





Contents

Introduction	Page 4
Programme	Pages 5 – 6
Abstracts	Pages 7 – 13
Biographies	Pages 14 – 22



Notes

Introduction

Welcome!

Welcome to the 2018 PEALS International Symposium. We are very glad that you are able to join us here in Newcastle at our 19th annual event. As in previous years, our ambition has been to bring together participants from a range of academic disciplines and from a range of interests in policymaking and in professional practice, to join together, in a collegiate and friendly atmosphere, to explore a major theme that challenges our thinking around matters of policy, ethics and life sciences.

Our focus this year is: ‘The implications and impacts of a responsibility agenda for synthetic biology’.

There is a growing global requirement for innovative science to be accountable, transparent and responsible not least in areas of science that appear to be ‘disruptive’. Responsible Research and Innovation (RRI) is a concept that has been developing and growing in salience for biological sciences for around a decade, and yet remains to be more widely considered, understood and implemented by those working within the field. Unlike the Ethical, Legal and Social Issues (ELSI) programmes common to many biotech projects the RRI approach is one which requires scientists themselves to take on the task of anticipating, reflecting on and engaging with, the social and ethical issues their research raises. However, implementation is in its early days and therefore this international interdisciplinary symposium provides an important opportunity to explore and debate the implications of different models of RRI for a range of interested parties. The symposium brings together leading social and scientific researchers, regulators, policy advisors, and other stakeholders to discuss the scientific, social, ethical, legal and regulatory issues raised by the burgeoning development of synthetic biology.

We are very pleased to be joined by colleagues from a range of disciplines (including science and technology studies, biochemistry, microbial genetics, biology, computer science, synthetic biology, history, law, ethics, philosophy, politics, sociology), from a range of jurisdictions and cultural experiences (including the Netherlands, Hungary, Italy, and the UK) and from a range of policy and practice backgrounds to assist these deliberations. Thank you to all of you who are contributing to this symposium by speaking, chairing sessions and participating in discussions. We are especially grateful to the EPSRC who provided the funding for this Symposium as part of the grant awarded to the *Synthetic Portabolomics* project (<https://portabolomics.ico2s.org/>)¹. We also thank Newcastle University whose Conference Support Scheme has contributed to funding the Symposium.

We are especially grateful to colleagues in the Policy, Ethics and Life Sciences Research Centre (www.peals.ncl.ac.uk) and the Interdisciplinary Computing and Complex Biosystems (ICOS) research group (<http://ico2s.org>) for their ongoing collegiality and general support. Finally, we should also like to add thanks to our colleagues Andrew Lawson, Trudi Pemberton and Sara Friedl for all their very hard work in assisting with the organisation and running of the symposium.

We are sure that the collective efforts of all will lead to a very enjoyable and stimulating meeting!

Ken Taylor and Simon Woods

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Programme

The implications and impacts of a responsibility agenda for synthetic biology

Urban Sciences Building, Newcastle University, Newcastle upon Tyne, UK.

Day 1: Thursday September 20th

12:00 – 13:00	Lunch and registration
13:00 – 13:15	Welcome and introduction Natalio Krasnogor and Simon Woods
13:15 – 14:45	Session 1. Responsible Research and Innovation: its place in and for science and society. Chair: Natalio Krasnogor 13:20 – 13:50 John Goddard 13:50 – 14:20 Anil Wipat 14:20 – 14:45 Discussion
14:45 – 15:00	Break for refreshments
15:00 – 15:15	Symposium photograph
15:15 – 17:15	Session 2: Sites of reflection: practice and profits of a responsible research environment. Chair: Darian Meacham 15:20 – 15:50 Richard Owen 15:50 – 16:20 Michael Reinsborough 16:20 – 16:50 Susan Molyneux-Hodgson 16:50 – 17:15 Discussion

Dinner



19:00 for 19:30

El Coto. 21 Leazes Park Road,
Newcastle upon Tyne, NE1 4PF

Day 2: Friday September 21st

00:90 – 09:25	Coffee on arrival
09:25 – 11:00	Session 3: The crystal ball: anticipation and meaningful actions.
	Chair: Matthias Wienroth
09:30 – 10:00	Rob Meckin
10:00 – 10:40	Sally Randles and Eniko Demeny
10:40 – 11:00	Discussion
11:00 – 11:15	Break for refreshments
11:15 – 12:40	Session 4. Governance and policy perspectives: the impact of regulation and responsibility on each other.
	Chair: Derek Bell
11:20 – 11:50	Sarah Hartley
11:50 – 12:10	Peter Border
12:10 – 12:30	Discussion
12:30 – 13:15	Lunch
13:15 – 14:30	Session 5: Industry perspectives on RRI.
	Chair: Janet Bainbridge
13:20 – 13:45	Mohammed Ahmadi and Natalio Krasnogor
13:45 – 14:10	Davide de Lucrezia
14:10 – 14:30	Discussion
14:35 – 15:20	Discussant: Observations, reflections and ‘next steps’.
	Chair: Simon Woods
14:40 – 15:00	Lionel Clarke
15:00 – 15:20	Discussion
15:20 – 15:30	Closing remarks Simon Woods and Natalio Krasnogor

Presentation Abstracts

Session 1. Responsible Research and Innovation: its place in and for science and society.

