

UCL at 200

Two Centuries of Insight and Impact

Edited by Virginia Mantouvalou

UCL  200

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Proceeds from the sale of this book will support UCL200
Scholarships, helping to create a lasting legacy for
UCL's Bicentenary programme

Designed by Bobby Birchall, Bobby&Co.

Contents

Reflections from UCL Council	6
President and Provost's message	7
Forewords	8
Introduction	9
Nobel Prize winners	12
Timeline	14
1 Healthy life for all	18
2 Culture and creativity	58
3 Environments	100
4 Community	124
5 Fairer futures	160
6 The power of education	188
7 Life on and beyond earth	216
Acknowledgements	252
Photo credits	253
Index	254

Reflections from UCL Council

As UCL's Chair of Council, it is with great pleasure that I introduce this commemorative volume, *UCL at 200: Two Centuries of Insight and Impact*, marking the bicentenary of University College London.

My own journey at UCL began in 1976, when I arrived at Bentham House to read law. Fifty years later, as we celebrate our bicentenary, I am honoured to serve as the university's Chair of Council.

UCL is an extraordinary institution. As an alumnus, I am deeply proud to have studied here and am grateful to have made and maintained lifelong friendships. Over the past five decades, I have engaged with fellow alumni worldwide and particularly in Asia, where I was instrumental in the foundation of UCL's Hong Kong Alumni Association in the early 1980s. More recently, it has been a pleasure to work alongside UCL colleagues and students to strengthen our university's resilience and sustainability as we enter our third century in an increasingly complex and challenging global environment.

UCL's unique foundational values have made the university what it is today. Exploring our history and role in society over the past 200 years, I have been particularly touched by the stories of international students who came to UCL from around the world – even in the nineteenth century. These generations of students have made remarkable societal contributions and paved the way for individuals like me to come to London to study. Today, our alumni community of almost 500,000 across 190 countries reveals countless stories of inspirational lives and achievements.

The essays in this book offer a glimpse of life at UCL over its 200 years and the ground-breaking research that continues to flourish here. You will find this collection enlightening and uplifting as UCL celebrates two centuries of innovation and discoveries that have truly transformed society.

Victor Chu CBE
Chair, UCL Council



The Front Quad during a bazaar and fete, summer 1909.

President and Provost's message

In 2021, I took a leap of faith. Amid a global pandemic, I packed up my family and left our home in Sydney to join University College London. Many questioned that decision, but I never did. UCL was the only institution that could inspire such a bold move, and I am thrilled to be here during our bicentennial year: a moment to reflect on two centuries of impact and to imagine the next two.

For me, UCL is not just a university, it is a place of extraordinary opportunity, nestled in the heart of one of the world's greatest cities. We often say, here it can happen. But in my experience, here it really does happen.

Here, your academic ambitions can be as daring as those of a future Nobel laureate or Fields medallist. Your creative aspirations might lead you to a Turner Prize or an Academy Award. You may arrive with a childhood dream of becoming a doctor, and leave not only with the knowledge and skills to do so, but with a rich, student-led educational experience, one that allows you to engage in social hackathons and community volunteering, to perform on stage at London's only student-led theatre, and to play top-level sport, all alongside your studies.

Whatever your career aspirations, your dreams of breakthrough discoveries, innovative business development, social impact, no matter what you want to make happen, UCL is the place to make it happen. We create an environment that inspires and enables our people to do brilliant things.

I have worked in some great universities, and my sense is that UCL genuinely is different. It is a marvellously dynamic place with a disruptive spirit that encourages imaginative approaches to the world's toughest problems.

Today, we gather more than 60,000 staff and students, speaking 100 languages, to create a city within a city, a research and innovation powerhouse that has won 32 Nobel prizes and leads the world in subjects as diverse as neuroscience, life sciences, education, the built environment and fine art.

From the very beginning, UCL was built on founding principles of diversity and useful knowledge

– we were created with the radical notion that you can think quite different things and yet live together well in a community. That founding ethos is at least as relevant today as it was 200 years ago. We are a place for speaking your mind but also being ready to change it.

This open, inclusive and pluralist environment has enabled us to ensure philosophical leaps, medical advances, technological breakthroughs, cosmic discoveries, world-changing innovations and creative insights that continue to happen each and every day.

This volume offers a mere glimpse into the richness and vitality of UCL's work, and I hope that it inspires you as we step boldly into our next century.

I hope you will enjoy reading about this chapter in our history. Here's to the next.

Michael Spence

President and Provost

Forewords

It is an extraordinary experience to step onto the UCL campus and through the Quad for the first time as a UCL student. Treading in the footsteps of two centuries of world-shaping staff and former students is a powerful reminder that UCL is a very special place. This recognition is a profound inspiration.

I feel fortunate to hold the position of President of UCL Students' Union at this significant moment in UCL's history. The Union (known then as the Men's Union Society) was established in 1893. Consistent with UCL's pioneering spirit, it was the first student-led organisation in England to bring all elements of student life under one roof including 'the promotion of social intercourse and of the means of recreation, physical and mental'. A tradition was started that I'm proud to continue. Student life is student-led here.

From their first moment at UCL, students immerse themselves in the culture, intellectual life and community of campus. A critical element in our educational experience is the enrichment of our learning and the opportunity to engage as partners in the academic research enterprise. Working alongside academics in classrooms and laboratories we learn from, are inspired by and help to shape the extraordinary research illustrated in this volume. Equally important, we connect our classrooms to the wider world and incorporate perspectives from beyond academia: we work with local communities to produce together research that drives beneficial social change.

Reading this volume, I reflect on the journey of thousands of students before me. Each generation of students is trusted to live the principles and values of the institution in the way they approach their student life. No matter how far along your UCL journey you are, the kind of impact you can have has never felt so clear.

Anam Eijaz Ahmed Choudhary
President, UCL Students' Union

Two centuries ago, UCL was founded with a radical vision: to open the doors of higher education to all, regardless of religion or background. In doing so, it became not only London's first university but also a beacon of progressive thought, social transformation and academic excellence.

Over 200 years, UCL has grown from a single building in Bloomsbury into a global institution, home to world-leading research, pioneering innovation and a vibrant, diverse community.

Here, great minds have gone on to discover noble gases, win Nobel Prizes, make philosophical leaps and medical breakthroughs, create world-changing architecture and world-leading businesses and shed light on ancient languages and far-flung galaxies. We've also continued to expand the realm of human cognition and creativity, by valuing free thinking, daring to challenge the status quo and collaborating across conventional boundaries. It cannot be denied that UCL's contributions have left an indelible mark on the world.

This volume is both a celebration and a reflection. It brings together more than 100 voices to honour the achievements, challenges and enduring spirit that have defined UCL's journey. Through personal recollections, scholarly reflections and archival treasures, we gain a small insight into the impact and evolution of this institution

As we look to the future and our next century, UCL remains committed to its founding principles: inclusivity, innovation and impact. The next century will demand fresh ideas, creative collaborations and courage. But if the past 200 years have taught us anything, it is that UCL will continue to rise to the occasion – boldly, thoughtfully and together. We invite you to explore these pages not only as a record of history but also as a testament to the power of education to shape a better world.

Hazel Genn
Pro-Provost, Bicentennial

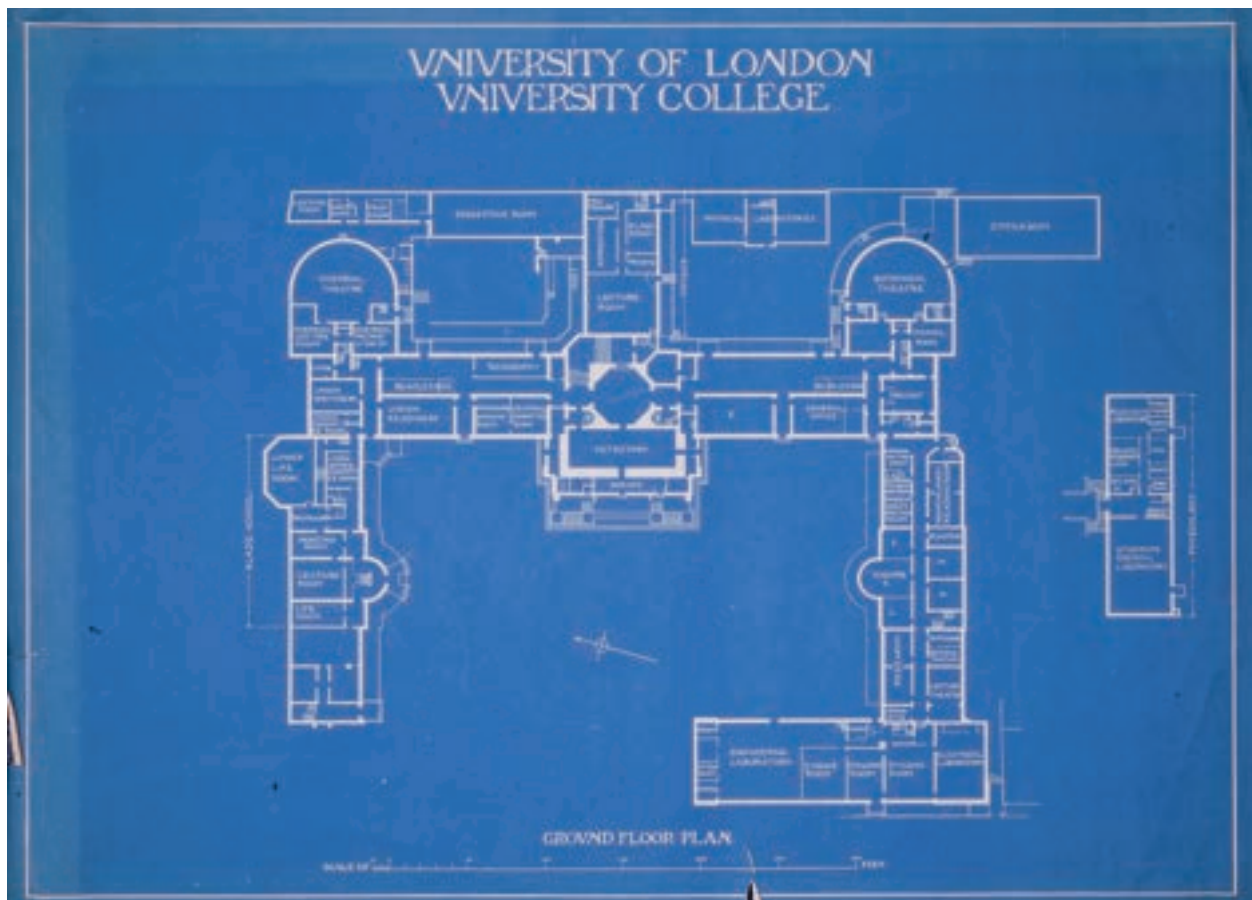
Introduction

Since its founding in 1826, UCL has been at the forefront of academic excellence, nurtured in a culture of academic freedom and an environment of inquisitive and rigorous thinking. Originally known as London University, it was the first university to be established in London, the first entirely secular university in the UK to admit students regardless of religion and, in later years, the first university in the UK to admit women into higher education alongside men. In 2026, we mark 200 years of this remarkable institution.

