issue 11 | spring 2022

UNIVERSITY of York

ChemYork

HIGHLIGHTS FROM A LEADING UK CHEMISTRY DEPARTMENT

New Director of Green Chemistry

MBE for Lucy Carpenter

The York Approach to Research Excellence

Team Chemistry

PROFESSOR CAROLINE DESSENT, HEAD OF DEPARTMENT, INTRODUCES THE SPRING EDITION OF CHEMYORK.

I'm writing my introduction on Midsummer's Day, and the weather in York today is suitably glorious with blue skies and full sunshine to enjoy on my cycle to work. Summer term is coming to a close, and our undergraduates are about to receive their exam results. The Covid pandemic dramatically affected the studies of our graduating third- and fourth-year students, but these cohorts seem to have flourished in spite of this. The fourth-year research projects are as impressive as ever, and exam performance is excellent. This is a true testament to the resilience and determination of our students who suffered repeated campus lockdowns, spells of Covid-isolation in bedsit rooms, and the challenges of getting used to electronic learning. It also mirrors the enormous commitment of all the academic and support staff who worked with our students over the last two years. This year's graduation ceremony in July will definitely be a point for us to celebrate a "job well done" for both students and staff.

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This year has been an exceptional one for research achievements in the Department. Our result in the Research Excellence Framework (REF) assessement saw us ranked as the 9th chemistry department nationally for the quality of our research, and 7th for our research power, according to the Times Higher Education rankings. In the previous REF exercise back in 2014, we were placed 17th for quality, so we have leapt 8 places up the ranking table. This exceptional achievement reflects a huge improvement in the quality and international recognition of research that goes on right across our department. It also reflects the exceptional technical facilities we have established to support our research activities, as well as our distinctive research culture (see pages 6-7). Our achievement is especially notable when realising that all of the chemistry departments performing better than us are located either in the south of the UK, or in very major cities. As the still new Head of Department, I have to say that I have somewhat basked in the limelight of our excellent REF result. I wanted to take this opportunity to acknowledge that Duncan Bruce should really have been the one enjoying the University REF celebrations I was invited to, as it was his leadership that played a major role in moving the Department upward over the last seven years. Important mentions should also go to Prof Paul Walton, who led the REF submission, and Profs Lucy Carpenter, Ally Lewis, and Ian Fairlamb, who all played key roles the submission, as well as Alison Edmonds and Damian Shaw, our research office team, who collected all the data that went into the submission. We are planning a Department-wide celebration in July, where I am sure the champagne will flow.

Alongside our outstanding REF result, there have been other research achievements to celebrate. We learnt in March that three members of the Department, Prof Simon Duckett, Dr Martin Fascione and Dr Alison Parkin, had been successful in winning highly prestigious European Research Council (ERC) grants, which

together will bring in more than £5M in research funds over the next five years. This is an exceptional achievement - most universities would not expect to win three such grants in a single round. Further, over the last 12 months, we have been awarded over £18M in new research funds, a record-breaking sum. This will help produce the next-generation of internationally-leading York Chemistry research. We have also had much to celebrate in terms of prizes and awards for York Chemistry staff. You can read about Prof Lucy Carpenter's New Years Honour and Prof David Smith's Science for Society award on Page 3.

I hope you enjoy the magazine. I'd like to put in a special mention for the articles on pages 10-11 which highlight some of the educational work in the Department. We have always been a Department where teaching and research are equally valued, and these articles highlight some of the inspiring work our teaching-focused staff are doing to deliver the very best of contemporary chemical education. I'll finish by wishing you all a very good summer, and hope that you are enjoying some excellent York Chemistry weather wherever you are!

Front cover image: *Researcher Saikiran Ravi by Christina Surdhar*

Compiled by *David Smith and Christina Surdhar*

Designed by *Cookie Graphic Design*

ChemYork

Honours and Awards for Academic Staff

Professor Lucy Carpenter MBE

Professor Lucy Carpenter received an MBE for services to atmospheric chemistry in the Queen's New Year Honours.

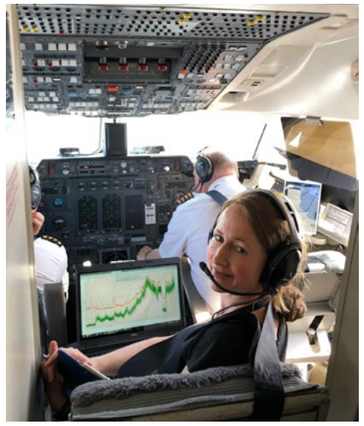
In 2000, Professor Carpenter was the first atmospheric chemist appointed in the Department of Chemistry. In the years since, she has become Professor of Atmospheric Chemistry and a Fellow of the Royal Society. She has been a winner of the RSC Tilden Prize, Royal Society Rosalind Franklin Prize and a Philip Leverhulme Award.

She plays a leadership role in the Wolfson Atmospheric Chemistry Laboratories (WACL), established in 2013 - the first centre of its kind in the UK, co-locating over 50 researchers across multiple academic groups, enabling experimental and theoretical studies relating to the science of local and global air pollution, and climate change.

Her own research is world-renowned for work on halogens. She helped establish that oceanic iodine and bromine mattered in the lower atmosphere, as well as discovering the predominant source of iodine into the atmosphere: chemistry occurring on the ocean surface. She has pioneered an understanding of how this process interfaces with the deposition of ozone to the ocean and delivers atmospherically important trace gases to the marine troposphere.