Responsible Research and Innovation and the Civic University

Professor John Goddard, School of Geography, Politics and Sociology, Newcastle University, UK.

The talk will introduce the work of the Horizon 2020 Advisory Group on Science With and For Society and discuss the implications of the principles of Responsible Research and Innovation for how collaborative research with industry is organised within universities to ensure a voice for civil society locally as well as globally. The discussion will be set in the context of evolving non-linear models of open innovation and of the university as an institution, most notably the civic university which highlights not only what it is 'good at' (science excellence) but what it is 'good for' (addressing societal grand challenges).

A tour of evolving ELSI, Post ELSI, Human Practices and RRI in synthetic biology – a personal perspective

Professor Anil Wipat, School of Computing Science, Newcastle University, UK.

Synthetic biology is a relatively new discipline. Over the past ten years the way in which synthetic biologists consider the interaction of their work with the wider world, and visa-versa, has evolved. Initially influenced by ethical, legal and social implications (ELSI) frameworks developed as part of the human genome sequencing programmes we have since seen the further adoption of concepts of post-ELSI principles, the introduction of human practises and more recently, the promotion of responsible research and innovation (RRI). In this talk I will review the research efforts of our group over the past ten years, presenting highlights of work demonstrating the evolution of the above concepts. In particular I will talk about research carried out as part of collaborative research programmes, work in contributing to the BBSRC synthetic biology dialogue, our artist in residence and by our student iGEM teams.

Session 2. Sites of reflection: practice and profits of a responsible research environment.

Institutionalising Responsible Innovation

Professor Richard Owen, School of Management, Bristol University, U.K.

(And with thanks to Sally Randles, Manchester Metropolitan University)

In this presentation I will briefly describe the development of a framework for responsible innovation in conjunction with the Engineering and Physical Sciences Research Council before focussing on some more recent experiences of putting this framework into operational practice. I will begin by setting some context, arguing that new areas of strategic science such as synthetic biology, and the need to demonstrate economic and social impact from this (e.g through innovation) both enlarge and complicate existing 'defacto' academic role responsibilities. As academics engage with such areas of techno-science as synbio and venture into a technological innovation system rooted in the triple helix of government-industry-university relations, they are faced with not only creating new knowledge but strong institutional and political incentives to valorise this, creating futures in complex, uncertain and sometimes profound ways, futures that are ethically, socially and politically entangled. Arguably this is an agenda that Universities are poorly equipped to deal with, with a reliance on narrowly- configured codes of research integrity and ethics that, whilst important, are quite insufficient. Frameworks for responsible innovation, and their cognates (such as anticipatory governance) respond to this, seeking to embed capacities for anticipation, (ethical) reflection, inclusive deliberation, and responsiveness in and around the processes and institutions of science and technology development. But this means hard work, with changes to norms and how knowledge is produced in Universities and the need for significant pedagogic innovation. Drawing together recent insights from the EU funded RRI Practice project and theories of institutionalisation and organisational change allows me to reflect on the move from concept to practice and the opportunities, tensions and challenges that institutionalising responsible innovation brings. Are Universities up for this? Based on these insights I will conclude with some key recommendations to support institutionalisation of responsible innovation in Universities, perhaps the most significant of which is the need for critical reflection on their role in an innovation system in which they, and the academics who work in them, are increasingly implicated.

Engaged social science methods for laboratory practice complemented with historical perspective and inclusive stakeholder engagement

Dr Michael Reinsborough, Department of Health and Social Sciences, University of the West of England, UK.

Social studies of science consider the production of scientific knowledge inside the laboratory (Latour and Woolgar 1979). Through ethnography, scholars have studied how the social, cultural and material arrangements of the laboratory support the ordinary production of facts (Knorr-Cetina 1999). Responsible Research and Innovation has this tradition as a resource for developing an engaged social science method. One example within the laboratory is use of the STIR protocol (Sociotechnical Integration Research, Fisher and Guston 2008). The researcher embedded within the laboratory group participates with the group and asks them to identify research choices that they are making. This may encourage reflexivity on the part of the lab researchers group, particularly in relation to relevant societal or ethical issues. This can be complemented with biosocial histories (Rabinow 1996) and inclusive engagement with stakeholders to expand the range of considerations that enter laboratory research planning. Whereas *sociobiology* uses biological knowledge to describe human activity through a biological lens in more deterministic terms, biosocial histories explore the uses humans have made of biological knowledge, the contingent narratives that we tell ourselves using biology.

Experiments in mutuality

Professor Susan Molyneux-Hodgson, Department of Sociology, Philosophy and Anthropology, University of Exeter, UK.

From my position as an STS researcher, I will reflect on a decade of ethnographic engagement with the synthetic biology enterprise. Drawing on experiences and findings from a series of collaborative projects with scientists and engineers, I want to describe some of the ways in which interdisciplinary interactions have been accomplished. I will explore some of the successes and tensions that emerge when working across boundaries of different kinds.

Session 3. The crystal ball: anticipation and meaningful actions.

A Sensory Approach to Situating the Anticipation of Biosynthetic Menthol in Everyday Life

Dr Rob Meckin, Responsible Research and Innovation Group, University of Manchester, UK.