This book celebrates two centuries of exceptional research and scholarship in the context of our bicentennial celebrations. It showcases some of our academic community's incredible achievements, ideas and discoveries that have made an impact across the world. The pieces featured in this book offer a window

to our research, reflecting the extraordinary breadth and depth of inquiry that defines UCL's academic community. They are not exhaustive of the work taking place every day in our university, but they provide an insight into some of the transformative ideas and achievements that have emerged during the last two centuries.

Selecting the work that was included in the volume was exciting and challenging. There is so much happening every day in such a multidisciplinary institution. To assemble this collection, we invited submissions from all 11 of UCL's faculties: Arts and Humanities, Brain Sciences, the Bartlett (Built Environment), Engineering Sciences, Institute of Education, Laws, Life Sciences, Mathematical and Physical Sciences, Medical Sciences, Population Health Sciences, and Social and Historical Sciences.



Plan of the ground floor of the Wilkins Building.



The cover of the Rag Magazine produced on the occasion of the celebration of UCL's centenary in 1927.

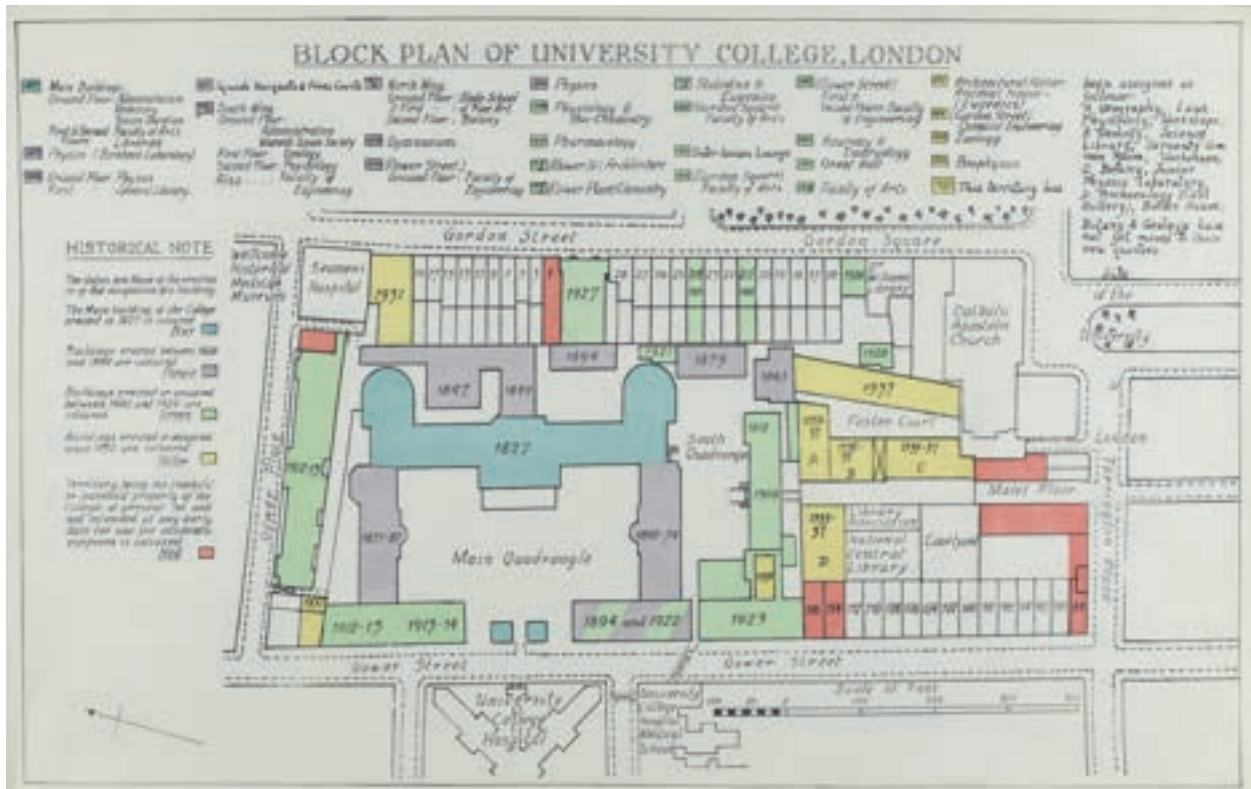
This bottom-up approach was designed to ensure that the book would reflect what colleagues themselves deemed most significant. We received a huge number of submissions of outstanding quality and insight. From these submissions, around 100 authors were selected, representing a wide spectrum of disciplines and topics. The selection process was supported by Faculty Deans and UCL at 200 'Champions', together with an outstanding multidisciplinary advisory group of senior academics.

As this book illustrates, research at UCL is driven by how best to tackle complex, real-world questions and problems, rather than being defined by rigid disciplinary boundaries. UCL academics, individually and through a range of collaborations within and beyond the institution, engage with these issues with imagination and rigour. The university's collaborative environment cultivates and sustains this interdisciplinary approach. Faithful to this spirit, this book is not organised by discipline but around a number of themes. After a presentation of

Nobel Prizes that have been awarded to members of our community and a timeline, the contributions are divided into seven broad, overarching themes: Healthy Life for all; Culture and Creativity; Environments; Community; Fairer Futures; the Power of Education; and Life on and beyond Earth. These themes reflect some of the central interests and concerns that drive our endeavour individually and collectively. Each section provides insights into the inquisitive nature of our work, its quality and its impact.

The work showcased contains several pieces celebrating the rich legacy of UCL, but it has a sharp focus on the present and future. It is both a celebration of what has been accomplished and a forward-looking exploration of how our work continues to shape a better world. For readers seeking a broader historical context or interested in further aspects of university life, this volume can be read alongside other UCL publications, including *The World of UCL* (edited by Negley Harte, John North and Georgina Brewis, UCL Press, 2018); *The UCL Institute of Education* (by Richard Aldrich and Tom Woodin, UCL Press, 2020); *The Petrie Museum of Egyptian Archaeology* (edited by Alice Stevenson, UCL Press, 2015); and its companion UCL at 200 titles: *Student London: A New History of Higher Education in the Capital* (by Georgina Brewis and Sam Blaxland) and *Survey of London, Monograph 19: University College London: The Bloomsbury Campus* (UCL Press, 2026).

While we are proud of our research, university life encompasses much more than that. Our work is informed and improved not only by working with colleagues but also by teaching and learning from our students in a dynamic environment where ideas are constantly exchanged, challenged and refined. This experience of openness and intellectual freedom is something which students take with them after they graduate from UCL. The bonds we maintain with our alumni also play a central role in shaping the intellectual and cultural life of the institution. And of course the same should be said about the work of support staff, which is vital to all aspects of university life. All these relationships and interactions ensure that we are not only a centre of



Block plan of UCL, 1935.



The Portico, 1937.

academic excellence but also a community grounded in shared purpose and mutual respect. No small part of that is UCL's location in the heart of London, which keeps us connected with institutions, industries and communities beyond UCL, in London, the UK and globally.

Taking on the role of Lead Editor of this book has been a transformative experience for me personally and intellectually. From the moment I was appointed by a selection panel chaired by Professor Dame Hazel Genn, and every step of the way, it was an incredible journey of learning about the value of my colleagues' work and the rich identity of my university. Learning about this research and its societal impact inspired me, excited my imagination and opened my mind. I hope readers will find it just as energising.

Virginia Mantouvalou

Lead Editor, Professor of Human Rights and Labour Law and Co-Director of the Institute for Human Rights

Nobel Prize winners

There have been 33 Nobel Prize laureates among UCL's alumni and current and former staff.

PHILIPPE AGHION

Nobel Prize in Economics 2025 for the theory of sustained growth through creative destruction

DEMIS HASSABIS

Nobel Prize in Chemistry 2024 for protein structure prediction

GEOFFREY HINTON

Nobel Prize in Physics 2024 for foundational discoveries and inventions that enable machine learning with artificial neural networks

ROGER PENROSE

Nobel Prize in Physics 2020 for the discovery that black hole formation is a robust prediction of the general theory of relativity

JOHN O'KEEFE

Nobel Prize in Physiology or Medicine 2014 for the discovery of cells that constitute a positioning system in the brain

JAMES E. ROTHMAN

Nobel Prize in Physiology or Medicine 2013 for the discovery of machinery regulating vesicle traffic, a major transport system in our cells

PETER HIGGS

Nobel Prize in Physics 2013 for the theoretical discovery of a mechanism that contributes to our understanding of the mass of subatomic particles

CHARLES K. KAO

Nobel Prize in Physics 2009 for ground-breaking achievements concerning the transmission of light in fibres for optical communication

MARTIN J. EVANS

Nobel Prize in Physiology or Medicine 2007 for the discovery of principles for introducing specific gene modifications in mice by the use of embryonic stem cells

PAUL NURSE

Nobel Prize in Physiology or Medicine 2001 for the discovery of key regulators of the cell cycle

JAMES J. HECKMAN

Nobel Prize in Economics 2000 for the development of theory and methods for analysing selective samples

BERT SAKMANN

Nobel Prize in Physiology or Medicine 1991 for discoveries concerning the function of single ion channels in cells

JAMES W. BLACK

Nobel Prize in Physiology or Medicine 1988 for the discovery of important principles for drug treatment

ULF VON EULER AND BERNARD KATZ

Nobel Prize in Physiology or Medicine 1970 for discoveries concerning the humoral transmitters in the nerve terminals and the mechanism for their storage, release and inactivation

GEORGE PORTER

Nobel Prize in Chemistry 1967 for the study of extremely fast chemical reactions, effected by disturbing the equilibrium by means of very short pulses of energy

ANDREW FIELDING HUXLEY

Nobel Prize in Physiology or Medicine 1963 for discoveries concerning the ionic mechanisms involved in excitation and inhibition in the peripheral and central portions of the nerve cell membrane

FRANCIS CRICK

Nobel Prize in Physiology or Medicine 1962 for discoveries concerning the molecular structure of nucleic acids and its significance for information transfer in living material

PETER MEDAWAR

Nobel Prize in Physiology or Medicine 1960 for the discovery of acquired immunological tolerance

JAROSLAV HEYROVSKY

Nobel Prize in Chemistry 1959 for his discovery and development of the polarographic methods of analysis

VINCENT DU VIGNEAUD

Nobel Prize in Chemistry 1955 for his work on biochemically important sulphur compounds, especially for the first synthesis of a polypeptide hormone

ROBERT ROBINSON

Nobel Prize in Chemistry 1947 for his investigations on plant products of biological importance, especially the alkaloids

