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Highlights from the 47th EUCHEM conference on stereochemistry, Bürgenstock, Switzerland, May 2012

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On Sunday the 29th April around 120 chemists descended on the beautiful town of Brunnen on the banks of the Vierwaldstättersee (Lake Lucerne), Switzerland (Fig. 1). The majestic Seehotel Waldstätterhof was the location for 47th annual Bürgenstock Stereochemistry Conference. The atmosphere was bustling and full of excitement as the eagerly awaited event was soon to begin. In keeping with tradition, the line up of speakers is kept strictly secret until the arrival of delegates. This is but one of the traditions that make 'Bürgenstock' one of the most celebrated events on the conference calendar. This year's organising committee comprising **Alain De Mesmaeker** (Syngenta, Stein), **Donald Hilvert** (ETH Zürich), **Jérôme Lacour** (Universite de Geneve), **Reto Naef** (Novartis, Basel), **Phillipe Renaud** (Universität Bern) and **Helma Wennemers** (ETH Zürich) together with President **Andreas Pfaltz** (Universität Basel) and vice-President **Luisa de Cola** (Universität Münster) had once again assembled a remarkable programme of world-renowned speakers, including no less than two Nobel Laureates. The subjects covered would range from catalysis and synthesis, to chemical biology, materials and computational chemistry whilst retaining the core theme of organic chemistry and stereochemistry.

Proceedings began with all delegates assembling for a wonderful welcome banquet in the beautiful dining room of the hotel during which the President, **Andres Pfaltz**, welcomed this year's guest of honour **Albert Eschenmoser** (ETH Zürich). The President completed his doctoral studies under the direction of Professor Eschenmoser and spoke with great fondness of the special life-long relationship he has with his former advisor, and which typically evolves between a great many doctoral students and their advisors. It is certain that many of the attendees also feel a strong affinity with Professor Eschenmoser, such is the unique impact he has had on the development of organic chemistry.

The scientific programme began immediately after dinner with former president **Jeremy Sanders** (University of Cambridge) chairing the first session. He was able to recount his memories of the opening speaker's very early research career as a doctoral student in Cambridge, when he had first developed an interest in the application of organic chemistry to the study of biological systems. The inaugural lecture delivered by **Roger Tsien** (University of California, San Diego), the 2008 Nobel Laureate in chemistry, set the standard for the week, describing many elegant applications of synthetic fluorescent molecules to the observation of biological processes. The sheer scope of the potential applications of the science was breathtaking: as well as innovative approaches to the visualisation and treatment of tumors,[1] he outlined his group's efforts towards the study of neurons firing in the 'world's best computers' – the human brain. After the traditional 30-minute post-lecture question session, the audience's 'computers' were refreshed with drinks in the hotel's main dining room.

Monday's scientific programme, chaired by **Clément Mazet** (Universite de Genève), commenced with a session with a distinct catalysis theme. To begin, **Frank Glorius** (Westfälische Wilhelms-Universität Münster) described his group's work on the development of novel processes including transition-metal catalysed C–H activation reactions and arene hydrogenations, and the asymmetric hydroacylation of unactivated olefins using *N*-heterocyclic carbene organocatalysts.[2] His lecture elegantly demonstrated how the discovery of new chemical reactions is driven both by rational design and by serendipitous observations.

Fig. 1 Snow capped mountains seen across the lake from outside the Seehotel Waldstätterhof.

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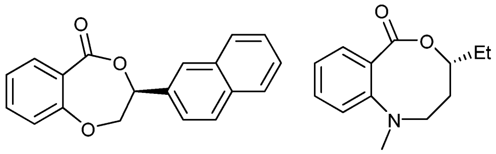

Fig. 2 Two of Vy Dong's favourite rings, prepared using Rh-catalysed asymmetric hydroacylation reactions.

Subsequently, **Vy Dong** (University of Toronto) described her elegant work on the synthesis of '*A few of my favourite rings*', including the application of a novel Rh-catalysed asymmetric Tischenko reaction to the synthesis of complex medium-ring architectures (Fig. 2),[3] and an intriguing innovative approach to the synthesis of cyclic and acylic peptides.

The afternoon was reserved for a poster session during which selected participants presented some of their most exciting recent results. This was preceded by an excellent session of short lectures presented by some of Europe's top young scientists: **Manuel Alcarazo** (Max-Planck-Institut für Kohlenforschung), **Stuart Conway** (University of Oxford), **Syuzanna Harutyunyan** (University of Groningen), **Ruben Martin** (ICIQ), **Nuno Maulide** (Max-Planck-Institut für Kohlenforschung) and **Jerôme Waser** (EPFL).