The agenda for responsible research and innovation (RRI) indicates publics' inclusion in *ex ante* technology assessment. This paper addresses some of the critiques of existing approaches to public participation and engagement activities by describing a creative and sensory approach to anticipating innovations with publics. The methods outlined in the paper situate anticipation of synthetic biology in the mundane and everyday contexts in which people would usually make decisions about and choose different products.

Proponents of synthetic biology have targeted various possibilities for industrial applications for their field, such as producing speciality chemicals including flavours and fragrances. To this end, researchers have used synthetic biology techniques to make the chemical menthol using microorganisms. The sensory aspects of menthol afforded us the possibility for using existing menthol and mint products (muscle rubs, cigarettes, chewing gums etc.) to understand the kinds of practices, uses and ethics with which menthol connected. The paper argues that menthol is best understood as being implicated in different practices with particular affective, bodily and ethical commitments, which inform anticipation of biotechnology in different ways. More situated anticipatory engagement with publics' may lead to a greater appreciation for how publics reconstruct synthetic biology futures in mundane contexts.

An Instituted Process Approach to De-facto rri in synbio

Professor Sally Randles and Dr Eniko Demeny

Sally Randles^{1,2}, Eniko Demeny³, Peter Kakuk⁴, Mohammad Hajhashem⁵

Although much recent academic work and policy calls around Responsible Research and Innovation have asked that attention be paid to ‘institutional change’ in order to embed RRI into organisations, practices, and structural research and innovation systems; little work has been done to date by science, technology and society (STS) or research and innovation (R&I) scholars on **how** institutional change processes occur. And yet, decades of work in the fields of organisational institutionalism and institutional sociology can shed light theoretically and empirically on this question.

Stepping off from these literatures, the presentation will draw on work done over the last two years under the **H2020 SMART-Map** project. SMART-Map comprised a longitudinal experiment, which sought to co-construct with a range of actors; a set of governance devices and mechanisms (or ‘tools’). The prototype ‘tools’ were piloted for five months to test and reflexively learn from the experiences of the pilots, in order to judge the potential and make recommendations for the scope and follow-up steps to encourage the future take-up of the co-designed active devices by a wider constituency of industrial actors. In so-doing the project provided for a longitudinal study of De-facto rri ‘In Action’ as the actors pro-actively engaged in bottom-up processes forming **coalitions of the willing**, across six paired countries, each pair working on a different technology. The UK and Hungary focussed on synthetic biology; whilst Germany and Spain focussed on Precision Medicine and Denmark and Italy worked on 3D.

The presentation will focus on the experience of UK/Hungary working on synthetic biology; whilst also reporting findings from the longitudinal ‘formative (or ‘learning) evaluation’ which accompanied the length of the project, shedding light on the real-time views and experiences of the actors involved as the process unfolded.

¹ Manchester Metropolitan University Faculty of Business and Law, Dept of Strategy, Enterprise and Sustainability, Manchester UK

² Centre for Ethics and Law in Biomedicine, Central European University, Budapest, Hungary

³ Centre for Ethics and Law in Biomedicine, Central European University, Budapest, Hungary

⁴ Manchester Metropolitan University Faculty of Business and Law, Dept of Strategy, Enterprise and Sustainability, Manchester UK

⁵ With thanks to SMART-Map Colleagues: Ilse Marscalek, Maria Scrammel, Nicola Nosengo, Ralf Lindner, Marie Carmen Alvarez, Angela Simone, Raffael Himmelsbach, Francesco Lescai (Co-ordinator)

Session 4. Governance and policy perspectives: the impact of regulation and responsibility on each other.

Co-development as responsible research governance

Dr Sarah Hartley, University of Exeter Business School, Exeter, UK.

Gene drive is one of the world's most cutting-edge technologies with enormous potential benefits for malaria eradication. The first field trials of the technology developed in the Global North will take place in some of the world's poorest counties in Africa with extremely limited resources to prepare for, shape or debate gene drive mosquitoes. We show how gene drive research has been imbued with narratives of responsibility introduced and shaped by technology developers and funders. Through this case, we explore how this explicit commitment to responsible innovation governance has been enacted through 'co-development of research' and demonstrate the different ways in which the actors involved understand and practice co-development.

The work of the Parliamentary Office of Science and Technology

Dr Peter Border, Parliamentary Office of Science and Technology, Westminster, London, UK.

Session 5. Industry perspectives on RRI.

Don't Guess, Don't Predict, Know! How InfoBiotica Ltd is helping biotechnologists minimise process errors

Professor Natalio Krasnogor (CTO) & Mohammed Ahmadi (CEO) InfoBiotica Ltd.

There is a systemic deficit in the way the R&D and commercialization of engineered microorganisms are performed both in academia and industry. A major frustration is the irreproducibility of previous results, which of course has been widely reported both in the specialised media (e.g. Nature, Science, etc) and the general public media. Irreproducibility of cell bioengineering results is due, in large part, to:

- (a) fragmented documentation and mislabelled/missing samples (i.e. the “*what is in this cell line?*” question) and
- (b) lack of transparency and traceability of engineered cell lines (i.e. the “*who built this cell line, when, where, how and why?*” question).