Professor Carpenter was a co-founder of the Cape Verde atmospheric observatory, which has proven exceptionally powerful in monitoring the signal of changing "background" atmospheric composition over the ocean. Furthermore, she has made key contributions to strategic intergovernmental work on reactive halogen chemistry and ozone depletion.

Lucy is a committed STEM ambassador, encouraging young people, particularly women, into



science careers through outreach to secondary schools.

Reflecting on her MBE, Lucy said: "I'm delighted and honoured to receive an MBE. I want to thank my amazing team and colleagues at York for being so great to work with and my family for always having their support."

Head of Department, Professor Caroline Dessent said: "It is fantastic to see Lucy's long-standing service to the Atmospheric Chemistry community rewarded with an MBE. She is an outstanding scientist, but has also given extremely generously of her time to support her research community. Excellent science cannot happen without such contributions."

SCI Science for Society Award

The Society of Chemical Industry, Yorkshire and Humber Division has awarded its 'Science for Society Award' to Professor David Smith in recognition of his sustained, outstanding and influential contributions to the advancement of science education.

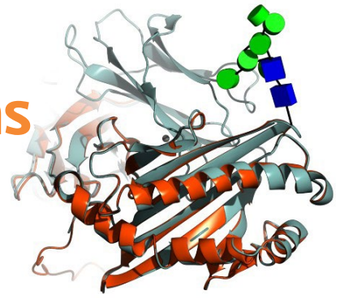
Professor Smith is a passionate educator – indeed, he has previously been recognised by the Royal Society of Chemistry Higher Education Award and an Advance HE National Teaching Fellowship. In 2019, York University Students' Union recognised him as the 'Most Inspiring' academic. He is well known for his engaging lectures, innovative teaching methods, and for championing student skills development within the chemistry curriculum.

He is also an outspoken advocate of Equality, Diversity and Inclusion (EDI) in science, and has reflected on the need for the prevailing culture of chemistry to change to become more inclusive. Recently, he has been involved in initiatives to incorporate EDI in the York undergraduate chemistry curriculum, such as the decolonisation of the chemistry curriculum to make it more global and inclusive.

In addition to his work within the University, Professor Smith also has a much wider profile, regularly giving public lectures about Medicinal Chemistry – he has spoken to over 50,000 UK school students. He has also developed his own YouTube chemistry channel, with well over half a million views, while as @professor_dave on Twitter he has over 25,000 followers.

In September 2022, Professor Smith will deliver his award lecture: 'EDI in Chemistry Education - From Engaging, Developing & Inspiring to Equality, Diversity & Inclusion' at a major event held here in York.

Building on artificial intelligence to model proteins



New research building on artificial intelligence (AI) algorithms, led by Dr Jon Agirre at University of York, has enabled scientists to create more complete models of proteins - paving the way for faster design of therapeutics and vaccines.

In particular, the study used AI to help understand more about the sugars that surround most proteins in our bodies. Up to 70 per cent of human proteins are surrounded or scaffolded with sugars, which play an important part in how they look and act. Moreover, some viruses like those behind HIV, Influenza, Ebola and COVID-19 are also shielded behind sugars (glycans).

The proteins of the human body have specialised shapes and compositions to get their jobs done. Protein structures can be predicted with AlphaFold, an AI program developed by Google's DeepMind, allowing scientists to understand a protein and predict the impact of mutations faster than ever. However, it cannot account for sugar modifications that affect protein structure and function. In this work (published in Nature Structural and Molecular Biology 2021, 28, 869) the researchers therefore created software that adds missing sugar components to the models, leading to a more complete structural prediction.

Reflecting on the work, Dr Jon Agirre said: "It is always great to watch an international collaboration grow to bear fruit, but this is just the beginning for us. Our software was used in the glycan structural work that underpinned the mRNA vaccines against SARS-CoV-2, but now there is so much more we can do thanks to the AlphaFold technological leap. It is still early stages, but the objective is to move on from reacting to changes in a glycan shield to anticipating them."

The research was conducted with Dr Elisa Fadda and Carl A. Fogarty from Maynooth University in Ireland. Haroldas Bagdonas, PhD student at the York Structural Biology Laboratory, which is part of the Department of Chemistry, also worked on the study with Dr Agirre.

Probing and imaging reactions with Nitrogen-SABRE

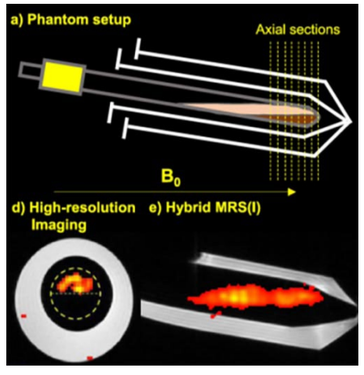
Recent research from Professor Simon Duckett has demonstrated how hyperpolarised NMR methods can be developed to follow reaction processes with much enhanced sensitivity, opening the possibility of creating hyperpolarized pharmaceuticals and following their distribution and reactivity in the human body by MRI.

Probing chemical processes within the human body is a challenging problem. Magnetic resonance imaging (MRI) is a cheap, easy-to-implement, powerful diagnostic method, but its inherent low sensitivity means most routine clinical measurements just probe highly abundant water. The ability to detect specific molecules, and interrogate their chemical reactions using MRI would be a game-changing technology.