The evening session, introduced by **Gerard Van Koten** (University of Utrecht), featured a lecture from the vice president **Luisa de Cola** (Universität Münster) who described how self assembly can be used to bring together a huge variety of systems with useful properties, including fluorescent transition-metal oligomers and ingenious nanoparticles able to selectively target and kill antibiotic-resistant bacteria (Fig. 3).[4]

On Tuesday morning, in a session chaired by **Bernd Giese** (University of Fribourg), the focus switched to the study of complex biological pathways as **Sarah O'Connor** (John Innes Centre) described her group's efforts to elucidate complex biosynthetic pathways in plants and to bioengineer them for the synthesis of novel complex products with potentially useful pharmacological properties.[5] **Virginia Cornish** (Columbia University) then described how genetic engineering could be exploited to harness organisms for chemical synthesis by linking their survival to the desired chemical outputs.[6]

The afternoon was left free and many delegates took advantage of the gorgeous weather (Fig. 4) to hike in the hills around Brunnen and take in the stunning views of Lake Lucerne and the nearby mountains.

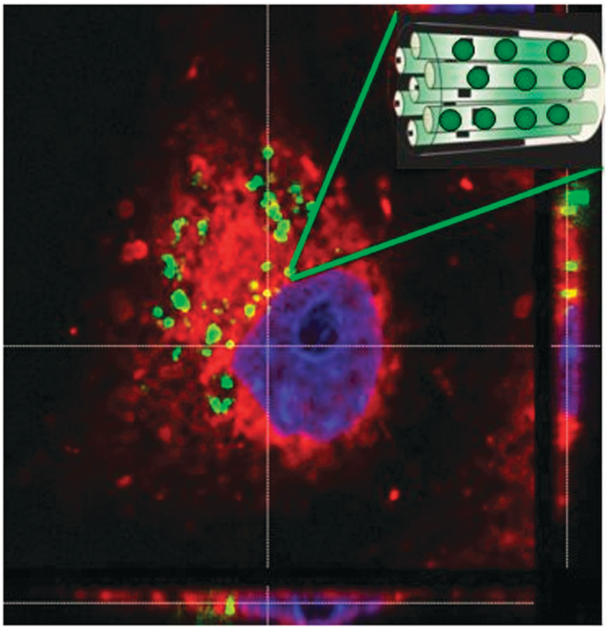

Fig. 3 Luisa de Cola's nanoparticles for selective targeting of antibiotic-resistant bacteria. Image kindly provided by Prof. Luisa de Cola.

The evening's scientific lecture, introduced by **Mohammad Movassaghi** (MIT), was delivered by **Paul Wender** (Stanford University), a man who, in his own words, knows no boundary to the lecture hour! He gave a fascinating illustration of the power of synthetic chemistry to construct complex molecules which offer huge potential to treat globally important life-threatening diseases including cancers, Alzheimer's disease and AIDS.[7] He concluded his thrilling lecture with a video which reminded us all of the importance of enthusing the next generation of scientists with a love for chemistry – the ingenious marriage of the famous iodine clock reaction and Rossini's overture dedicated to a local hero, the legendary Swiss patriot William Tell.[8]

The Wednesday morning session, chaired by **Bernhard Kräutler** (Universität Innsbruck), began with a captivating talk by **Bernhard Jaun** (ETH Zürich) who discussed the efforts of his group to elucidate the catalytic mechanism of methyl-coenzyme M reductase – the enzyme responsible for the formation and functionalisation of methane in archaea.[9]

Milan Mrksich (Northwestern University) delivered an intriguing seminar entitled *'Label-free Screening for the Discovery of Chemical Reactions'* in which he described his group's research into switchable surface chemistry. Structurally defined and spatially organized alkanethiolate monolayers assembled on gold surfaces were used as points of attachment for various organic molecules. Furthermore, by applying external stimulus (electrical or optical) to the gold surface, the reactivity of the attached organic molecule could be switched on or off. The utility of this control was demonstrated in the context of Diels–Alder reactions.[10]

In keeping with tradition, Wednesday evening provided an opportunity for the conference delegates to relax and enjoy an excellent musical concert. This was immediately followed by a post-concert get-together with the musicians and a further opportunity to discuss the week thus far.

Thursday's proceedings, chaired by vice president **Luisa De Cola**, began with **Douglas Stephan** (University of Toronto) who provided an engaging overview of

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Fig. 4 The glorious sunshine and blue skies kindly provided by the vice president continued virtually uninterrupted throughout the week!

the power of frustrated Lewis pairs (FLPs) as a novel reactivity platform. These entities were discovered in Stephan's laboratory and he discussed the dedicated and comprehensive efforts of his group to elucidate, understand and exploit their unusual reactivity. FLPs permit the heterolytic metal-free activation of numerous C–H bonds and small molecules and are even able to catalytically activate hydrogen gas.[11] In addition to demonstrating the numerous unique activation modes that have been developed in his laboratory, this reactivity has been extended to accomplish the reduction of various unsaturated functional groups, such as imines, alkenes and heterocycles, under extremely mild and metal-free conditions (Fig. 5). Undoubtedly, his group will be at the forefront of the many future discoveries which await this burgeoning field.