Furthermore, these go against the grain of responsible innovation because as biotechnological projects become more complex and genetic engineering more widely available, experimental reproducibility, traceability and -ultimately- responsibility becomes harder to discharge. In addition, tax-payers money spent by academia and thousands of billable hours in industry are lost due to lack of necessary tools to address these points and keep track *jointly* and *persistently* of cell lines and their data footprint in a responsible and transparent manner. We will discuss these points and briefly overview a possible solution.

Promise and pitfalls of making biology easier to engineer: RRI, DIY and biohacking

Dr Davide de Lucrezia (MD) Doulix

Synbio has already revolutionized production paradigms in many different fields. These remarkable achievements have been largely ‘one-offs’ since each one is a special case and though they must be regarded as milestones in the respective field they do not provide a comprehensive and coherent engineering framework. This framework is rapidly changing due to the progress in vivo characterization of BioBricks and development of a computer aided design tools (bioCAD) that promise to make biology easier to engineer. What are the implications for the do-it-yourself movement and biohacking? I’ll present the latest results from a survey conducted to assess the public perception of doulix’s bioCAD.

Session 6. Discussant, Professor Lionel Clarke OBE.

Participant Biographies

Dr Mohammed Ahmedi

Dr Jaume Bacardit

Jaume's research interests include the development of machine learning methods for large-scale problems and their application to challenging problems, mostly involving biological data. He has published papers on algorithmic advances to improve the scalability of machine learning methods, tackling challenges such as large dimensionality spaces, large sets of records, or the use of data-intensive computing technologies such as GPUs and MapReduce. The main focus of his applied research on biological data is knowledge discovery: analysing the structure of the machine learning models to discover useful knowledge, such as (panels of) biomarkers or functional networks and in this way bring the data mining process closer to the domain experts. Jaume applied his methods to a variety of biological/biomedical domains: the process of germination in plants, cancer in humans or osteoarthritis both in humans and model organisms and multiple data-generating biotechnologies: transcriptomics, proteomics, lipidomics, etc.

Professor Janet Bainbridge OBE

Janet initially qualified as a Medical Microbiologist and several years later retrained as a Biochemical engineer. She has had a long and successful career spanning business (CEO of a small company), academia (Dean of Science and Technology, researcher, writer (with over 100 publications) and Government advice in the Department of Trade and Investment (formerly UKTI) as well as being a former Chair of many UK Government regulatory and scientific committees. She has been a former Council Member of EPSRC and Monitoring Liaison Officer for Innovate UK. She has also sat on the MHRA Borderline Substances Committee and was Chair of the British Potato Council and founder member of AHDB (the Agricultural and Horticultural Development Board). Janet is a Member of the UK Synthetic Biology Leadership Council and its Governance sub-group, Chairs the N8 Universities External Advisory Board, governor of an Agricultural College and sits on 2 the Boards of 2 Small innovative companies. She now runs her own small company, Innovation and Sparkling Science Ltd, which is focussed upon enabling innovation in businesses and she advises on finance for innovation, writes Grant Applications and advises companies on regulatory requirements for their goods and services.

Professor Derek Bell

Derek is Professor of Environmental Political Theory and Head of the Politics subject area in Newcastle University. His research focusses on environmental and social justice and he co-teaches a third stage undergraduate module, 'Community-based research in politics', which gives students the opportunity to conduct original applied research in collaboration with local voluntary and public-sector organisations. He completed his BA in Philosophy, Politics and Economics (PPE) at Balliol College, Oxford University in 1990 before returning to the North-East of England. He was awarded a British Academy studentship in Newcastle University to conduct his PhD. His thesis, 'The metaethical and ethical basis of political theory: a dual standpoint approach', critically examined Thomas Nagel's moral philosophy and attempted to develop a distinctive account of justice. Derek was awarded the PSA's annual Sir Ernest Barker Prize for the Best Dissertation in Political Theory (1999). He has recently completed a chapter, 'Justice on One Planet', for the *Oxford Handbook of Environmental Ethics* (ed. by Stephen Gardiner and Allen Thomson), is working on a co-authored monograph, *Global Justice and Climate Change* (with Prof.



Simon Caney, Oxford University) and is completing a co-edited book, *Justice and Fairness in the City* (with Prof. Simin Davoudi, Newcastle University).

Dr Peter Border

Pete is an advisor in the biological science and health section of the Parliamentary Office for Science and Technology (POST) and has a PhD in biochemistry. Before joining POST he worked in the agri/biotech sector and as a freelance writer.

Dr Dario Cecchi

Dario Cecchi is currently the head of the Synthetic Biology Laboratory at Doulix, a business unit of Explora Biotech S. r. l. After graduating as a Master of Science in 2012 in Molecular and Industrial Biotechnologies at the University of Bologna under the supervision of Prof. A. Danielli, he was hired as a graduate intern at the Centre for Genomic Regulation (Barcelona) under the supervision of Dr. R. Johnson. He obtained a PhD in Biomolecular Sciences in 2017 at the University of Trento under the supervision of Prof. S. Mansy and during that period he spent few months as a visiting PhD student at the Centre for Protolife Research (Bristol) under the supervision of Prof. S. Mann.