OTTO HAHN

Nobel Prize in Chemistry 1944 for his discovery of the fission of heavy nuclei

CORNEILLE HEYMANS

Nobel Prize in Physiology or Medicine 1938 for the discovery of the role played by the sinus and aortic mechanisms in the regulation of respiration

OTTO LOEWI AND HENRY DALE

Nobel Prize in Physiology or Medicine 1936 for discoveries relating to chemical transmission of nerve impulses

FREDERICK HOPKINS

Nobel Prize in Physiology or Medicine 1929 for his discovery of the growth-stimulating vitamins

OWEN WILLANS RICHARDSON

Nobel Prize in Physics 1928 for his work on the thermionic phenomenon and especially for the discovery of the law named after him

ARCHIBALD V. HILL

Nobel Prize in Physiology or Medicine 1922 for his discovery relating to the production of heat in the muscle

FREDERICK SODDY

Nobel Prize in Chemistry 1921 for his contributions to our knowledge of the chemistry of radioactive substances, and his investigations into the origin and nature of isotopes

WILLIAM BRAGG

Nobel Prize in Physics 1915 for services in the analysis of crystal structure by means of X-rays

RABINDRANATH TAGORE

Nobel Prize in Literature 1913 because of his profoundly sensitive, fresh and beautiful verse, by which, with consummate skill, he has made his poetic thought, expressed in his own English words, a part of the literature of the West

WILLIAM RAMSAY

Nobel Prize in Chemistry 1904 in recognition of his services in the discovery of the inert gaseous elements in air, and his determination of their place in the periodic system

Timeline

1826



1828



1851



9 FEBRUARY 1825

First public announcement of the University

11 FEBRUARY 1826

UCL founded as self-styled 'London University'

30 APRIL 1827

Foundation stone laid by Duke of Sussex

1827

UCL appoints its first professors

1828

UCL admits its first students

1828

Robert Grant gives his first lecture using zoological specimens that would later form the basis of UCL's Grant Museum of Zoology

1830

University College School founded adjacent to the Quad to help sustain UCL through early financial struggle

1832

UCL welcomes women into higher education when two women attend a natural philosophy course

1834

University College Hospital (UCH) founded and UCL becomes the first English university to establish its own teaching hospital

1836

UCL incorporated by Royal Charter

1851

Opening of Flaxman Gallery, which contains the largest single group of works by sculptor John Flaxman

1868

First series of lectures for women offered by UCL professors, in collaboration with the London Ladies' Educational Association

1871

UCL's Slade School of Fine Art opens with women studying alongside men

1878

UCL becomes the first institution in the UK to award degrees to women and formally welcomes women into higher education alongside men in Science, Arts and Laws. Degrees are given in the name of the University of London

1892

The Edwards bequest establishes the first Chair of Egyptology in the UK, held by the archaeologist Flinders Petrie

**1893**

The men's Union Society is established as the first officially recognised students' union in England

1897

The Women's Union is formed

1897

The Slade School of Art begins acquiring prize-winning student works, including many by trail-blazing women artists initiating the collection that is now housed in UCL's Art Museum

1907

UCL is incorporated into the federal University of London

1927

UCL's centenary celebrations culminate in a month of events in June, opening with a visit from King George V and Queen Mary

1939

UCL is evacuated on the outbreak of the Second World War

1940-1

The college's campus is damaged in bombing – including the destruction of the Great Hall

1942

Lunch Hour Lectures begin – building on UCL's tradition of open debate, and making academic research accessible to all

1949

Crystallographer Kathleen Lonsdale is appointed UCL's first female Professor

1960

UCL acquires the Orwell Papers – the definitive archive of the writer and thinker George Orwell

1968

Bloomsbury Theatre (owned by UCL) opens, to showcase the best of theatre, music, dance and comedy

1972

The Students' Union helps form one of the first 'Gay Socs' at a UK university

1977

A new royal charter re-establishes UCL as a legally independent institution and formalises its identity as University College London

1985

UCL's Main Quadrangle (begun in 1827) is finally completed after the addition of pavilions to the North-West and South-West Wings, marked by an official visit by Queen Elizabeth II

1985



2022



1988

UCL alumni numbers reach 50,000 alumni worldwide.

1993

UCL's first commercialisation company is established to help translate research into real-world impact; it has evolved into UCL Business (UCLB)

1998

UCL alumni numbers rise to 100,000 alumni worldwide

2001

UCL publishes its first Widening Participation strategy marking its commitment to increase the number of students from underrepresented backgrounds at UCL

2003

UCL Consultants (UCLC) is established to connect organisations with experts at UCL to work on consultancy projects and the delivery of bespoke training and executive education.

2005

UCL is granted the power to award its own degrees for the first time

2012

UCL alumni numbers rise to 250,000 alumni worldwide

2012

UCL becomes the first university in the UK to sponsor an academy school – the UCL Academy

2015

UCL Press is founded as the first fully open-access university press in the UK

2022

Launch of UCL Student Life Strategy, which is the university's biggest ever investment in co- and extra-curricular life

2022

The opening of UCL East at the Queen Elizabeth Olympic Park, Stratford, is the largest campus expansion of the university in nearly 200 years

2024

UCL is named University of the Year by the Times and Sunday Times Good University Guide

2026

UCL alumni numbers expected to reach 500,000 alumni worldwide across 190 countries

2026

To mark the 200th anniversary of the founding of UCL a major programme of bicentennial events and activities celebrates and reinforces the excellence and impact of UCL's ground-breaking work and people

Status of UCL

Years	Name	Status
1826–36	London University	Joint stock company (unincorporated)
1836–69	University College, London	College with proprietors, incorporated by Royal Charter
1869–1907	University College, London	College incorporated by Act of Parliament
1907–77	University of London, University College	Part of the University of London
1977–present	University College London	College incorporated by Royal Charter

Institutions that have merged with UCL

1986 Institute of Archaeology	1998 Royal Free Hospital School of Medicine
1987 Middlesex Hospital Medical School	1999 School of Slavonic and East European Studies
1987 Institute of Urology	1999 Eastman Dental Institute
1987 Institute of Orthopaedics	2012 School of Pharmacy
1987 Institute of Laryngology and Otology	2013 Survey of London
1995 Institute of Ophthalmology	2013 Translation Studies Unit
1995 National Hospital College of Speech Science	2013 MRC Laboratory for Molecular Cell Biology
1996 Institute for Child Health	2014 Institute of Education
1997 Institute of Neurology	2017 MRC Prion Unit

1

**Healthy
life for all**

Anaesthesia and amputation: a public demonstration

David Walker



Robert Liston performing the first surgical operation in England with ether as an anaesthetic, 21 December 1846.

On a busy day in Bloomsbury, commuters going about their daily business could be forgiven for not spotting two discreet wall-mounted English Heritage blue plaques, hung on numbers 14 and 24 Gower Street. The plaques commemorate the administration of the first anaesthetic in England and the man who undertook this new and daring procedure, in an era when death during and after surgery was commonplace.

The first properly reported general anaesthetic had taken place in September 1846 at Harvard Medical School in Boston: William Morton used inhaled ether to facilitate a tooth extraction from a patient who would go on to report this episode to have been a painless procedure. Meanwhile in the UK, Hampshire-born James Robinson was practising dentistry at his home

at 14 Gower Street. Robinson received news from his friend, the retired American physician Francis Boott, that Morton was achieving great success experimenting with ether to facilitate his surgery. Using a homemade inhaler device, Robinson would go on to deliver the first documented general anaesthetic in the UK, which took place at the home of Boott, at 24 Gower Street. Robinson, however, was soon to give up his experimentations with ether and return to dental practice at the Royal Free Hospital. He would later go on to found University College Hospital (UCH) Dental Hospital, but not before he had demonstrated widely his newly acquired skill.

In the audience at one of Robinson's public demonstrations was Robert Liston, the first Professor of Surgery at UCH. Liston was renowned for being a

very fast surgeon, at a time when speed meant the difference between life and death. Liston, impressed with the effects of ether, commissioned the chemist Peter Squire to build him a similar anaesthetic apparatus to deliver the agent for his own patients. On 21 December 1846 the chemist's nephew, William Squire, a UCL medical student, anaesthetised a patient for a Liston leg amputation. Liston was so impressed that, with reference to Morton's 1846 anaesthetic feat, he declared 'This Yankee dodge beats mesmerism hollow', signifying that ether was a preferred anaesthetic to hypnotism, a widely practised and wholly ineffective means of anaesthesia for surgery at that time.

Liston's amputations typically took 30 seconds, but his reported mortality rate was 1:6. During one

alarming clinical event, Liston managed to amputate his assistant's finger; the man went on to die of infection, as did the patient. At this same event, a front-row observer died from a heart attack, thus making a 300 per cent mortality for this single procedure!

Today the William Squire Lecture is an annual event in the calendar of the university's academic Centre for Perioperative Medicine, held in commemoration of the contribution of a UCL medical student to the popularisation of anaesthetic techniques in the UK.

David Walker is Professor and Honorary Consultant in Anaesthesia, Perioperative and Critical Care Medicine.



The First Operation under Ether, painting by Robert Cutler Hinckley depicting William Morton's use of anaesthesia at Massachusetts General Hospital, 1846.