In Journal of the American Chemical Society 2022, 144, 8756, Professor Simon Duckett and his research team in the Centre for Hyperpolarisation in Magnetic Resonance describe how the innovative magnetic resonance method, SABRE, developed in their laboratories, can be used to improve the detectability of a range of very important ^{15}N-containing species through hyperpolarisation.

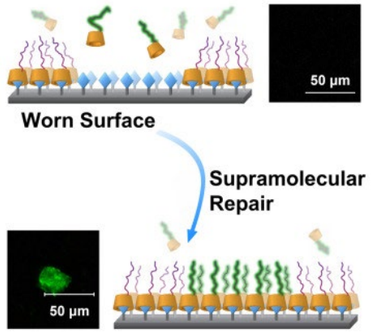
They applied this method to reactive ^{15}N-labelled species that can react with other organic molecules and thus incorporate the hyperpolarisation. The relatively long signal lifetimes allowed the researchers to successfully probe reactivity by NMR over several minutes. For example, in the case of $^{15}NO_2^-$ the diazotization of $PhNH_2$ and a subsequent reaction process was monitored. Each step could be followed using the NMR method. This indicates that ^{15}N-SABRE may potentially be used to understand how ^{15}N-labelled 'hyperpharmaceuticals' react and interact within a patient.

The researchers then went on to demonstrate that they could detect the location of the signals of these ^{15}N species in a test tube, in a magnetic resonance imaging experiment (see image) - the first step in translating the method towards MRI.



Professor Duckett said: "Taken together, the results of this work indicate that it is possible to use SABRE to achieve high intensity, long-lived magnetic resonance signals which can be used to follow ^{15}N-labelled reaction processes. In the future, we hope to develop the approach further to follow the distribution and metabolism of hyperpharmaceuticals in a living organism, potentially allowing MRI to achieve transformative steps forward in terms of diagnostic imaging."

Slippery sugar-coated surfaces repair themselves



Using nature for inspiration, a team of scientists including researchers in York, Durham and China has developed low-friction surfaces designed to repair themselves if damaged. These smart materials might one day be used in medical implants, like hip replacements.

The new sugar-coated surfaces mimic the way cartilage works to lubricate joints. Cartilage uses water to make a slick surface that minimises wear and tear. If cartilage becomes damaged, it can usually be repaired by the body, but artificial surfaces are not normally repaired so easily. This is the problem the new materials, published in Chem 2022, 8, 480, aim to solve.

The new artificial polymer coating has two major parts. Firstly, it has a long molecular chain with positive and negative charges to hold onto a water layer – using an effect similar to static electricity. A cyclodextrin sugar ring is then attached to one end of the chain, which anchors the chain to a surface by docking with specific molecules, called adamantanes. Treating titanium metal with the adamantane docking unit, allows the polymer coating to adhere to the surface.

Dr Alyssa-Jennifer Avestro, a Dorothy Hodgin Fellow at the University of York said: "If our protective coating layer is worn off, it is restored again without needing our intervention, as the interactions that hold the polymer to the titanium surface can re-establish themselves."

Creating artificial materials compatible with artificial joints and capable of self-repair required the expertise of an international team of mechanical engineers and chemists. Yulong Sun, a researcher working with senior author Dr Paul McGonigal in Durham University, spent time investigating the low-friction surfaces with Yixin Wang and Hongyu Zhang in Tsinghua University's Department of Mechanical Engineering in China. He bridged the gap between the chemical expertise needed to make the coatings and the engineering techniques used to measure their function.

Reflecting on the work, Dr Paul McGonigal added "In addition to medicinal use, we could also imagine developing a range of these materials that work in very different environments. Avoiding and repairing damage caused by friction is equally important to ensure that cars and other machinery last for a long time."

50-year-old synthetic challenge solved

Landmark research from the Department of Chemistry has developed an innovative synthetic method, able to convert any aromatic halide into a phenol, solving a long-standing problem in organic synthesis.

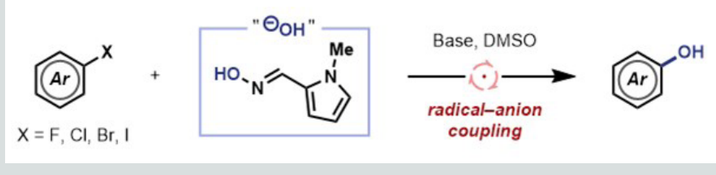
Phenols are compounds with high value in the pharmaceutical, agrochemical and polymer industries. In general, their synthesis relies on the conversion of an aromatic halide (C-X) bond into a phenol (C-OH) using a hydroxide anion reagent. However, this approach only works for fluorides and chlorides that are highly activated, and fails for bromides, iodides and non-activated systems.

With the goal of solving this problem, Dr Michael James decided to make use of a radical substitution approach - this had previously been considered impossible because hydroxide anions will not participate in this type of process.

In their work, published in Chemical Science 2021, 12, 14641, Dr James and his research team of Masters students developed a new reagent capable of facilitating this process, and in collaboration with Professor Victor Chechik also developed a detailed mechanistic understanding of the way it works.

The oxime reagent (see Figure, blue box) can transfer its hydroxyl group to an aryl radical (created on loss of the halide), enabling the smooth conversion of aromatic halides into phenols. The team were delighted to discover that this reagent was compatible with all aromatic halides, including the previously problematic bromides and iodides, and also worked effectively for non-activated systems.