Professor Lionel Clarke OBE

Lionel Clarke co-chairs the UK Synthetic Biology Leadership Council (SBLC), which produced the UK Synthetic Biology Roadmap in July 2012 and the 2016 Strategic Plan for UK Synthetic Biology, 'Biodesign for the Bioeconomy'. He is an Advisory Board member to Department for Business, Energy and Industrial Strategy (BEIS). Lionel is a visiting professor at Imperial College London and Manchester University, and sits on external advisory boards there, in Nottingham and the Portabolomics project in Newcastle University. He is a member of both an EPSRC strategic advisory team and a Royal Academy of Engineering panel for Engineering Biology, and he was an advisor to the 2015 US National Research Council study 'Industrialization of Biology'. Lionel is involved with several start-up companies drawing on his previous academic experience at Imperial College, Cambridge and Grenoble and his lengthy industrial experience with Shell, where he formed numerous academic and industrial partnerships to take innovative ideas for better fuels and technologies from laboratory through to global markets. He was recently awarded an OBE for Service to Synthetic Biology.

Dr Richard Daniel

Richard is a Senior Lecturer at the Centre for Bacterial Cell Biology (CBCB), Newcastle University (UK). His work primarily focuses the mechanisms employed by bacteria to grow and maintain their characteristic cell morphology. This research employs genetic manipulation, microscopy, biochemical characterisation and analytical chemistry to explore the biological roles of specific proteins and how they interact with other cellular processes to coordinate the complex structural changes necessary for a bacterial cell to grow and divide. This work is primarily focused on providing an understanding essential cellular processes, but has application in the development of novel antibiotics and re-engineering of bacterial cells for biotechnological processes.

Mrs Karen Davies

Karen is a Portfolio Manager at the Engineering and Physical Sciences Research Council (EPSRC). Her specific areas of interest are Synthetic Biology and Biomaterials and Tissue Engineering.

Dr Davide de Lucrezia

Davide De Lucrezia is currently the Managing Director of Doulix and adjunct professor in Bi-nanomaterial at University Ca Foscari Venezia. Until 2012 he served as operative coordinator of the LivingTech Lab at the European Centre for Living Technology (Venice, Italy). He graduated in 2004 in Biology at the University of Rome “Roma Tre” and pursued a PhD degree in biochemistry in 2009. Prior joining ECLT he has been head of the pharmacokinetics and metabolomics unit at San Raffaele Hospital in Rome. In 2001-2003 he was staff scientist at Polyphor AG (Switzerland), and research technician at the Swiss Federal Institute of Technology of Zurich. He wrote several papers published in international peer-reviewed journals and books for both specialized and general audience and is the inventor of 1 patent. He has been involved in several European and international projects both as coordinator (THEGRAIL and NEXT projects) and WP leader (MAGISTER, ETOILE, AMCARE, DRIVE, LIAR and TOPCAPI). He designed and supervise pre-clinical trials for ATMP and IND safety and efficacy study #904/2015-PR, #905/2015-PR and CESA A 38 2011 and act as director for pre-clinical study #1046/2016-PR. He also leverages his competences in IP strategic management for private investor and biotech companies at both national, European (EPO) and International (PCT).

Dr Enikő Demény

Enikő Demény is Associate Research Fellow at the CEU Center for Ethics and Law in Biomedicine (CELAB). She received her PhD in Philosophy in 2006 at the Babes-Bolyai University, Cluj. Her research interests include the impact of new technologies on identity and the family; ethical, legal, social and policy aspects of new converging technologies (biotechnology, nanotechnology, information technology and cognitive sciences); social sciences and bioethics, gender and science, feminist epistemology, the anthropology of international bioethics governance.

Professor John Goddard OBE

John is Emeritus Professor and Special Advisor to the Vice Chancellor of Newcastle University. He was previously founding Director of the Centre for Urban and Regional Development Studies (CURDS) and Deputy Vice Chancellor responsible for the University’s engagement with business, the community and the city. John has been a member of the Horizon 2020 Advisory Group on Science With and For Society, an evaluator of the European Institute of Technologies’ Knowledge and Innovation Communities and visiting Fellow at NESTA. He is currently Vice Chair of an independent Commission of enquiry into the role of civic universities in the UK and advisor to the Department for Business, Energy and Industrial Strategy on Smart Specialisation and Science and Innovation Audits. He is co-author of [The University and the City](#) and [The Civic University: the Policy and Leadership Challenges](#). In 2012 John received the Lord Dearing Lifetime Achievement Award for Higher Education; in 2015 he was elected a Fellow of the Academia Europaea and in 2018 received an Honorary Doctorate from Hasselt University in Belgium in recognition of his work on civic universities.

Dr Sara Hartley

Sarah Hartley is a Senior Lecturer at the University of Exeter Business School where she researches the governance of technological solutions to global challenges with a focus on regulatory governance and responsible research and innovation. She explores efforts to open up governance through case studies involving sustainable agriculture and global health, critically examining ways in which the trajectory of technology and innovation can be shaped by a broad range of actors and exploring the factors that facilitate or restrict these efforts in Europe, Africa, and North and South America. Current research explores the governance of GM insects and new



plant breeding techniques, including genome editing and gene drives. Sarah engages with scientists and policymakers, providing advice to the House of Lords Science and Technology Committee, Nuffield Council on Bioethics, and research councils. Sarah has a PhD in Politics and Environmental Studies from the University of Toronto.