Nanofibres for the manufacture of biopharmaceuticals

Daniel G. Bracewell

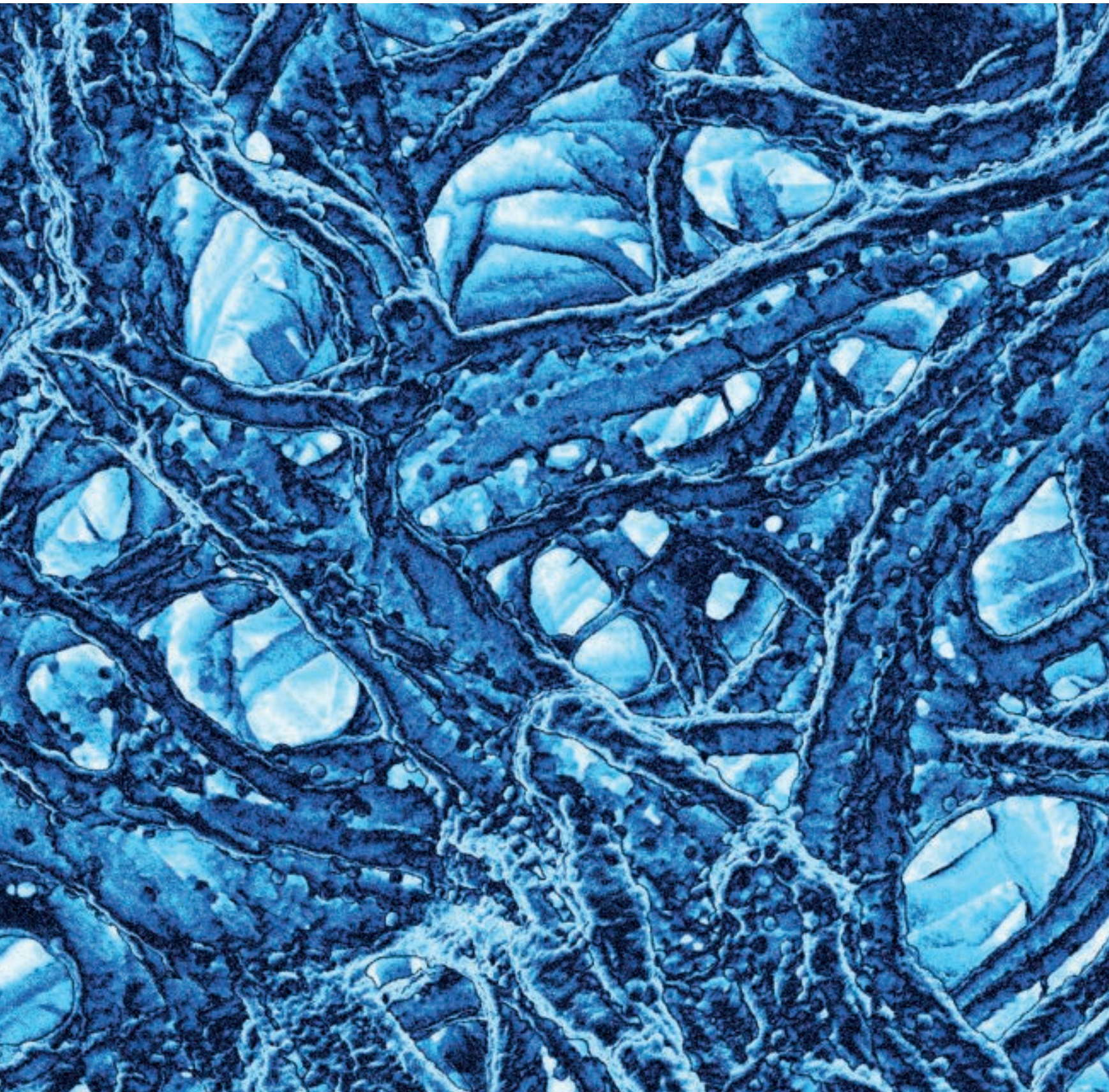
Research I led at the UCL Department of Biochemical Engineering has pioneered the use of nanofibre materials for the purification of biological products, significantly advancing the production of biopharmaceuticals such as antibodies. The theoretical basis for this new material is that it must provide a large accessible surface area for the sorption of biological products and thereby enable their isolation. The concept was that by using materials with such properties we could operate more rapidly by moving from being dependent on relatively slow diffusive processes for the binding and release of biological products to a far more rapid convective mode of operation. Layers of nanofibres forming a network of tiny strands provide this opportunity, but the material must also meet the requirements of the pharmaceutical sector. This means it must adhere to regulatory expectations surrounding material compatibility, safety, robustness and quality and be resistant to the process environment. To address this, we designed the material based on electrospun cellulosic nanofibres. Cellulose, a sugar polymer, has the desired hydrophilic properties to avoid damage to biomolecules during their purification and is known to regulators; it also allows us to derivatise the surface chemistry to create the desired binding properties for the material. Our work led to the formation of a spinout company, Puridify, in 2013. Puridify's Fibro technology, based on nanofibre adsorption, has been transformative, achieving a sixfold increase in biomanufacturing efficiency and accelerating drug discovery processes for companies such as AstraZeneca. The team's success led to the acquisition of the technology by GE Healthcare in 2017, a move that cemented its impact on the global biopharmaceutical industry.

The research began in 2007 when we began to collaborate with the Rutherford Appleton Laboratory in Oxfordshire, initiating a joint PhD project using their electrospinning facilities to

fabricate these new materials. The work of the research led in the lab by the PhD student led to a nanofibre adsorbent material that enabled rapid and efficient protein purification at flow rates 100 times faster than conventional resins, delivering a tenfold productivity boost. Subsequently, the research team expanded its work to develop scalable adsorbent housing and applications for complex therapeutic products such as viral vectors. By 2016, the team had demonstrated the technology's unprecedented capacity and recovery rates for viral vectors, further establishing its potential. The excitement at this achievement is because these vectors are used in the latest cell and gene therapies that aim to treat, prevent or potentially cure diseases, targeting the underlying cause of genetic and acquired diseases. However, the manufacture of these products remains challenging in terms of cost and consistency and has been associated with commercial failures to reach market. As a result, such advancements are critical to making these new therapies accessible to patients.

Daniel G. Bracewell is Professor of Bioprocess Analysis.

The excitement at this achievement is because these vectors are used in the latest cell and gene therapies that aim to treat, prevent or potentially cure diseases, targeting the underlying cause of genetic and acquired diseases.



Colourised electron microscope image of adenovirus bound to the nanofibres.

Defeating Alzheimer's disease

John Hardy

Alzheimer's disease is the most common form of dementia and afflicts nearly a million people in the UK. The pathology of the disease includes pinprick-like deposits of a protein called amyloid throughout the brain cortex. While most cases are late onset, with typical cases having ages of 70+, a few cases are hereditary and have earlier onset. In 1991 our group, which then included myself and my colleague Martin Rossor, found amyloid mutations in a family from Nottingham. This led me to postulate the amyloid hypothesis for the disease, and this theory has underpinned most of the drug trials since that time.

Over recent years, this theory has begun to pay off, with two drugs, lecanemab and dononemab, having passed clinical trials and been approved as the first mechanistic therapies for this horrible disease.

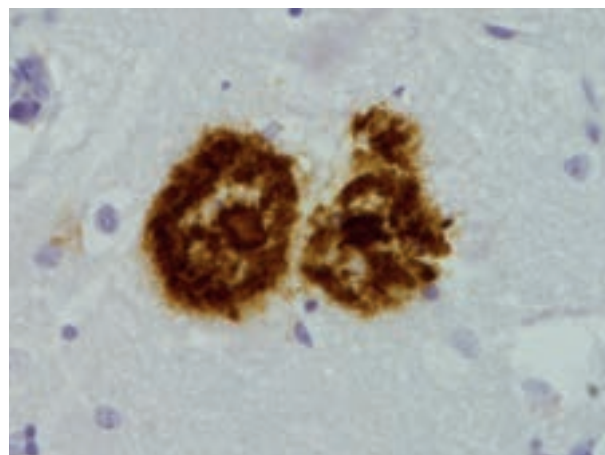
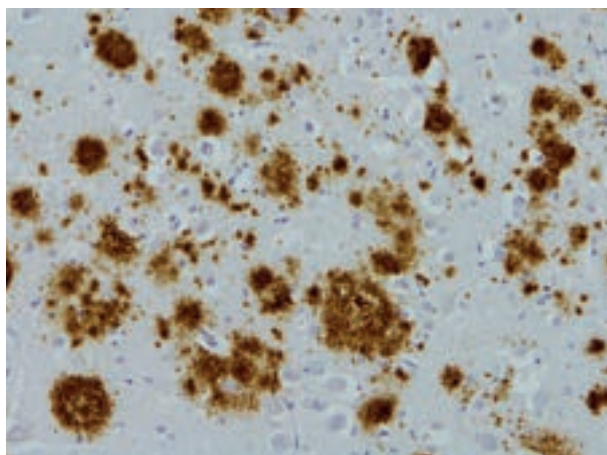
This success has been driven by close collaboration between basic scientists like myself, with clinical colleagues, such as Nick Fox in dementia and Huw Morris in Parkinson's disease and Henry Houlden in rare diseases. We are all interested in the same diseases and are grouped together on the same small campus at Queen Square, which means working together is easy. We study the families, find their root disease causes and now, with the Leonard Wolfson Experimental Neurology Centre and the biomarker lab under Henrik Zetterberg and Amanda Heslegrave,

We are all interested in the same diseases and are grouped together on the same small campus at Queen Square, which means working together is easy.

we have everything we need under one roof to go all the way from disease cause to successful monitoring and treatment. This set-up is unique in the UK and almost unique in the world.

We now have the first mechanistic therapy for Alzheimer's disease. More and better therapies are on the way, and we are using the same collaborative approaches with Parkinson's disease, other dementias, motor neuron disease and the ataxias. This is a golden era for research in all these diseases and we researchers are fortunate in being in the right place at the right time.

John Hardy is Chair of Molecular Biology of Neurological Disease.



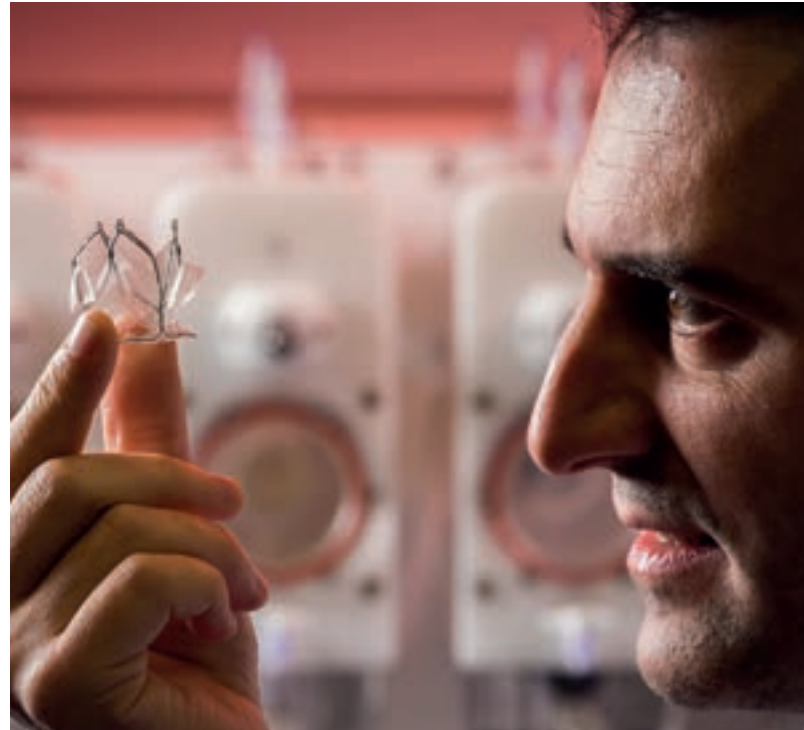
Amyloid plaques taken from the frontal cortex of a patient with Alzheimer's disease.