The team hope that this 'transition-metal free' reagent will soon be commercialised and made widely available to others who wish to perform this kind of reaction. Dr James said "The conversion of a halide into a phenol looks so simple on paper, but for many years has been challenging except in very specific cases. This new reagent opens the possibility of a general transition-metal-free approach to this type of reaction which could be of high value in both academic and industrial settings."



The York approach to research excellence

THE OUTSTANDING RESULTS OF REF2021 PLACE THE DEPARTMENT OF CHEMISTRY IN THE TOP 10 CHEMISTRY DEPARTMENTS FOR RESEARCH, AS RANKED BY TIMES HIGHER EDUCATION, WITH THE MAJORITY OF ITS RESEARCH ACTIVITY BEING SCORED AS WORLD-LEADING (4*). IMPORTANTLY, THE DEPARTMENT HAS TAKEN A UNIQUELY INCLUSIVE APPROACH TO ACHIEVING THIS RESEARCH EXCELLENCE.

The REF assessment rated more than half (52%) of the Department's 'research outputs' as world-leading (4*) with all of the rest being internationally excellent (3*). In addition, 70% of the 'research impacts', ranging from atmospheric science to software enabling drug discovery, achieved the maximum 4* score. The 'research environment' achieved a 4* ranking of 87.5% - the 5th best score of any UK chemistry department.

These outstanding results propelled the Department of Chemistry into the Top 10 in the UK (9th) as ranked by Times Higher Education with a grade point average (GPA) of 3.60. This is a significant improvement on REF2014 and well above the national average for chemistry departments (median: 3.35). The University of York as a whole also moved into the Top 10 universities in the UK for the first time.

We therefore thought it was the ideal time to reflect on what makes the Department of Chemistry's research environment special.

An interdisciplinary approach

The guiding principle of Chemistry research at York is the aim to achieve the highest international quality, whilst having a unique reach across traditional disciplinary boundaries, facilitating societal impact wherever possible. Additionally, it aims to do all this with a focus on inclusion & diversity, allowing individuals to thrive.

The breadth of research in York is unusual for a chemistry department. Our research themes demonstrate how fundamental chemical principles reach out to fields as diverse as archaeology, biology, environmental science, medicine, laser spectroscopy and sustainable development.

Quality Outputs

Across the diverse research themes, York researchers are producing work of the highest quality. Reflecting this, over the past 7 years, the annual research income of the Department has risen by more than 50%, from £6.9M to over £10M.

This has underpinned a real growth in the quality of published outputs. Almost 75% of all papers published by researchers in the Department are in the 10% most cited papers worldwide in the relevant field. This was recognised by REF2021 which assessed all of our submitted outputs as being world-leading (4*) or internationally excellent (3*), with a majority (52%) achieving the highest 4* status.

Impact for the public good

The Department has developed a unique approach to translating research, in which it co-locates external researchers to work alongside and within its research themes, enabling integration of academic research outputs into an applied setting.

For instance, the Wolfson Atmospheric Chemistry Laboratories (WACL) houses staff from the UKRI National Centre for Atmospheric Science, and has joint academic appointments with DEFRA and industry. This helped deliver impact across scientific and environmental policy issues. York atmospheric chemists act on governmental science advisory groups, and regularly advise Parliamentary Select Committees and the United Nations.

The ability of researchers to respond quickly and deliver impact was also demonstrated during the COVID pandemic (see ChemYork, issue 7, pages 10 and 12). For example, in Structural Biology, electron microscopy was used to investigate the structure of some of the less-studied COVID viral proteins. Meanwhile, in Organic Synthesis, researchers synthesised fragments that were screened for binding to COVID targets, helping inform future development of anti-COVID therapeutics.

Infrastructure

During the period of REF2021 assessment (2014-2020), investment in departmental infrastructure saw well over £10M spent on facilities from Protein Structure Determination Labs to the Centre of Excellence in Mass Spectrometry. Building on the extensive investment in new laboratories since 2005, York is now one of the best-equipped chemistry departments in the UK.

Putting people first

Crucially, the research environment is about more than outputs, impacts and funding. The Department is a beacon of good practice for Equality, Diversity and Inclusion, with a focus on people at the heart of its approach.

A 2020 culture survey revealed that many felt the Department is a 'great place to work' (87% of academic, research and professional support staff). Furthermore, 90% of academic staff, 92% of professional support staff, and 83% of postgraduate researchers confirmed an understanding of the Department's policies in relation to equality; underlining the emphasis on a supportive, fair and sustainable culture.