Professor Marcus Kaiser

Marcus studied biology and computer science at the Ruhr-University Bochum and the Distance University Hagen and obtained his PhD from Jacobs University Bremen in 2005. He is leader of Neuroinformatics UK, Chair of the British Neuroscience Association SIG Neuroinformatics, and leader of Neuroinformatics research at Newcastle University. He is author of the first major review (Trends in Cognitive Sciences, 2004; cited 1,700+ times) as well as of more than 60 other publications in the field of brain connectivity (connectomics). Since 2016, he is Fellow of the Royal Society of Biology. Research interests are understanding the link between structure and function by modelling brain development, neural dynamics, and therapeutic interventions.

Professor Natalio Krasnogor

Natalio is Professor of Computing Science and Synthetic Biology at Newcastle University, co-directs Newcastle's Interdisciplinary Computing and Complex BioSystems (ICOS) research group and is the director of the Centre for Synthetic Biology and the Bioeconomy (CSBB). Krasnogor holds an EPSRC Leadership Fellowship in Synthetic Biology (grant EP/J004111/1 & 2), is Principal Investigator for the EPSRC Program Grant "Synthetic Portabolomics: Leading the way at the crossroads of the Digital and the Bio Economies" (EP/N031962/1) and was the overall lead in the EPSRC Synthetic Biology ROADBLOCK project (grants EP/I031642/1, EP/I031812/1, EP/I03157X/1) involving Newcastle, Nottingham, Sheffield, Warwick and Bradford Universities. He won several best papers prizes, Bronze, Silver and Gold awards of the American Computing Society's (ACM) HUMIES award for human-competitive results that were produced by any form of genetic and evolutionary computation as well as an ACM's Impact award. His research activities lie at the interface of Computing Science and the Natural Sciences, e.g. Biology, Chemistry and Physics.

Professor Jackie Leach Scully

Jackie's first degree was in biochemistry, and her PhD in cellular pathology. She held research fellowships in oncology and neurobiology at research institutes in Switzerland, before moving to help establish the first interdisciplinary unit for bioethics at the University of Basel. There she developed her research interests in the regulation of genetic and reproductive medicine, and in the more general areas of bioethics, disability, the social construction of moral issues, and in feminist and psychoanalytic approaches to understanding moral processes. Between 2002 and 2004 Jackie was temporarily based at the Policy, Ethics and Life Sciences Institute at Newcastle with a Wellcome Trust-funded project investigating ethical issues in prenatal sex selection. In 2006 she returned to Newcastle to join Newcastle University's Sociology department, and in 2008 joined PEALS (the Policy, Ethics and Life Sciences Research Centre) as Director of Research. Jackie has an overarching interest in the development of moral questions, frameworks of understanding, and identities in the bioethical arena. Her most recent research is part of the 'sociological move' within bioethics, and reflects a longstanding interest in the responses of socially marginalised groups and religious groups to health and life science developments and policy.



Dr Darian Meacham

Darian is Assistant Professor of Philosophy at Maastricht University, Senior Research Fellow in Philosophy at the University of the West of England, Bristol and Deputy Director for Responsible Research and Innovation at BrisSynBio (a BBSRC / EPSRC funded Synthetic Biology Research Centre at the University of Bristol). He studied at McGill University (BA) and University of Leuven/KULeuven (MA, PhD). His main teaching and research interests are in political philosophy, philosophy of nature and bioethics. He is particularly interested in problems surrounding the concept of Europe and post-national political institutions and leads on the post-Europe Project - www.post-europe.org.uk), and the ethical and anthropological issues raised by the technological alteration of the human body and mind. At the most fundamental level Darian is interested in the relation between sense and nature.

Dr Robert Meckin

Rob is a postdoctoral researcher in the Responsible Research and Innovation (RRI) Group at the University of Manchester. His interests include science and technology in everyday life, changing software and hardware infrastructures in the life sciences, interdisciplinary collaboration and experimenting with creative methods in social research. His PhD thesis explored how synthetic biology researchers in the UK aligned their field with other domains in society in material, organisational and rhetorical ways.

Professor Susan Molyneux-Hodgson

Susan joined University of Exeter in 2016 as Professor of Sociology, following 15 years in Sociology at University of Sheffield. She has been studying the development of synthetic biology since 2007, being part of the original Networks in Synthetic Biology alongside Phil Wright (now PVC at Newcastle). Working within the field of STS, her main research interest is in the emergence, maintenance and reproduction of technical research communities. Industry - academia collaboration, interdisciplinarity and understanding responsible innovation in practice, are areas in which she currently holds grants. Alongside synthetic biology and industrial biotech, she works on nuclear waste and radiological protection issues.

Professor Richard Owen

Richard is Professor of Innovation Management at the University of Bristol, UK. Originally trained as a scientist researching climate change records and the impact of pollutants on vulnerable ecosystems his journey to the social sciences began when he started to ask questions about how his data was being used, by whom and for what purpose. This led him first into risk assessment and risk governance, then regulation and innovation governance. It included a spell between 2003 and 2008 at the UK Environment Agency where he was Head of Environment and Human Health, leading on the risks and regulation of new technologies. It was there that he learned at the coal face about the strengths and limitations of regulation for new areas of technology, leading him to return to academia in 2008 to develop a new approach for governing innovation and technologies around the concept of 'Responsible Innovation', working closely with the UK Research Councils to develop a policy and framework for Responsible Innovation in 2013. His research interests are around the politics, risks, ethics and governance of innovation and new technologies in society, from big data in financial services to inclusive innovation for development in the global South. His research sits at the intersection of innovation governance and science and technology studies as a critical, interdisciplinary scholar.