Engineering the future of cardiac care

Gaetano Burriesci

The work of our researchers has led to ground-breaking advancements in cardiac healthcare by combining expertise from engineers, medical professionals and material scientists, and working closely with the biomedical industry. Through this collaborative approach, we have developed innovative implantable devices that have significantly improved patient outcomes and quality of life. A key innovation is represented by a semi-rigid annuloplasty ring (Corcym MEMO 3D™), which unlike traditional rigid devices adapts to the heart's natural movements, restoring the physiological motion of the mitral valve and enhancing long-term performance. A second breakthrough in the area is the world's first and most widely implanted sutureless self-anchoring cardiac valve prosthesis (Corcym Perceval™), enabling minimally invasive surgical procedures. Its self-expanding design reduces surgical time, leading to fewer complications and shorter recovery periods. Another example of innovation that we have contributed to is a novel valve device (MitrAssist Sikelia™), which has become the first fully synthetic transcatheter aortic valve implanted in humans. This offers a minimally invasive and retrievable solution that adapts to irregular native anatomies, prevents harmful calcium build-up and provides a far more affordable option for patients.

Collectively, these devices have already been implanted in more than 50,000 people worldwide in over 300 cardiac centres across more than 30 countries. They have demonstrated their safety and efficacy, improving patients' health as well as clinical practice. Early clinical results have confirmed the efficacy of the semi-rigid annuloplasty ring to correct mitral valve regurgitation, a condition where the mitral valve does not close properly, causing blood to flow backwards into the atrium instead of moving forwards. Likewise, the sutureless valve has represented a significant change in heart valve surgery, facilitating minimally invasive procedures. This allows a substantial reduction in procedure



Gaetano Burriesci with the prototype of a synthetic transcatheter valve.

times, thus improving feasibility of combined procedures and related post-operative outcomes. Initial clinical results with the synthetic transcatheter valve confirm significant improvement in patients' outcomes, marking a landmark in the history of transcatheter valve technology and opening new perspectives for global healthcare.

Our research is highly interdisciplinary, involving engineers, clinicians, physicists, business experts and industrial partners. This collaborative approach has been crucial in developing innovative therapeutic solutions through the introduction of novel materials, advanced engineering approaches and new procedures. The commercial success of these devices has also contributed to economic growth in the healthcare industry.

Gaetano Burriesci is Professor of Bioengineering.

Pioneering women's medicine: Elizabeth Garrett Anderson

Anna David

As the first woman to become a doctor in the United Kingdom and a pioneer of women's rights and education in medicine and society, Elizabeth Garrett Anderson (1836–1917) is the perfect person to highlight the broad history and mission of UCL. Not only did Elizabeth qualify as a physician and a surgeon despite vigorous opposition from the medical establishment, but she was also the first female dean of a British medical school, the first woman in Britain to be elected to a school board and, as mayor of Aldeburgh, the first female mayor in Britain. Elizabeth founded the New Hospital for Women, the first British hospital for women, in 1872. Two years later she co-founded the London School of Medicine for Women, subsequently called the Royal Free Hospital School of Medicine, which in 1998 merged to become part of the UCL Medical School. In 2008, University College London Hospital's maternity and neonatal services moved to the new Elizabeth Garrett Anderson Wing.

Born in Whitechapel, London, in June 1836, just 10 years after UCL was founded, Elizabeth Garrett grew up in Aldeburgh on the Suffolk coast, where her father became a self-made businessman. Garrett was initially educated at home, but boarding school in London introduced her to early feminists such as Emily Davies, who co-founded the women-only Girton College, Cambridge. In 1859 she met Elizabeth Blackwell, the first female doctor in the United States, and joined the newly established Society for Promoting the Employment of Women. Inspired by Blackwell and financially supported by her father, she spent the next six years working her way through various schemes and ruses to finally achieve her aim to qualify and practise medicine.

Elizabeth began this journey by gaining experience as a surgery nurse at the Middlesex Hospital, London, now amalgamated with UCL Hospital. After being prevented from enrolling in the hospital's



Elizabeth Garrett Anderson.

Medical School, she supplemented her education in anatomy and physiology with the hospital's apothecary and private tutors. She was allowed into the dissecting room and chemistry lectures, but in 1861 the male students protested against her admittance as a fellow student, obliging her to leave the Middlesex Hospital. Unsuccessful applications to several medical schools in England and Scotland followed; UCL at the time had yet to open its Medical School to women. She continued to study privately, obtaining a certificate in anatomy and physiology, which allowed her to join the Worshipful Society of Apothecaries in London in 1862, by way of a 'side

door' through a loophole in their admissions. In 1865 she scored the highest marks in their licence exam, finally qualifying as a doctor.

After the award of her licence, the Society of Apothecaries closed this route, meaning that women could no longer gain a British qualification. It would not be until 1876 that the new Medical Act allowed British medical authorities to license all qualified applicants whatever their gender. As a woman, Garrett (who was married to the businessman James Anderson from 1871) was still unable to hold a post as a medical doctor in any hospital. Again she found a work-around, setting up her own practice in Upper Berkeley Street, London, then establishing a dispensary and subsequently a hospital for women. Her legacy continues at UCL Medical School where the Fishmongers' Livery Company, which is connected to the Garrett Anderson family, generously enables EGA Bursaries each year to UCL medical students in financial need. These were originally open only to women, but in recent years have been widened to male students.

Elizabeth Garrett Anderson fought tirelessly for women to have access to high-quality healthcare and for the right of women to have an education and to practise medicine. She was a frequent contributor to medical journals and published on contemporary feminist issues. She inspired and advised a number of subsequent early British female doctors, many of whom studied under her guidance. She was later heralded by suffragists as an important role model. Our UCL Institute for Women's Health is proudly named after her and our Medical School retains her proud heritage.

Anna David is Professor of Obstetrics and Maternal Fetal Medicine.



The New Hospital for Women, Euston Road, London, which opened in 1890 with 42 beds. It had been founded by Elizabeth Garrett Anderson above a dispensary in Marylebone and was the first hospital in Britain with only medical women appointed to its staff. In 1918 it became the Elizabeth Garrett Anderson Hospital and continued to have only female medical staff until its absorption into the larger UCL Hospital in the 1980s.

Thomas Lewis and modern cardiology

Perry Elliott

Often referred to as the father of modern cardiology, Sir Thomas Lewis is one of the most influential cardiovascular scientists to have worked at UCL.

Born on 26 December 1881, to Henry Lewis, a Welsh mining engineer, and Katherine Hannah Davies, Lewis was educated first at home and then at Clifton College, Bristol. After matriculation at 16, he entered the science department at University College Cardiff, where his rather eccentric explanation for his pursuit of a medical career was 'for the curious reason that conjuring fascinated me'. He obtained a first-class BSc degree in anatomy and physiology in 1902, and in the same year he enrolled at University College Hospital (UCH) Medical School.

Although Lewis initially found the transition to a hospital environment challenging, his precocious talent for science soon led to an acquaintance with some of the leading scientists working at UCL, including the physiologists Ernest Starling and William Bayliss and the pharmacologist Arthur Cushny. It was also at this time that he was introduced to Henry Dale, the subsequent Nobel Prize winner, who later remarked of Lewis, 'Though he was my junior by 6 years, it never occurred to me to think of him other than a contemporary in scientific development and experience.'

Lewis qualified as a doctor in 1904. Following his appointment as a house physician at UCH, he began his study of the cardiovascular system, publishing a paper in the *Lancet* on the arterial waveform in aortic regurgitation. However, it was his acquisition of one of the first electrocardiographs that propelled his research and international reputation in the study of cardiac rhythm. Lewis's laboratory at UCH nurtured many talented researchers, including some first-generation American cardiologists who played a critical role in establishing cardiology in the United States. In 1916 he became the first full-time clinical



Electrocardiograph used by Thomas Lewis at University College Hospital.

researcher for the Medical Research Committee, and in 1919 he founded the Department of Clinical Research at UCH.

Vision, single-mindedness, courage, energy, determination and precision are common descriptions applied to Lewis in various biographies. Lewis's status as a pioneer in cardiovascular research is reflected in a curriculum vitae that includes many markers of esteem, including a CBE (1920), a knighthood (1921) and the Royal Society Copley Medal (1941). However, perhaps his greatest achievement was in bridging the gap between the scientific method and the examination of human disease at the bedside under the rubric of 'clinical science'. For this reason alone, he deserves his place in the UCL bicentennial celebrations.

Perry Elliott is Professor in Inherited Cardiovascular Disease.

Changing mental health policies and practice to support young people across the UK

Jessica Deighton

In 2023, according to NHS Digital, one in five children and young people in England had a probable mental health disorder. This statistic highlights the need to develop effective programmes that support young people's mental health and wellbeing during adolescence – a critical period for development.

HeadStart was a major programme, commissioned by the National Lottery Community Fund, established in 2014, to explore and test new ways to improve the mental health and wellbeing of young people aged 10–16 and prevent serious mental health issues from developing. Following a successful pilot, the full-scale programme was launched in 2016 in Blackpool, Cornwall, Hull, Kent, Newham and Wolverhampton. These local authorities worked closely with young people, schools, charities and public services to design and trial a range of interventions to support young people, their parents and carers, and staff in their schools and communities.

The HeadStart Learning Programme was the first large-scale, multi-site, longitudinal investigation of resilience-based approaches to support the mental health and wellbeing of young people in England. The Evidence Based Practice Unit at UCL and Anna Freud led the HeadStart Learning Team, a consortium of partners that collected and evaluated evidence about what did and didn't work locally to benefit young people.

As part of the programme, the HeadStart Learning Team also developed the Wellbeing Measurement Framework (WMF). This uses comprehensive questionnaires to capture details of young people's wellbeing, behavioural and emotional difficulties, and ability to deal with stress and manage emotions. It also explores potential sources of support – such as school, home and in the community. More than 60,000 pupils in 210 secondary schools in England participated in the WMF questionnaire, providing both a snapshot of young people's mental health and resilience at Year 9 (aged 13–14), and a longitudinal follow-up of young people from Year 7 (aged 11–12) to Year 11 (aged 15–16).