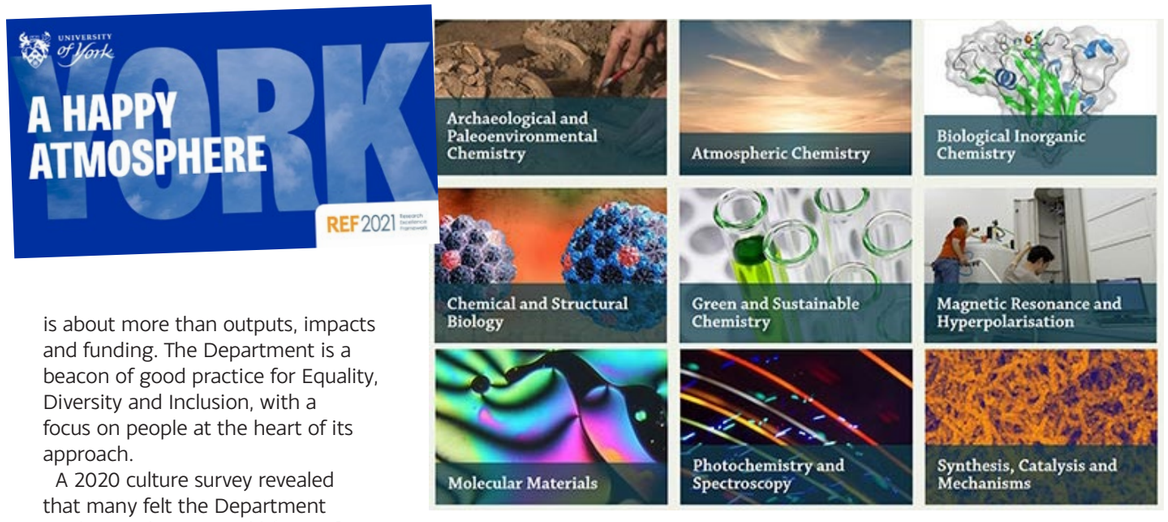
Since the previous REF assessment, the Department appointed many new academic staff members. These include new leaders in Synthesis Catalysis & Mechanism and Photochemistry & Spectroscopy, as well as boosting capacity in Structural and Chemical Biology and underpinning new emerging themes such as Molecular Materials.

Inclusion

The departmental focus on inclusion is exemplified by figures showing equivalent female and male appointment rates for research positions. The Department is also working to eliminate gender pay gaps, and at the time of the REF2021 submission, had a balanced gender 'pipeline' amongst academic staff - 25% of professors, and 28% of all academic staff, were female. Flexible working is common - 10 academic staff (21%; 5F, 5M) were working part-time including 5 members of professorial staff (2F, 3M).

Nurturing the next generation

A key part of our research culture is ensuring the next generation can thrive, and trying to ensure a diverse range of chemists can excel.



The Department has developed a new process to support early career researchers (ECRs). This involves support during grant writing, as well as mentoring, matching funds and research studentships and has led to significant growth in fellowships. The Department has an excellent record of helping independent fellows secure permanent lectureships (>90%).

Postdoctoral researchers (PDRAs) are supported by an Academic 'Champion'. All PDRAs are also provided with a peer mentor and one-to-one career development support.

Postgraduate research students (PGRs) have a mentor from the research student community and an academic Independent Panel Member (IPM), who provide an additional point of support.

The Department also runs the EPSRC DTP Mobility Training Pilot, which helps UK businesses up-skill their employees and attract applicants from non-traditional backgrounds.

Collaboration

The focus on people and inclusion generates an ethos of collaboration. Over one third of the Department's REF2021 outputs had two or more authors from departmental academic staff, and 80% had at least one non-York author. Over 60% of all publications included at least one international author.

As an example, research using enzymes to create biofuels from plant waste developed from a departmental collaboration between Chemical Biology and Bioinorganic Chemistry, and then forged links to researchers in France. This work has been translated into the industrial sector, being recognised by the Institution of Chemical Engineers Global Energy Award.

The Green Chemistry Centre of Excellence (GCCE), working alongside members of the Synthesis, Mechanism & Catalysis research theme, participated in Europe's largest public-private partnership (CHEM21) dedicated to making pharmaceutical manufacture more sustainable. This project (>£20M), brought together 6 pharmaceutical companies, 13 universities and 4 small-to-medium enterprises across Europe.

Very recently, members of the Department have been successful in receiving Royal Society of Chemistry (RSC) 'Horizon Awards', which recognise collaborative research (see ChemYork, issue 10, page 3).

A Unique Approach

The overarching themes of interdisciplinary working, alongside a commitment to equality, have helped Chemistry at York develop globally leading research. This has led to greater citation rates, increased collaborations, growing grant income, international research awards and genuine societal impact. It was particularly pleasing to see this recognised in the REF2021 results. Most importantly, however, this has been achieved while developing and supporting the people involved, helping them be as creative and successful as possible.

New Director of Green Chemistry

THE GREEN CHEMISTRY CENTRE OF EXCELLENCE (GCCE) IS A WORLD-LEADING ACADEMIC FACILITY PIONEERING GREEN AND SUSTAINABLE CHEMICAL RESEARCH. IT HAS A STRONG EMPHASIS ON WASTE VALORISATION, CLEAN TECHNOLOGIES AND PROVIDING HIGH QUALITY EDUCATION AND TRAINING PROGRAMMES.

Since its inception, the GCCE has been led by Professor James Clark. With Professor Clark stepping down from his role, the Department of Chemistry embarked on the search for a new Director. This led to the appointment of Professor Helen Sneddon, previously a Scientific Team Director at GlaxoSmithKline (GSK). We caught up with her to find out more.

Where did you originally study?

I studied Natural Sciences at Christ's College, Cambridge, then did my PhD there with Steve Ley, applying beta-keto dithianes to natural product synthesis. I then moved to University of California Irvine, where I was a Royal Commission for the Exhibition of 1851 research fellow with Larry Overman looking at the catalytic asymmetric chemistry of Palladium(II)

You're entering academia from industry, what roles did you have there?

