism determining the significance of this metabolite in urine (Kuehnelt *et al.* 2015), a finding likely to have wider implications for human health.

Kevin has been also the chairman of numerous conferences and meetings. Kevin was able to bring researchers from all around the world to Denmark to the International Conference on Environmental and Biological Aspects of Main-group Organometals (ICEBAMO) 1998. The diversity of that conference was not only geographical but mirrored Kevin's wide range of interests and talents. From human toxicologists and ecotoxicologists, to synthetic chemists, biochemists, and analytical and environmental chemists, anyone interested in trace elements in marine and terrestrial organisms and environmental media was to attend.

Kevin also has a passion for bringing state-of-the-art research directly to those who usually cannot travel to faraway conferences to get up-to-date information. He organised, with the help of Danida (Danish International Development Agency), a workshop in Phuket, Thailand, to provide hands-on experience of arsenic and tin speciation in the marine environment. Furthermore, his organisational skills were critical when he organised and chaired a large-scale analytical conference (the European Winter Conference on Plasma Spectrochemistry in 2009) with more than 500 participants. This biennial conference, which has featured speciation of trace elements since the 1990s, pays tribute to an analytical technique (ICPMS) that revolutionised the study of arsenic compounds in biofluids, marine organisms and the environment and Kevin was, and still is, a key figure in this community.

And finally, Kevin was a founding member of the first journal dedicated entirely to environmental chemistry and he quoted in the first issue: 'Environmental chemistry is one of the (few) public and friendly faces of chemistry. The decisions based on research in environmental chemistry have enormous consequences for us all, so that research has to be very sound. I welcome the introduction of a journal focussing on this area, …' (Green and Hecker 2004). This illustrated what Kevin stands for, and that is foremost excellent analytical chemistry, which creates facts that can be interpreted in an environmental context and can inform legislators to change regulations that influence us all. Later, during his time at Graz, he was working not only closely with toxicologists such as Tanja Schwerdtle (e.g. Witt *et al.* 2017; Bornhorst *et al.* 2020) but also with epidemiologists such as Ana Navas-Acien (Spratlen *et al.* 2017). He became an advisor of the

European Food Safety Agency, where the panel worked on a scientific opinion about arsenic in foodstuff (EFSA Panel on Contaminants in the Food Chain (CONTAM) 2009), which paved the way to introduce arsenic speciation into legislation (a maximum contaminant level for inorganic arsenic in rice). His passion for good quality publications and environmental chemistry made him one of the founding fathers of the very same journal in which this special issue is published in his honour.

This special issue, a dedication to Professor Kevin Francesconi, illustrates the breadth of Kevin's interests and passions. It includes an analytical chemistry paper that demonstrates state-of-the-art speciation methodology of organoarsenicals as minor constituents of arsenic in biological samples that are available to everybody through the NRCC (Gajdosechova *et al.* 2023) and a paper describing the development of an affordable method to screen for arsenic containing hydrocarbons by using GC-MS so that more data about these elusive toxic organoarsenicals can be generated worldwide (Raber *et al.* 2023). Both papers make arsenic speciation analysis more transparent and democratic, and enhance the proficiency of arsenic species determination, absolutely in line with Kevin's passion for only the best analytical chemistry. Other papers feature the purification of organoarsenicals so that they can be used for toxicological testing (Stiboller *et al.* 2023), and determining arsenic species in marine foodstuffs (Matos *et al.* 2023; Sim *et al.* 2023). Arsenic speciation has become more relevant in terrestrial food, and it is prominently featured in this special issue with papers on fungi (Walenta *et al.* 2023) and two on rice (Raab et al. 2023; Martin *et al.* 2023). The latter described how one can determine a minor arsenic compound nowadays with molecular mass spectrometry. All these analytical principles apply not only to arsenic but also iodine (Jerše *et al.* 2023), although iodine speciation in food and feed is still in its infancy.

But one question still remains that has not been tackled or answered by Kevin: is arsenic, in whatever form, essential for life beyond bacteria? Kevin, thank you for leaving this for the next generation of researchers interested in arsenic natural products in biota. Or are you still working on this in your well-deserved retirement in Graz (Fig. 2)?

Fig. 2. Kevin A. Francesconi retired in 2018 from his position as Head of Analytical Chemistry at the University of Graz, Austria.

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