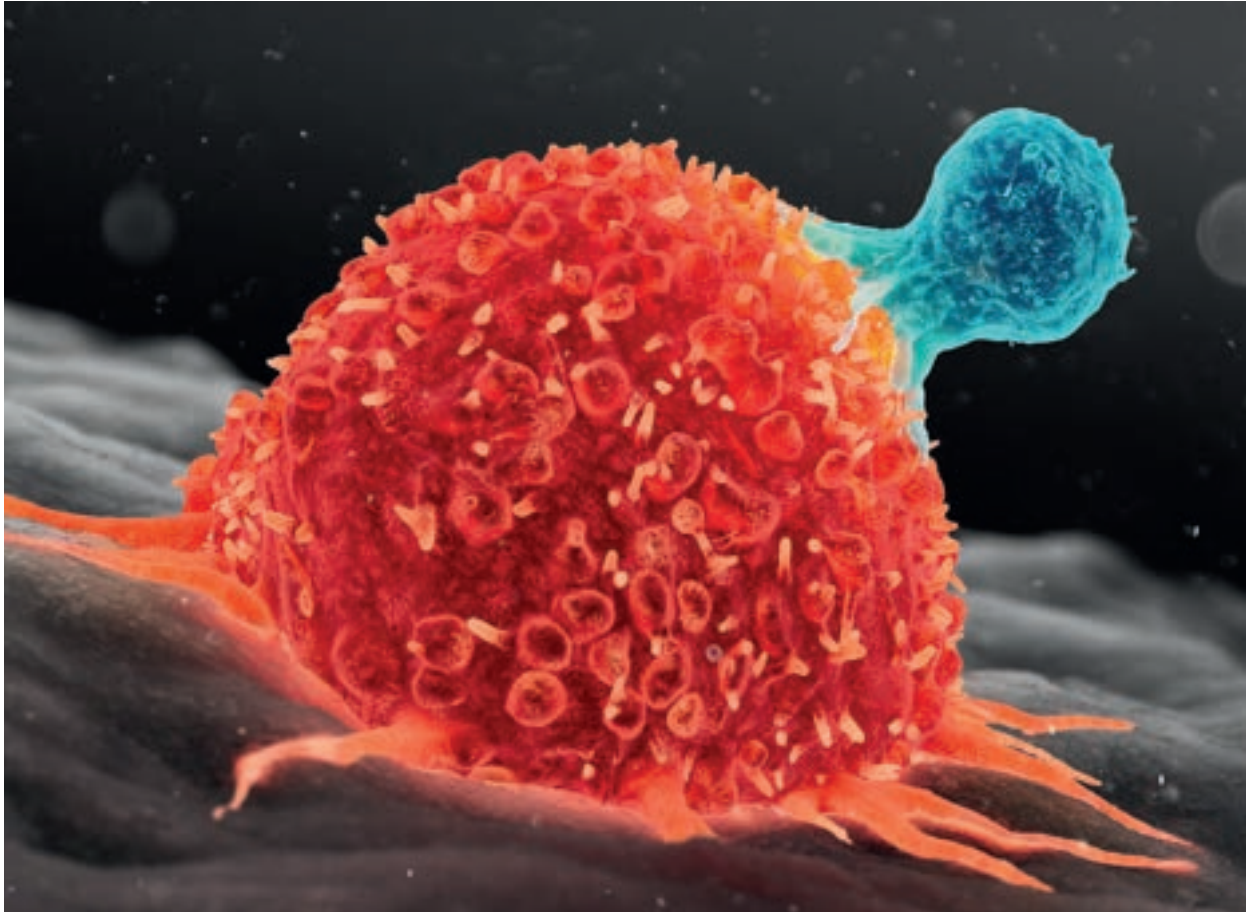
The programme provided clear evidence that young people's mental health often varies based on their own lived experiences and identities and that some challenges young people experience can make mental health difficulties more likely. It was able to point to a number of interventions that were effective and some that were not. It called for careful thought around how those in need of support are identified – taking into account not only their level of mental health difficulties, but also the degree of risk and challenge they are exposed to in their lives. Specifically, young people experiencing high levels of risk coupled with a lack of social support might have quite different support needs compared to young people who can access informal support from family, school and friends. The programme highlighted that HeadStart, as a multi-layered intervention embedded across the system, provided more opportunities for young people to experience multiple sources of support.

The HeadStart Learning Team's work was embedded in the real world – it worked closely with local authorities, community groups, schools and young people. And the programme has had real-world impact. The WMF was a major channel for youth voice in schools, which has ensured interventions aligned with the needs and preferences identified by young people themselves. The HeadStart Learning Team's evaluation created a detailed national picture of young people's mental health that has informed policy development. Furthermore, the legacy of this work in advocating for foregrounding youth voice and embedding the widespread monitoring of the wellbeing of young people in schools and communities lives on in current large-scale programmes such as #BeeWell (<https://beewellprogramme.org>).

Jessica Deighton is Professor of Child Mental Health and Wellbeing, UCL, and Director of Applied Research and Evaluation, Anna Freud.

Immunotherapy treatments for cancer and rare diseases

Emma Morris



A T cell attacking a cancer cell.

Fundamental research in immunology and genetic engineering at UCL over many decades has culminated in the development of life-saving immunotherapy treatments for cancer and rare diseases, the creation of biotech companies and approval of licensed medicines.

Back in the 1950s and 1960s the UCL scientists Sir Peter Medawar (winner of the 1960 Nobel Prize in Physiology and Medicine for the discovery of acquired immune tolerance) and Avriion Mitchison described the fundamental basis of the human immune system, after identifying which cells in the blood (T cells and B cells) were able to recognise foreign tissue and discriminate it from normal

tissues or cells (referred to as 'self'). In the years that followed, many UCL scientists contributed to understanding these cellular interactions and the molecular mechanisms that underpinned them. This knowledge was critical to developing interventions that could purposefully manipulate human immunity, including the acceptance and long-term survival of transplanted organs (immune tolerance to 'foreign' tissue) and the recognition and killing of virally infected cells (viral immunity and vaccination).

The T cells of the immune system circulate in the blood, where they search for and kill infected cells. They can move to sites of disease, copying

UCL clinician scientists developed methods to alter the genetic code of human stem cells and immune cells, creating tools required to permanently correct inherited immune deficiencies.

themselves, and survive for extended periods, providing long-lasting protection. This makes them well equipped to eradicate cancers, but because cancers are derived from normal tissues, they are recognised as 'foreign' by too few T cells for the body to eradicate the cancer. However, in the late twentieth and early twenty-first centuries, UCL clinician scientists developed methods to alter the genetic code of human stem cells and immune cells, creating tools required to permanently correct inherited immune deficiencies. This same approach was used to equip T cells with new genes (referred to as genetic engineering), reprogramming patients' own immune cells to seek out and destroy cancer cells. The most common form of genetically engineered T cells now used in clinical practice is called chimeric antigen receptor T cells (CAR T cells).

The UCL CAR T-cell programme, based at the UCL Cancer Institute and the UCL Institute of Child Health, stands as Europe's most comprehensive academic initiative in CAR T-cell therapy focusing on developing advanced treatments for both adult and paediatric cancers, including B- and T-cell malignancies, myeloma and neuroblastoma. The

clinical trial pipeline also includes lung and prostate cancer, and life-limiting autoimmune diseases such as systemic lupus erythematosus and rheumatoid arthritis. These T-cell immunotherapies can be effective when chemotherapy and radiotherapy have failed, and ongoing research is developing strategies to further increase the efficacy of CAR T cells and minimise their toxicity, allowing the treatment to be given to a wider range of people of all ages.

The impact of UCL in this field is world leading, made possible by partnership working with the extraordinary ecosystem surrounding the university, including leading NHS research hospitals, clinical trial units, cell and gene therapy manufacturing facilities, and biotech investment partners. Several clinical-stage companies have been spun out of this activity, with Autolus Therapeutics the most successful to date, having launched Obe-cel, a treatment for leukaemia, in 2024.

Emma Morris is Professor of Clinical Cell and Gene Therapy, Honorary Consultant in Haematology and Dean, Faculty of Medical Sciences.

Growth charts

Tim Cole

Child growth is a potent indicator of child health: children who are healthy tend to grow well, whereas children who are ill, for whatever reason, often fail to thrive. Growth charts provide a simple yet elegant way to compare the size and growth of children with reference children of the same age. So they are an important tool in paediatrics and child health, with uses extending from routine check-ups for all through to the detailed monitoring of those with a growth disorder. The chart consists of a series of centile curves where the child's height or weight is plotted, the centiles defining the distribution of measurements at each age as seen in the reference children.

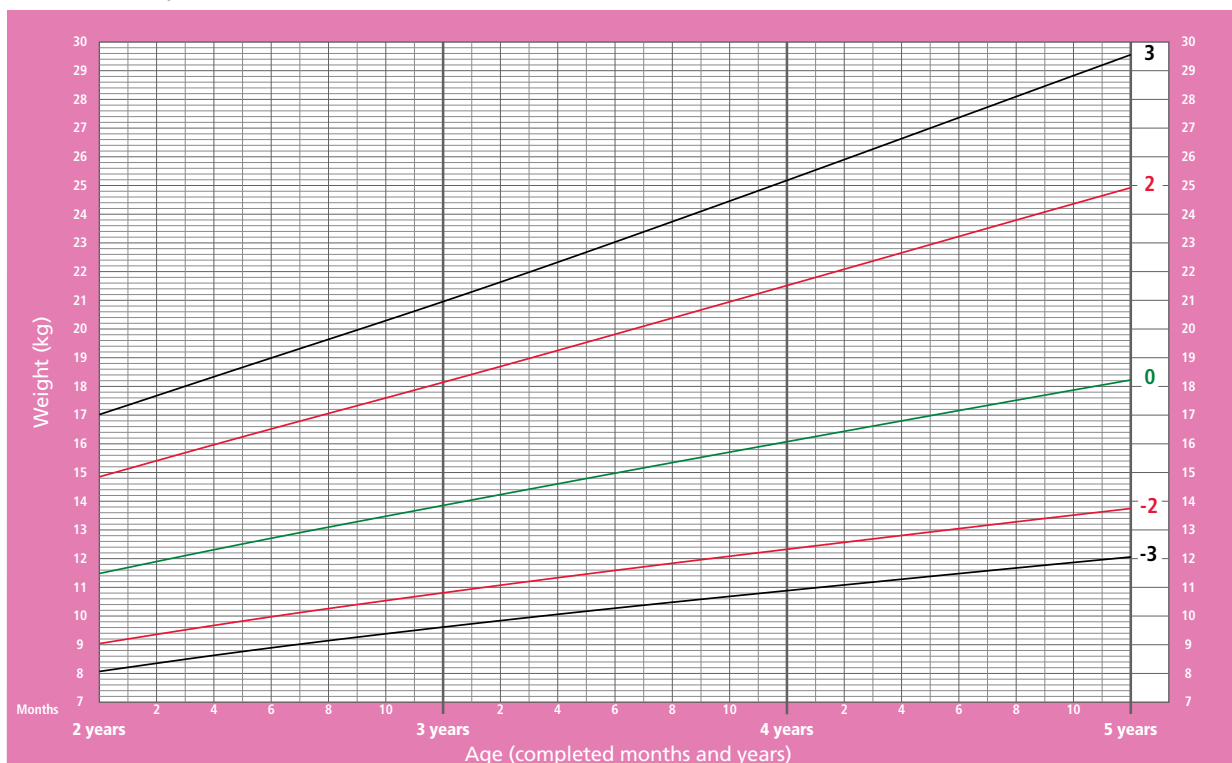
James Tanner (Institute of Child Health, University of London) was a world authority in the early development of growth charts, and his 1966 Tanner-

Whitehouse charts remained the official UK charts for over 25 years. They were constructed using data collected from several thousand children and analysed by hand.