I was with GSK for 15 years. I joined 'Med Chem' first working on hit-to-lead, then ion channels. However something had been nagging away at me since my postdoc. I'd worked on a new catalyst, and scaled it up for sale by Sigma-Aldrich. In doing so, I'd become aware of the cost of palladium, not just in financial terms, but also its carbon footprint. Learning from colleagues in Process Chemistry and Manufacturing how their catalysts were recycled, I started exploring how we could apply a related approach in the discovery phase. I became increasingly involved in making our operations more efficient, and our synthetic routes more sustainable. Ultimately I got the opportunity to pitch to the head of R&D for funding to lead a group within GSK focussed only on Green Chemistry - as a result, I led Green Chemistry for GSK since 2011.

How did this role lead to change in GSK?

I always felt there was a balance to be struck between immediately impactful operational changes, and longer-term more ambitious projects.

In the operational sphere, I am most pleased with more than halving GSK's R&D chlorinated solvent usage in the UK and decreasing it significantly worldwide. This was achieved through our solvent guide, chromatography studies, and research into reaction conditions. This allowed us to start to break the mindset that specific conditions are always needed for certain reactions.

A lot of my team's time was spent improving routes to candidate drugs. I'm particularly proud of (in different synthetic pathways) more than doubling the yield, reducing the process mass intensity (PMI) 8-fold (for a given scale), and finding a viable, more benign, alternative for a previously essential chromium(VI) oxidant in a key process.

What type of research are you planning to do here in York?

I want to transform approaches to molecules containing carbon-halogen bonds. That may seem an odd choice for research in a Green Chemistry Centre, but halogens are ubiquitous in the pharmaceutical industry (49 of the 119 small molecule therapeutics in the top 200 best-selling drugs of 2020 contain aryl halides...and many more of the non-halogenated products have halogen containing intermediates). I'm interested in data-driven approaches to more benign ways of creating these molecules. Furthermore, in instances where halogenation - in pharmaceuticals and elsewhere - leads to persistence, I'm interested in understanding when halogens can and can't be avoided, firstly through retrospective studies, then wet chemistry.

You bring a set of unique experiences to the Department, how do you hope to bring that to life for our students?

I've worked with the GCCE for years as a visitor, giving lectures and workshops to the Masters students. I hope to bring my industry knowledge, and experiences with the Nottingham Carbon Neutral Lab, and Brazil Centre of Excellence in Research in Sustainable Chemistry to relevant parts of the undergraduate curriculum. I am keen to hear from our students about changes they would like to see in the incorporation of industrial context and Green Chemistry in the curriculum. Please get in touch!

What are your visions for the future of the GCCE?

The GCCE has such a talented team, with deep expertise across solvents, microwaves, bio-based mesoporous materials, clean synthesis and sustainable organic synthesis. I'm incredibly lucky to be working with them. The wider department is also exceptional. There are great examples of collaboration between the two already, and I will seek further collaborative projects to the mutual benefit of both, to increase the GCCE's impact across academia and industry.

Green chemistry comic books

DEVELOPED BY ACADEMICS HERE IN YORK AND AT TEESSIDE UNIVERSITY, "GREEN KID" AIMS TO BOOST ENTHUSIASM ABOUT SCIENCE IN CHILDREN AGED BETWEEN 9 AND 12.

Image: University of York and Teeside University.

The project, funded by the Royal Society of Chemistry, will ensure every primary school in York will receive 30 copies and a teacher pack with extra learning materials.

The comic, set in 2064, sees the character 'Green Kid' travel back in time to the 2020s where they meet their inventor Summer as a child to see how scientific research to create green solutions and a circular economy could save the world from the ravages of climate change.

The comic, which also includes educational games and puzzles, focuses on the sustainable solvent Cyrene™, discovered by York researchers in 2014. The bio-based chemical can be used to sustainably manufacture a range of products from lithium batteries and carbon fibre bicycles to medicines. Made from sawdust, Cyrene™ is safe, sustainable, recyclable and does not harm the environment. A company called Circa is building a plant in France to produce Cyrene™ and will sell it to manufacturers to replace toxic solvents.

Dr Rob McElroy, co-inventor of Cyrene™ and one of the researchers behind the comic, said: "I love comics and visual arts and wanted to use them to help get across the exciting world of Green Chemistry. When I met Julian Lawrence from Teesside University, we talked about how he wanted to use his art to help inform the public about scientific research. We wanted to show kids science isn't boring - the comic gets across exciting scientific concepts in a simple way. The plot is centred around the climate crisis, but with a hopeful message that scientists are working hard to come up with solutions like Cyrene™."

The researchers have tested what children and their teachers think about the comic at two schools in York - Acomb Primary Academy and All Saints RC Secondary. Teachers read the comic with their classes and did a lesson around its themes including an experiment with sugar, starch and cellulose to demonstrate the power of solvents. Feedback suggested pupils gained an increased understanding of words like sustainable and solvent.

Tom Dennis from Acomb Primary said: "The comic had a real impact on the children's subject knowledge and confidence when discussing key issues in relation to climate change. Not only did the comic engage them, with the approachable character Green Kid, but was informative about climate change and how chemical processes, like the production of Cyrene, can help improve the situation. When asked after finishing the comic what could be improved, all children were unanimous - they wanted another one! A real, ringing endorsement and this was mirrored in the work they produced."

Chemistry PhD Student competes in UK Championships

HARRY MASLEN, A PHD STUDENT IN THE GREEN CHEMISTRY CENTRE OF EXCELLENCE, COMPETED IN THE HEPTATHLON AT THE UK INDOOR CHAMPIONSHIPS.

Photo credit: Olavi Kaljunen.

