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Special Issues in Honor of Professor Dr. Dr. hc mult. Wittko Francke, 28 November 1940–27 December 2020

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The current issue is the second of two special issues to honor the memory of Professor Wittko Francke, a driving force in chemical ecology over the past half century. Prof. Francke died unexpectedly on 27 December 2020 at the age of 80, after a short illness.

Wittko, as everybody called him, was almost a force of nature. He was an extraordinarily productive and driven scientist, with an intense curiosity about the natural world and the chemical signals that make it work. His interests and projects included many beyond chemical ecology, but his most lasting impact was in chemical ecology. He was an integral part of the small group of biologists and chemists who laid the foundations of chemical ecology as a standalone discipline, who organized and founded the Journal of Chemical Ecology and the International Society of Chemical Ecology, and who initiated the annual meetings of the Society. These meetings have taken place at venues around the world, including the very successful and well-attended meeting in Hamburg in 2004 which Wittko himself organized and hosted. He was also a strong proponent and advocate for the flourishing Max Planck Institute for Chemical Ecology, and he played an integral role in its founding and the selection of its first set of directors. However, his contributions extended far beyond the administrative: he was actively involved in hands-on research within his group throughout his whole career, and particularly, with interpretation of mass spectra, which were often the only types of spectra available from chemical ecology projects, in which organisms may only produce nanogram quantities of active compounds. He also had a deep understanding and appreciation for biosynthetic pathways, and how considerations of such pathways could provide guidance in identifying new natural products, based on what was and was not possible biosynthetically. The preface to the first Special Issue in his honor described some of the details of his scientific projects and career, and rather than reiterating those, suffice it to say that he published more than 350 papers. These included major and often seminal contributions to new areas of both chemical ecology and organic chemistry, elegantly combining trace analysis and identification of new natural products with the synthesis of those compounds. His chemistry opened up or helped to open up whole areas of chemical ecology, such as bark beetle pheromones and kairomones, deceptive signaling by orchids to trick pollinators, and pheromones of geometrid and arctiid moths, as well as forays into areas as diverse as insect defensive chemistry, chemical signals used in aquatic habitats, and bacterial semiochemicals. His understanding and appreciation for the biological tenets underpinning much of his work provided him insights that made him a valuable and highly sought-after collaborator. He insisted on rigor, and strongly advocated for functional bioassays to verify and prove the putative biological functions of newly described natural products. Among many other honors, the interdisciplinary nature of his work was recognized by the award of prestigious medals from two German scientific societies, the Society of German Chemists, and the German Society for Applied and General Entomology, certifying his impact both in Chemistry and Entomology. The extraordinary breadth of his interests and the multidisciplinary nature of his projects required him to work closely with biologists, with whom he developed strong rapports and often life-long friendships. Thus, he leaves not only a massive body of published work, but also a huge network of friends and colleagues who will sorely miss his friendship, his generosity, and his enormous breadth of knowledge. The contributed manuscripts in this second Special Issue unequivocally reinforce this, with Professor Francke being a coauthor of some, and a friend and mentor to many of the other authors, all of whom were influenced by and benefited from his science or his guidance.

Thus, the second of these two Special Issues honoring Professor Francke's memory begins with a manuscript

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from Prof. Francke's former student Stefan Schulz's group (Gerbaulet et al. 2022), describing the identification of large numbers of wax esters from body extracts and the silk of both sexes of the spider *Argiope bruennichi*. The ester blends were sex-specific, and were dominated by long-chain esters of 2,4-dimethylalkanoic acids. The work includes descriptions of the methods used to determine the methyl branch points, and representative syntheses of enantiomers to establish the likely absolute configurations of the natural products. The second manuscript, from Stefan Dötterl and coworkers, and including Professor Francke as a coauthor (Etl et al. 2022), identifies (2*E*,6*Z*)-2,6-nonadienal as a key component of the floral scent of the arum *Anthurium acutangulum*, which attracts its specific pollinator, an undescribed gall midge. This is one of the first detailed studies of the chemical ecology of plants pollinated by gall midges, and the first to identify specific attractants. Interestingly, the floral scent also contained some of Professor Francke's beloved spiroacetals, but they did not appear to be part of the attractant blend. The next manuscript, contributed by Etya Amsalem's group with Abraham Hefetz as a coauthor (Orlova et al. 2022), analyzed the labial gland contents of females of different physiological states and castes in the bumblebee *Bombus impatiens*. A large number of straight chain and terpenoid esters were identified, forming the basis for ongoing studies to unravel the functions of these compounds as mediators of the life history of this species. The fourth manuscript, contributed by Till Tolasch, another former student of Professor Francke, and his coworkers (Tolasch et al. 2022), details the identification, synthesis, and field testing of two components of the pheromone of the click beetle *Agriotes pilosellus*. The two compounds were both esters of terpenoid alcohols, and there was strong synergism between them. David Hall and coworkers (Hall et al. 2022) then described the identification of the male-produced aggregation-sex pheromone of a newly identified haplotype of another beetle, the coconut rhinocerus beetle *Oryctes rhinocerus*. In contrast to reports from > 25 years ago that the pheromone of populations of this species from Indonesia consisted of ethyl (*S*)-4-methyloctanoate, Hall et al. found that populations from Guam and the Solomon Islands produced exclusively the (*R*)-enantiomer, and responded more strongly to the latter. The 6th manuscript, from Gerhard Gries' group (Chalissery et al. 2022), identified methyl 2-methoxy-6-methylbenzoate as the trail-following pheromone of the pavement ant *Tetramorium immigrans*. This work dovetails nicely with previous work on congeneric species, in which two species have been shown to use the analog methyl 2-hydroxy-6-methylbenzoate as a component of their trail pheromones. The next paper, also from Simon Fraser University, by Erika Plettner (Pinnelli and Plettner 2022), describes the synthesis of labelled analogs of the gypsy moth pheromone disparlure, for use in unravelling the details of how the enantiomers of disparlure are discriminated by the moth's antennal receptors for disparlure. The 8th paper, from Rod Peakall and coworkers (Bohman et al. 2022), builds on their previous work with Professor Francke on the drakolides, a class of β-ketolactones that are used by orchids to attract their wasp pollinators by mimicing the wasps' sex pheromone. Here, they tested stereoisomers and analogs of drakolides with two pyrazines which are also part of the pheromone blend and found that attraction of the wasp pollinators decreased substantially with changes in the drakolide structures. The issue closes with a manuscript from the laboratory of Professor Francke's long-time friend and colleague Jim Tumlinson (Jones et al. 2022) describing tests with 10 caterpillar species to determine whether their oral secretions contained isomerases, dehydratases, or hexenal-trapping molecules which shape the profile of herbivore-induced volatiles that are released when the caterpillars feed on plants. Surprisingly, there did not appear to be patterns of use of these effector proteins that correlated with the caterpillar phylogeny, suggesting that the various species had developed idiosyncratic patterns of utilizing the effectors to alter host plant volatile blends, according to the dictates of their ecologies and life histories.

In sum, the manuscripts in this and the first Special Issue provide a fitting illustration of the breadth of the chemical ecology studies in which Professor Francke was directly involved, or in which he maintained a strong ongoing interest. They also illustrate the profound regard in which Professor Francke was and is held by his former students, collaborators, and colleagues, with a total of 19 contributed manuscripts in the two Special Issues. We thank all the authors for their contributions, and hope that these Special Issues will serve as a permanent memorial to our greatly esteemed and greatly missed friend and colleague, Professor Wittko Francke.

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