In 1992, together with Peter Green at the University of Bristol I developed the LMS (lambda-mu-sigma) method, a statistical technique for chart construction that accounted for skewness (asymmetry) in the weight distribution and automated the curve-drawing process. LMS has since become the method of choice for constructing growth charts worldwide. Two examples are the British 1990 charts, published by me, Mike Preece, Jenny Freeman and others in 1995 and the official UK charts from then until 2009, and the charts of the World Health Organization (WHO) growth standard,

Weight-for-age GIRLS

2 to 5 years (z-scores)



One of the WHO's Child Growth Standards.

which were published in 2006 and have since been adopted for use in over 140 countries.

Many countries use the WHO standard in early life and their own charts at older ages. The four UK countries all have as their official charts the UK-WHO charts, which are a combination of WHO from soon after birth to 4 years, and British 1990 for birth and 4 to 20 years. Compared to most academic outputs, the charts have considerable exposure: all children born in the UK receive a Personal Child Health Record ('Red Book') which contains copies of the charts. The Red Book was distributed to some 700,000 children in 2021 and to well over 20 million since its inception in 1993.

The LMS method also underlies the International Obesity Task Force (IOTF) body mass index (BMI) cut-offs, a form of BMI chart that I developed with three colleagues to define overweight and obesity in children. Published in the *British Medical Journal*

(*BMJ*) in 2000, the cut-offs addressed two distinct problems: first, the prevalence of child obesity varied according to the BMI chart used, but the IOTF cut-offs avoid this by providing a universal chart for all to use; and second, children and adults had previously been assessed for obesity in different and incompatible ways, but the cut-offs allow them to be compared directly.

The *BMJ* paper has proved to be very influential, and is among the most highly cited of all UCL-authored papers. Its global definition of childhood overweight and obesity has encouraged international research, informed public health policy, and ultimately contributed to more effective strategies for tackling the childhood obesity epidemic.

Tim Cole is Professor Emeritus of Population, Health and Practice.

Child growth is a potent indicator of child health: children who are healthy tend to grow well, whereas children who are ill, for whatever reason, often fail to thrive.

Neuroprostheses to restore function after spinal cord injury

Nick Donaldson and Tim Perkins

This picture shows Mrs Julie Hill cycling at UCL in 1998. Julie had been paralysed by a complete spinal cord lesion in 1990. She volunteered to have an experimental implant that we called the Lumbar Anterior Root Stimulator, which stimulated the 12 nerve roots that innervate the leg muscles, where they emerge from the spinal cord. This neuroprosthesis was intended to restore muscle function for standing and mobility. Compared to implants with electrodes close to the target muscles, nerve root stimulators are compact, with all the electrodes at one surgical field, which would improve reliability and reduce risk.

The clinical team included a neurologist, a surgeon and therapists from Salisbury Spinal Injury Unit and the Royal National Orthopaedic Hospital. We had worked with Julie for several years previously, trying

unsuccessfully to get good standing and stepping, before finding that she could cycle very well using this device. No one before or since has tested implants like this, so the results are unique. The responses to stimulation could not be foreseen and could only be found by trying it out on a human volunteer.

We made the implant and its controller in the labs at UCL, in what is now the Department of Medical Physics and Biomedical Engineering. That was just before the regulations for implanted medical devices came into force. Now, because of the regulations, such a project would need a much larger team and much more funding to carry out the same experiment.

Nick Donaldson is Professor of Neuroprosthesis Engineering. Tim Perkins is Senior Engineer in the Implanted Devices Group.



Julie Hill after the experimental implant of a neuroprosthesis, 1998.

Separating cranially conjoint twins

Noor ul Owase Jeelani

Ormond Street Hospital and Gemini Untwined, a UK-based charity, has successfully undertaken nine sets of craniopagus twin separations across four continents. This constitutes the world's largest experience of such separations, where cutting-edge surgical skills and the latest technologies are made available to all children across the globe who are in need of them.

Cranially conjoint (craniopagus) twin separations are some of the most complex operations undertaken by paediatric neurosurgeons. Traditionally the majority of such children have not survived. Now with techniques such as in silico and AI-driven predictive modelling, novel distraction devices and augmented-reality platforms deciphering complex anatomy, we have successfully linked patients, surgeons and scientists from across continents to make such separations safer and more accessible.

This required breaking down what seemed like an impossible problem into smaller, more manageable steps and bringing together a wide team with diverse skill sets of doctors, healthcare professionals, engineers and software specialists to find optimal solutions to the various steps. Together we have achieved some excellent outcomes for these children.

The technologies developed for these complex cases are then utilised to help improve some of the more common medical challenges we encounter, broadening the benefits to the wider society beyond conjoint twins. What we are especially proud of is the transnational element of this work, where the benefits of cutting-edge science and specialist skills are made accessible to children in remote parts of the world, thereby reinforcing our shared purpose as humans.

Noor ul Owase Jeelani is Professor of Paediatric Neurosurgery.



Minal and Mirha, 10 days after their separation surgery in 2024. The girls continue to thrive as two normal children.

Cranially conjoint twin separations are some of the most complex operations undertaken by neurosurgeons. Traditionally, the majority of such children have not survived.

Building healthy spaces: MY Heart Centre, Rwanda

Julia Backhaus



Aerial view of the proposed design for MY Heart Centre.

Facing a health challenge is a deeply personal and at times overwhelming journey. When my daughter was just three days old, she underwent life-saving heart surgery at Great Ormond Street Hospital in London. Today, she is a thriving teenager. She was fortunate to be born into a socio-economic context that ensured her immediate access to world-class medical care. Heart disease remains a global issue of inequality, leaving many without access to necessary medical care. In Rwanda, for instance, a mere two local paediatric cardiologists and one adult cardiothoracic surgeon are serving a population of 12 million people.

Meeting Sir Magdi Yacoub, the renowned Egyptian-British pioneering cardiothoracic surgeon and philanthropist, was a pivotal moment in my work. With a vision to provide world-class, free cardiac care and research into neglected heart diseases across East Africa, regardless of patients'

socio-economic background, he was in search of an architect to help bring his dream to life. This encounter quickly led to our first trip to Rwanda in late 2019, which took a leisurely 36 hours, courtesy of numerous delays and missed flights. As we shuffled our luggage through various airports, I was treated to an impromptu masterclass in cardiac surgery and Yacoub's vision for equitable access to care. This marked the beginning of a shared commitment to turn that vision into reality.

Together with William Wijns, a Professor in Interventional Cardiology at the University of Galway, we co-founded a local NGO and assembled a diverse board of trustees, combining local and Western expertise. Training programmes for a new generation of Rwandan medical professionals to build local capacity and future independence from temporary mission programmes began shortly thereafter.



Construction site in Rwanda, November 2024.

As architects, we often overlook how our design solutions can better support medical evaluation, while the medical community, in turn, frequently underestimates the impact of the built environment on patient outcomes and care quality, especially in resource-constrained settings. How could we bridge this divide?

Engaging all stakeholders – including patients, families, nurses, physicians and administrators – early in the design process allowed us to evaluate the hospital from multiple perspectives: economy, education, equality, safety, environment and emotion. This collaboration highlighted how every design aspect could enhance the human experience and improve health outcomes. With this in mind, we aimed to create a healing environment that supports both physical and emotional wellbeing while addressing clinical imperatives.

Limited funds and our participatory approach inspired innovative thinking, leading to a unique hospital design that leverages Rwanda's tropical climate and local resources. The entire hospital is laid out as a lush landscaped health garden, featuring strategically placed external walkways, views, green space and courtyards to reduce patient stress and improve recovery time. A central tropical courtyard garden connects all medical departments and doubles as a cardiac rehabilitation track. Each inpatient room provides access to outdoor spaces

and calming views. Additional green spaces, such as a kitchen garden, supply fresh food for the canteen and opportunities for informal knowledge sharing. By integrating indoor and outdoor areas, we optimise the flow of patients, staff and visitors, enhance natural ventilation and improve infection control for safe interactions.

Sustainability is integral to our vision: the roof of the surgery ward acts as the building's battery, providing sufficient area for the installation of solar panels. Double-skinned vaulted roofs allow for passive ventilation, mitigating energy consumption and noise caused by tropical rains. Rainwater harvesting irrigates the surrounding gardens. The use of locally sourced materials and labour-intensive practices strengthens the local building industry and empowers local labour, including women workers.

Our vision transcends constructing a healthcare facility: it's about fostering healing, empowering communities and delivering meaningful social impact. The hospital, which began construction in 2022, will open in early 2026 and is projected to perform 1,200 surgeries and 800 complex cath lab procedures annually once fully operational. By integrating world-class care with human-centred design and nature-based solutions, we aim to optimise health outcomes, promote equity and uphold human dignity.

Julia Backhaus is Associate Professor in Architecture.

Managing respiratory failure in Covid-19 patients

Rebecca Shipley and Mervyn Singer

In the early weeks of the Covid-19 pandemic in 2020, there was a dawning recognition that there were insufficient mechanical ventilators in UK hospitals to cope with the predicted number of patients who would develop severe respiratory failure, let alone the staff and the intensive care beds to operate them safely. Non-invasive support devices such as 'CPAP' (continuous positive airway pressure) that could aid breathing and oxygenation were being used successfully in China and Italy, anecdotally preventing deterioration in around 50 per cent of patients, but were in very short supply worldwide.

To meet this need, a team of mechanical engineers and medical scientists at UCL and clinicians at UCLH – including Tim Baker, Dave Brealey and David Lomas – worked around the clock with Mercedes-AMG High Performance Powertrains, to re-engineer and improve upon an old CPAP device that could be manufactured at speed and at scale. This breathing aid, named 'UCL-Ventura', was produced within a rapid timeframe – indeed, it took fewer than 100 hours from the initial meeting to production of the first device. Shortly after, an improved Mark II version was produced that contributed to a reduction in oxygen use of up to 70 per cent, a particularly relevant modification to mitigate the oxygen shortages being experienced by hospitals at the time. The device rapidly gained regulatory approval with successful patient evaluations at UCLH and sister hospitals. An order of 10,000 units by the Department of Health and Social Care was met within just three weeks.

Devices were delivered to more than 120 UK hospitals. Importantly, to help meet the pressing international need, especially in lower-income countries, we released the designs, manufacturing and clinical use instructions free of charge to governments, healthcare organisations and legitimate manufacturers across the globe, with online technical and educational support. For some countries lacking the manufacturing resource,



UCL-Ventura in use to treat a Covid patient.

donations were made by the UK government and charitable organisations. In total, 30 countries used the UCL-Ventura for patient care.

The partnership demonstrated the way that universities, the NHS and industry came together to shape the national response to the pandemic, by providing vital technologies that enabled better care for patients. At UCL we have an ecosystem of partnerships spanning engineering, healthcare and industry, ready to be mobilised in times of need. The rapid deployment of these partners to meet the international challenges presented by the Covid-19 pandemic is a true demonstration of collaboration.