Harry Maslen graduated with a Masters in Green Chemistry at York and is now working towards his PhD in Green Chemistry's 'Clean Synthesis' research group with Dr Tom Farmer. He is also a competitive athlete, and this year competed in the UK Indoor Championships.

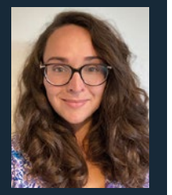
Harry is no stranger to competition at this level. He previously competed in the American Collegiate national Championships during his undergraduate degree at Angelo State University, Texas. In 2019 he also represented Great Britain and Northern Ireland in the decathlon at the World University Games in Napoli. This year was his first time at the UK Atletics Indoor Championships, where he came 5th.

Talking about balancing competitive athletics with PhD research, Harry said: "Time management is crucial to balance research and training, and some athletics coaching I do with City of York AC, but truthfully I couldn't do it if I didn't enjoy all of it. I have been thoroughly enjoying my project and the Clean Synthesis group is a fantastic team to be working in. Training for multiple events makes for a busy schedule - I couldn't do it without a lot of support from those around me, and without having fun when I train for each event."

New Horizons in chemical education - triple recognition

MEMBERS OF THE DEPARTMENT HAVE BEEN RECOGNISED WITH THREE ROYAL SOCIETY OF CHEMISTRY PRIZES FOR EDUCATION, HIGHLIGHTING INITIATIVES THAT ARE MAKING A REAL IMPACT.

Excellence in Education



Dr Julia Sarju, Lecturer in Chemistry Education, has become one of the first winners of the Royal Society of Chemistry's Excellence in Education Prize. These prizes recognise a wide range of skills – from curriculum design to effective teaching, and from personal development to working culture.

In her role, Julia provides high quality teaching and strives to meet the diverse needs of all students and actively promotes equality, diversity, and inclusion. She takes a scholarly approach to teaching innovation and works closely with students as partners in chemistry education projects. She also leads prize-winning teaching and accessibility training, which received positive feedback and excellent engagement from students.

After receiving the prize, Dr Sarju said: "To have won an award for work that I care deeply about is extremely moving and a great privilege. Awarding prizes for efforts in Equality, Diversity, Inclusion, and Accessibility signifies the great importance the Royal Society of Chemistry places on progress in this area."

Massive Step Change

The Horizon Prizes for Education celebrate ground-breaking innovations and initiatives that mark a step change in education. The team behind the University's first-ever massive open online course (MOOC), 'Exploring Everyday Chemistry' (see ChemYork, Issue 2, pages 6-7) was recognised with one of these prizes. The course is designed to allow participants to gain an insightful look into everyday chemistry, and was developed to encourage students to study chemistry at university.

Professor Parsons said some students were opting not to study chemistry because its applications were unclear. With the help of colleagues, he therefore developed the course to explain everyday applications of Chemistry, with topics including the search for new antibiotics, how to make the most delicious coffee, and designing performance-enhancing sportswear. The course is designed to motivate students to learn, as well as giving an insight into what university-level chemistry can offer.

Targeted at sixth formers, the free four-week course has been a massive

success, attracting over four times more under 18-year-olds than a typical FutureLearn course, with over 25,000 learners from around 150 countries since its launch in January 2017. Learners contribute to discussions (facilitated by York undergraduate chemists), participate in quizzes, learn about modern research and undertake kitchen experiments.

Professor Andrew Parsons said: "The success of this course is all down to teamwork. It has been a pleasure to work with Katrina Sayer and Iain Barr, two talented administrative colleagues, who have helped me design, deliver and advertise the course. Ten undergraduate chemists helped develop and refresh the course content, as well as facilitate the course during summer vacations. The opportunity to enthuse learners across the globe has been a real privilege."

Inspiration and Dedication

Nicky Waller has received the Royal Society of Chemistry's Excellence in Primary Education Prize. Nicky was chosen by the RSC's prestigious panel of judges as one of the most inspirational, innovative and dedicated people in education.

For 17 years, Nicky has been an advisory teacher in the North East for the Children Challenging Industry programme, based in the Centre for Industry Education Collaboration (CIEC). This pioneering teaching and learning programme is designed to bridge the gap between industry and education and has 25 years of experience in inspiring young children to become interested in science.

In her role, Nicky has supported industry partners to get the most from outreach with primary children, and made strong connections between the science that takes place in industry and the primary science curriculum, ensuring that school science has 'real life' relevance to children.

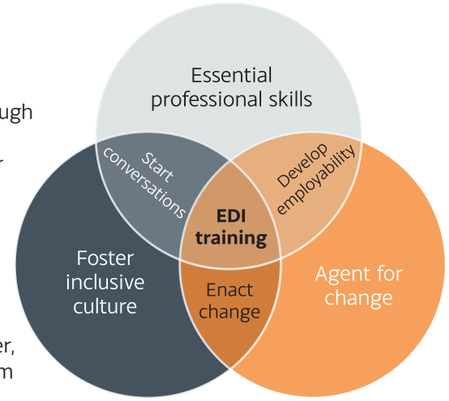
After receiving the prize, Nicky said: "I have worked hard to enthuse and support teachers and children over many years and help them to gain confidence and expertise within this subject area. To be recognised at such a high level is an absolute honour and a real highlight of my career."