Professor Sally Randles

Sally holds the Chair in Sustainability and Innovation within the Department for Strategy, Enterprise and Sustainability at the Manchester Metropolitan University Faculty of Business and Law, UK, where she is also co-convenor of SEEG: the Sustainable and Ethical Enterprise Group. SEEG is a cross-disciplinary research and engagement group impassioned by the desire to deliver cross-disciplinary research-led teaching and learning at Masters and PhD levels. She was the ABIS Scientist in Charge for European Commission Marie Curie Training Network 'Innovation for Sustainability (IAS)' (2012-2016) co-ordinated by the Academy of Business in Society. Sally's current research focuses on understanding how actors embed understandings of 'responsibility' into research and innovation situations, organisations and governance processes, a line of research which has supported her role as partner and WP lead on a number of EU FP7 projects, most recently RES-AGorA (2013-2016) and the two current H2020 projects SMART-Map and JERRI. She retains Honorary/Associate Fellow roles at the Manchester Institute of Innovation Research at the University of Manchester and the Centre for Organisations Research and Design (CORD) at Arizona State University, USA. Sally has a BSc.Hons in Management Sciences from Lancaster University Management School, an MBA and a PhD from the University of Manchester in urban geography and political economy. Previous posts include Principal Economic Development Officer within regional government in the UK; Survey Officer and author at the UK Consumers' Association publishers of *'Which?'* magazine; and co-ordinator for a community training company in the Spitalfields neighbourhood of East London, UK.

Dr Michael Reinsborough

Michael Reinsborough is a researcher at the University of the West of England, Bristol in the Social Sciences Research Group and works with BrisSynBio, a BBSRC/EPSRC Synthetic Biology Research Centre, located at the University of Bristol. He is a visiting scholar with Department of Global Health & Social Medicine, King's College London where he worked with the Human Brain Project Foresight Laboratory. He previously worked as a researcher at the Centre for Nanotechnology and Society – Arizona State university. Michael received a Ph.D in the History of Science from Queen's University Belfast, Department of Anthropology.

Dr Paul Rouse

Paul has worked in and around the science policy world for almost thirty years, both as a researcher and within funding agencies (ESRC, EPSRC and the Department of Health). Whilst at the ESRC, as head of environment, energy and food research, he developed over £100M of new multidisciplinary co-funded directive mode research. He completed a PhD during a career break, before returning to the EPSRC this spring where he, amongst among other activities, leads on EPSRC's responsible innovation in engineering agenda. Paul's PhD, received in 2018 (University of Southampton), explored responsible innovation issues associated with risk governance of geoengineering. Paul is particularly interested in how researchers and the wider world of science and innovation, can participate more fully, and reflexively in the social appraisal of technology.

Dr Immanuel Sebastine

Immanuel is a Chartered Chemical Engineer and Fellow of Higher Education Academy with more than 25 years of experience in academia, R&D and industry. He has worked with multidisciplinary research teams - applying engineering principles to chemical and biological sciences (reactor design, filtration, formulation, particulate processing, industrial biotechnology, bioprocess engineering, regenerative medicine, healthcare engineering and scale up) and has written several scientific journal articles. Immanuel is currently working with the academic institutions across

the UK to understand their individual needs, assist them in their research to move to higher technology readiness level (TRL) in accordance with Centre for Process Innovation (CPI) technical and business strategies.

Dr Wendy Smith

Wendy is a senior research associate who is a member of a multidisciplinary research group headed by Professor A. Wipat, based in the Synthetic Biology wet lab in the Centre for Bacterial Cell Biology, Newcastle University. She was awarded her PhD in Medical Microbiology at Newcastle University for her thesis 'A functional genomic analysis of group A streptococcal virulence factors'. Her initial research involved investigating the mechanisms of pathogenicity utilized by the Gram positive bacteria *Streptococcus pyogenes*, with specific emphasis on the role of pili and adhesion. Wendy then became interested in synthetic biology and has been applying her expertise in projects in this field for 9 years. Currently working on the Portabolomics project, Wendy is developing systems for monitoring and measuring the metabolic load imposed on *Bacillus subtilis* and *Escherichia coli* chassis when synthetic parts/systems are integrated into them. She has also recently worked on synthetic quorum peptide mediated communication systems in *B. subtilis*.

Dr Ken Taylor

Ken is a Research Associate in the PEALS Research Centre, Newcastle University. His research interests centre on the impact of developments in biological sciences for researchers, policymakers and the citizens whose lives may be affected by them. Ken currently works with Dr Simon Woods on the 'Responsible Innovation' strand of an interdisciplinary synthetic biology project. Previously he worked with Professor Erica Haines on a number of projects examining the provision and acquisition of human reproductive tissue for scientific research. Ken is a Fellow of the Newcastle University Policy Academy, which develops knowledge and skills to improve the impact of academic research on policymaking. His PhD examined aspects of the politics of developments in genetic technologies. In his early career Ken ran DNA sequencing and synthesis services for an agricultural research institute and researched malting quality attributes of new barley breeding lines.