Stefan Grimme (Universität Bonn) delivered a fascinating insight into the world of computational chemistry, illustrating the many limitations of widely used molecular force fields such as B3LYP and their inability to account for important stabilizing interactions. His group has worked extensively on the development of more effective DFT methods that can provide reliable predictions about the stability and interaction of a wide variety of molecular systems. Notably, dispersion interactions are not incorporated into the most commonly used computational methods and this leads to poorly predictive calculations in many cases. Dispersion interactions involving bulky alkyl groups are able to lend stability to certain strained systems such as hexaarylethanes despite an apparent increase in steric crowding which one might naively expect to destabilize the molecule (Fig. 6).[12]

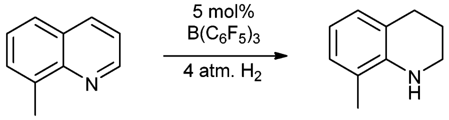

Fig. 5 Douglas Stephan has been able to hydrogenate nitrogen heterocycles in the absence of a metal catalyst using frustrated Lewis pairs.

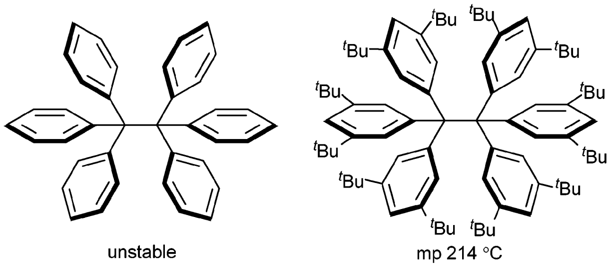

Fig. 6 Stefan Grimme's computational work demonstrated the remarkable stabilizing effect of dispersion interactions on polysubstituted hexaarylethanes.

Once again, the afternoon was reserved for an informal poster session, which was again preceded by an excellent session of short lectures presented by: **Takahiko Akiyama** (Gakushuin University), **Martin Albrecht** (University College Dublin), **Christian Hackenberger** (Freie Universität Berlin), **Yujiro Hayashi** (Tokyo University of Science), **Corey Stephenson** (Boston University) and **Hayato Tsuji** (The University of Tokyo).

Thursday evening's speaker, introduced by **Shu Kobayashi** (University of Tokyo), was 2010 Nobel Laureate **Ei-ichi Negishi** (Purdue University) who began his talk with a brief overview of cross coupling chemistry and the inspiration behind his developments in the field. Thereafter, he discussed the zirconium-catalyzed asymmetric carboalumination of 1-alkenes (the 'ZACA' reaction); a remarkable reaction that allows for the simple and enantioselective introduction of alkyl stereocentres from readily available olefin starting materials.[13] In addition, he provided an exceptional demonstration of the power of this chemistry in the context of the numerous natural products prepared by his research group.

The final session of the conference, introduced by **Jieping Zhu** (EPFL), began with **Takashi Ooi** (Nagoya University), who detailed his group's efforts in the realm of asymmetric catalysis. Using the principle of ion-pairing, Ooi and his group have designed a bewildering array of chiral ion pairs for a plethora of catalytic asymmetric processes including enolate alkylations, Pd-catalysed allylations and Mannich-type reactions.[14]

The final lecture of the meeting was provided by **Thomas Ward** (Universität Basel) who delivered an inspiring lecture demonstrating the synthetic potential of artificial metalloenzymes. These entities, in which a catalytically-active transition metal is housed within a protein scaffold, harness and exploit the power of both biological and transition metal catalysis leading to highly enantioselective metal-mediated reactions.[15]

The president **Andreas Pfaltz** brought proceedings to a close, and the responsibility for the 2013 conference was officially passed to next year's president **Luisa de Cola** and her vice president **Antonio Echavarren** (ICIQ). Together they have

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the daunting task of arranging the already eagerly awaited 2013 meeting.

Following a final conference lunch in the magnificent dining room of the Seehotel Waldstätterhof hotel, the speakers and delegates took time to reminisce on the week's science and say their goodbyes before parting for home. Thus, the 47th annual Bürgenstock Stereochemistry Conference was brought to a close.

TDS would like to thank the organising committee of the 47th annual Bürgenstock Stereochemistry Conference for the award of a JSP bursary to attend the meeting.

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