Inclusive training

TWO PAPERS RECENTLY PUBLISHED IN JOURNAL OF CHEMICAL EDUCATION HIGHLIGHTED THE INNOVATIVE WAYS THE DEPARTMENT OF CHEMISTRY IS APPROACHING THE TRAINING OF UNDERGRADUATE STUDENTS AND GRADUATE TEACHING ASSISTANTS. THE WORK AIMS TO FOSTER AN INCLUSIVE CULTURE THROUGHOUT THE DEPARTMENT AND DEVELOP THE NEXT GENERATION OF PROFESSIONAL CHEMISTS.

Equality and Diversity Training

It is perhaps surprising that although undergraduates receive extensive training and teaching across their degree, very rarely does any of this address equality, diversity and inclusion (EDI). The recent introduction of an EDI training workshop in the Department of Chemistry at York, developed by Employability and Diversity Officer, Dr Leonie Jones, aims to transform the training provided to first year undergraduate students at the beginning of their degree. It is hoped that this will set students up



to succeed both in their university studies, and their future lives as professional chemists.

Training Graduate Teaching Assistants

Synergistic with the work to train undergraduates in EDI described above, Dr Julia Sarju led the development of training for our graduate teaching assistants (GTAs). GTAs help support the learning of our undergraduate students, particularly in Teaching Labs. The overarching aim of providing them with EDI training was to improve the equity of student experience in undergraduate chemistry laboratories, an issue which had been raised through undergraduate feedback. We aimed to achieve this by improving GTA awareness of inclusive teaching practices and EDI principles, and sharing inclusive teaching practices. Encouraging reflection on inclusive learning environments, cultures, and practices was highly valued by GTAs. In addition, the participants engaged in a rich discussion of inclusive teaching and drew from their own lived experiences. Indeed, the EDI

Overview of EDI training for graduate teaching assistants (GTAs).

training for GTAs was specifically designed to value their contributions. As Dr Julia Sarju reflects: "Graduate students have a diversity of lived experiences which are likely to be closer to undergraduates when compared with faculty and senior faculty, and there is higher representation of minorities. It was therefore vital to value and harness their own lived experiences and, in many cases, recent experiences of learning in undergraduate chemistry laboratories."

Authentic Voices

The training incorporates short authentic videos from a diverse range of departmental voices. This provides students with insights into how they can access support, act as allies, and respect diverse peers. Specifically, the training explores issues faced by black and ethnic minority scientists, women in STEM, LGBT+ individuals, and disabled scientists. Students also carry out an exercise in unconscious bias and learn about the ethos of the department and its diversity work.

This prepares students for study, particularly activities such as group practical work and tutorial group teaching. Beyond that, it helps prepare them for their professional life in chemistry, where many of them will take on leadership positions.

Reflecting on the training, Dr Leonie Jones said: "Hearing staff talk about their own experiences, or their professional insights into EDI, supported by data and evidence, engages students with the subject and allows them to see its practical relevance in the real-world."

Reflections

Head of Department, Professor Caroline Dessent said: "In the longer term, transforming the culture of chemistry, requires the next generation of scientists to be aware of cultural issues and committed to equity, inclusion and empowerment. We believe that providing formal training in these aspects enables our students to go on to be agents for change. We also hope that other chemistry departments develop EDI training programs for their students, and are making materials available to help them in doing so."

Chemistry effort for Ukraine

THE RUSSIAN INVASION OF UKRAINE IN FEBRUARY WAS NEWS THAT SHOCKED THE WORLD AND ALL OUR THOUGHTS TURNED TO WHAT COULD BE DONE TO HELP. IN CHEMISTRY'S UNDERGRADUATE OFFICE, THANKS TO THE PASSIONATE COMMITMENT OF LAB ADMINISTRATOR, ANIA TRATKOWSKA-PASTWA, THE WHOLE TEAM WAS SOON ON BOARD TO TURN THOUGHTS INTO ACTION AND SEND PRACTICAL AID TO THOSE FLEEING WAR.

As events in Ukraine began to unfold, Lab Administrator Ania Tratkowska-Pastwa, who is from Lublin in Poland, about 60 miles from the Ukrainian border, was hearing first hand from family and friends how refugees had begun to arrive in desperate need of help.

"When I heard what was happening, I had a very strong feeling that I had to do something. The situation was reopening wounds from the past - occupations by Germany and Russia - which greatly affected my family. In Poland, fighting for freedom is a familiar scenario and even though far away, I felt the call to action.

"I found out that the Polish Society in Leeds was organising a collection of essential practical items for a bigger project organised by the Polish Consul in Manchester. I called them to see how I could help, and I agreed to collect donations from across York. Our Student Experience Manager, Katrina Sayer, and colleagues in Chemistry were immediately on board, and an appeal went out to the University and beyond. It was fantastic to see how people responded. The Chemistry Undergraduate Office was soon full - we could hardly move!

Ania with husband Slawek and daughter Olivia (left) and Chemistry's Student Experience Manager Katrina Sayer with her son James (right)

Katrina and son James with Undergraduate Office Administrator, Elin Karner helped fill a lorry, kindly lent by YDL and driven by James, with the Ukraine donations.

"We collected around 55 boxes of essential items, and York's Tesco donated 60 crates of food and drink as well as 2 rails of clothes. My husband, Slawek, and Katrina's son, James, organised the transportation to Leeds, with a van and a lorry kindly lent by their workplaces. It was an amazing effort from everyone and I hope we can help again in the future."

The donations from York were taken to Ukraine in mid-March as part of the Polish Society project.

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A call was sent out across the department and wider university for specific donations (toiletries, nappies, non-perishable food etc) which were collected in the Chemistry Undergraduate Office.