Dr Ilke Turkmendag

Ilke has a PhD in Genetics and Society (Institute for Science and Society and School of Law, University of Nottingham), and a Master's degree in Science and Technology Studies (University of Oslo). Her doctoral work concerned the social and ethical implications of the removal of donor anonymity from gamete donors in the UK. She joined the Policy, Ethics and Life Sciences Research Centre (PEALS) at Newcastle University and from 2010-2012, worked with Professor Erica Haines as a Post Doctoral Research Associate on 'Interdisciplinary Approaches to the Uses of Reproductive Tissue in Stem Cell Science'. Ilke was granted a Mildred Blaxter Postdoctoral Fellowships funded by the Foundation of Sociology of Health and Illness to disseminate the findings from my PhD thesis. After moving to Sheffield University, Ilke coordinated large grant applications, taught 'Social Theory and Analysis' and 'Sociology of the New Genetics' and supervised 3rd year students for their final dissertations in Sociology. In Sheffield I also coordinated the activities of the Biosociety Network and played role in launching a new university research centre, iHuman. In February 2016 Ilke joined the Newcastle Law School as a Lecturer in Law, Innovation, and Society. She is a member of Executive Committee of Socio-Legal Studies Association.

Dr Matthias Wienroth

Matthias is a Science and Technology Studies (STS) scholar at the Policy, Ethics and Life Sciences (PEALS) Research Centre, Newcastle University (UK). In his work he approaches sciences and technologies as social phenomena within a programme of understanding what constitutes and fosters ethical research and innovation, and how knowledge production and valuation practices intersect. To that effect, Matthias is particularly interested in the social and ethical aspects of technology, as well as the governance mechanisms through which scientific knowledge and technological application are organised. He applies this analytical gaze to new and emerging socio-technical developments in the life sciences in different social domains, including forensics and health. An integral part of his work is cross-disciplinary collaboration with social and ethical analysts, geneticists, practitioners, and policy makers.

Professor Anil Wipat

Anil is Professor of Bioinformatics in the School of Computing Science at Newcastle University, co-directs the Interdisciplinary Computing and Complex Biology Systems Group (ICOS), is director of the Centre for Health and Bioinformatics (CHaBi) and co-founder, and associate-director, of the Newcastle Centre for Synthetic Biology and Bioeconomy (CSBB).

Anil trained first as a molecular microbiologist (with a special interest in Gram positive bacteria) and subsequently as a computer scientist. His recent work has focused on both bioinformatics and design in Synthetic Biology. He now carries out research at the interface of all of these subjects including a significant number of laboratory-based projects. Anil is also very active in the development of standards for data exchange in Synthetic Biology and is the Chair of the International SBOL steering committee. He has over 100 refereed publications many of which are interdisciplinary in nature.

Dr Simon Woods

Simon Woods is Reader and Deputy Director of the Policy Ethics and Life Sciences Research Institute (PEALS), an interdisciplinary bioethics research centre at Newcastle University. Simon has a longstanding interest in developments within the life sciences, medical ethics and bioethics more broadly. His research explores the social and ethical aspects of new and emerging biotechnologies. Simon has been work-package leader, or ethics advisor to ten EU projects and several with a focus on rare disease genomics in which issues related to the care and treatment of children have been central. Simon holds bachelor and doctoral degrees in philosophy and over the past 15 years he has pursued a career of teaching and research within bioethics. Simon has considerable expertise in the ethics and regulation of bioscience research; he has been a member and vice-chair of NHS research ethics committees and is a member of the NHS Health Research Authority's National Ethics Advisors' Panel.

Dr Yulia Yuzenkova

Yulia is a Royal Society University Research Fellow; before moving to Britain she did her PhD in Academy of Science (Russia), and postdoctoral research at Rutgers University (USA). Her group's main research topic is the regulation of gene expression in various bacteria, including major human pathogens and cyanobacteria. Yulia's group is working on basic mechanisms of transcription, the first stage of gene expression, and modes of action of antibiotics targeting this stage. In the Portabolomics project, Yulia's group is investigating circadian regulators, which switch genes on/off at the level of transcription. Ultimately, they aim to design elements of circadian control to use as tools for Synthetic Biology applications in industrially important microorganisms.



Professor Nikolay Zenkin

Nikolay hails from the small town of Dubna, the nuclear physics research centre of USSR. He graduated from Moscow State University, Department of Molecular Biology of the Biological Faculty in 2001 and obtained PhD from the Institute of Molecular Genetics of Russian Academy of Sciences in 2004. Part of his PhD was done in laboratory of Konstantin Severinov in Waksman Institute of Rutgers University in New Jersey, where he returned to after PhD completion as a post-doc. In 2007 Nikolay was offered a Lectureship in the Institute for Cell and Molecular Biosciences in Newcastle University, where he continues to run his lab. In 2009 he was promoted to Senior Lecturer and in 2013 to full Professor. Nikolay was awarded the Fleming Prize Lecture, Leverhulme Prize, and a Wellcome Trust Senior Investigator Award.