*Rebecca Shipley is Professor of Healthcare Engineering.
Mervyn Singer is Professor of Intensive Care Medicine.*

Janet Elizabeth Lane-Claypon and modern epidemiology

Harry Hemingway and Alvina Lai

The Covid-19 pandemic thrust epidemiology, the distribution and determinants of disease in defined populations, into popular consciousness. While John Snow is recognised as the founding father of epidemiology for his investigation and intervention in the Soho cholera outbreak of 1854, virtually no one, epidemiologists included, has heard of Janet Elizabeth Lane-Claypon (1877–1967). This is surprising – shocking, even. Her foundational, but largely forgotten, achievements in understanding health and disease would appear to qualify her as the ‘mother of epidemiology’.

Lane-Claypon was, in today’s parlance, a clinical academic and an exemplar of interdisciplinarity. An undergraduate at UCL, she received her bachelor’s degree with first-class honours in 1902, a DSc in physiology in 1905 and an MD in 1910. The 1911 Census records her occupation as ‘Registered medical practitioner, Lecturer in Hygiene and Physiology’. She was the first woman awarded a British Medical Society Research Scholarship, with which she travelled to Germany. Her doctoral research (on the developmental histology of the ovary and the hormonal control of lactation) was carried out in the laboratories of the renowned UCL physiologist Ernest Starling. Her work was extensively cited (always as *Miss Lane-Claypon*) in Francis Marshall’s *The Physiology of Reproduction* (1910), the first textbook on this topic.

In 1912 Lane-Claypon published her investigation of weight gain of 204 infants fed boiled cows’ milk compared with 300 infants fed human breast milk. Her findings demonstrated the nutritional superiority of breastfeeding, which challenged prevailing misconceptions and informed early infant nutritional policies. Most reports struggle to do one thing new, but this report made at least four innovations. First, it is likely that this was the first retrospective cohort study, a study design that has been reported more than 100,000 times since. Second, it may also have been the first ever longitudinal research study



Photo of Janet Lane-Claypon.

using health records collected as part of usual care (an early example of ‘health data science’?). With an international research fellowship, Lane-Claypon had visited Germany and analysed data from infants in Berlin in a facility serving 100 babies per day. She used repeated measures in the same individuals to demonstrate the potential of health records to track outcomes over time, which laid the foundation for modern longitudinal research. Third, it was the first application of the statistical test (‘t test’) in an epidemiological study (1912). She utilised the t-test developed by William Sealy Gosset for quality control in brewing to analyse health data. Fourth, she provided one of the earliest modern descriptions of confounding in epidemiological research. She recognised that financial incentives (nursing bonuses) offered to nursing mothers could influence breastfeeding behaviour and, in turn, affect infant weight gain.

The following schema shows the method of calculation.

Trouble under consideration.		Cancer positive	Cancer negative.	
Positive ...	A	B	Then— $\frac{A \times 100}{A + B} =$ Percentage of breasts affected which became cancerous. $\frac{C \times 100}{C + D} =$ Percentage of breasts not affected which became cancerous.	
Negative ...	C	D		
	A + C	B + D		

This schema is used below for each variety of trouble in order as given above.

2x2 table from *A Further Report on Cancer of the Breast* by Janet Lane-Claypon, 1926.

In 1926 Lane-Claypon published an investigation into the causes of cancer, ground-breaking both for the results (which remain true today) and for the method. She carried out what is recognised as the first example of a case control study designed to understand risk factors for a disease (in this case, breast cancer). In the 100 years since her report, there have been more than 100,000 further case control studies. She recruited and interviewed 500 women with breast cancer (cases) and compared their reproductive histories with those of 500 women without breast cancer (controls). Having recruited her patients from University College Hospital and the Elizabeth Garrett Anderson Hospital (among others), Lane-Claypon offers a paragon of a UCL scientist working with partner hospitals. The rationale, methodology (including a detailed questionnaire) and analysis of the data are described with exceptional

clarity; and the elegant and profoundly important 2x2 contingency table is introduced. Countless such 2x2 tables have been generated in the last 100 years across a wide range of genetic, molecular, behavioural and social 'troubles under consideration'. Remarkably, the findings included most of the currently recognised risk factors for breast cancer. Independent re-analysis of her data in 2010 found that 'Lane-Claypon's scientific efforts, as manifested in the 1926 UK study, are an excellent example of how one investigator's work can help develop a field of scientific inquiry'.

In celebrating Lane-Claypon's contributions to science and medicine, we might also ask: why did they get forgotten?

Harry Hemingway is Professor of Clinical Epidemiology. Alvina Lai is Associate Professor at the Institute of Health Informatics.

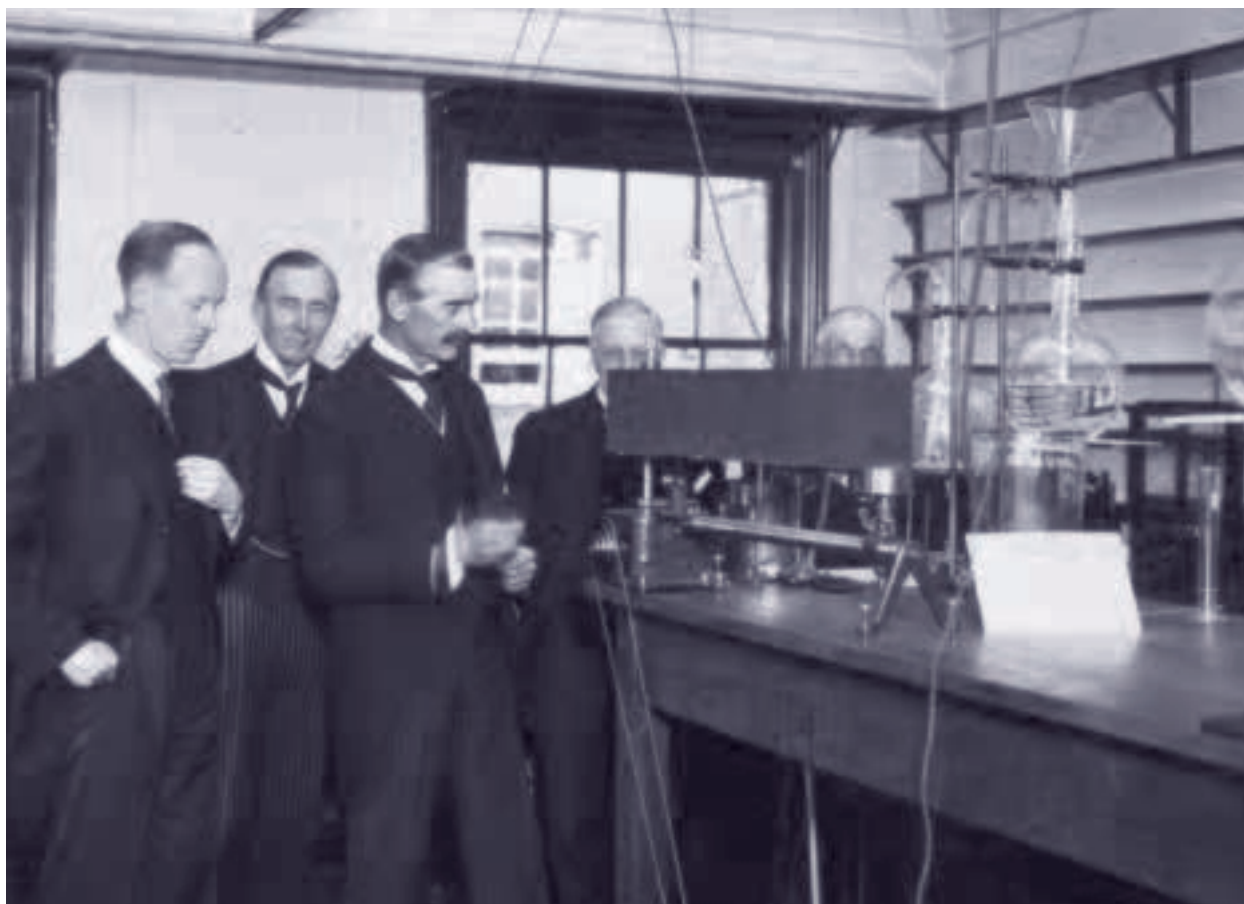
The first drug-testing facility

Ahad Rahim

Prior to the 1920s, the formulation and verification of medicines produced by pharmaceutical companies and sold to the public was more of an art than a science. This compromised both the safety and the reliable therapeutic effect of medicines in patients. During a debate on the matter in the House of Lords, the Marquess of Salisbury commented that 'indeed even the medical profession itself is unable to be rightly advised as to what is being prescribed unless there is some standard regarding these therapeutic substances upon which reliance can be placed'. The UK government's response was to pass the Therapeutic Substances Bill on 7 August 1925. In June 1926, the Minister of Health (and

future prime minister) Neville Chamberlain opened the 'Laboratory for the Biological Examination and Standardisation of Remedial Substances' at the pharmacological laboratories in London led by J.H. Burn. This revolutionary facility had a transformative effect on the testing of medicines worldwide. It is now the modern-day Pharmacology Department at the UCL School of Pharmacy, where research into new drugs and their effect on the body continues.

Ahad Rahim is Professor of Translational Neuroscience.



Neville Chamberlain attends the opening of the drug-testing lab (now UCL School of Pharmacy) at Bloomsbury Square, 1926.

Population-based HIV research

Shabbar Jaffar

UCL scientists at the Institute for Global Health have played a substantial role in the response to the HIV epidemic since the 1980s. We have documented the changing landscape of the infection over the past 40 years. Our early studies defined the natural course of the infection and identified factors influencing this; since then we have studied the effects of antiretroviral drug treatment and, more recently, the impact of HIV on many aspects of physical and mental health. Through a programme of multidisciplinary research, we have built on a deep understanding of the underlying biological, clinical and social pathways to support the development and evaluation of effective interventions, and to influence the care that people with HIV receive globally. For example, in partnership with policymakers, healthcare providers and patient groups, we have shown, in large interdisciplinary research studies, that integrating care for HIV with other high-burden chronic conditions is as effective as the current vertical (specialised) approach, and is cost-saving and popular with patients living with these conditions.

A key randomised trial ('START'), co-led by UCL academics, established that antiretroviral therapy should be initiated immediately in order to reduce the risk of clinical AIDS and non-AIDS diseases. A separate study co-led from UCL ('PARTNER') established that people living with HIV receiving antiretroviral treatment in whom the level of viral replication in blood is extremely low are no longer sexually infectious ('Undetectable = Untransmissible'). Together, these studies have demonstrated that antiretroviral therapy is the most useful weapon for the control of the HIV epidemic. The resulting increase in the number of people who are receiving antiretroviral treatment has been fundamental to achieving a sustained decline in the number of new HIV cases worldwide, particularly in parts of sub-Saharan Africa, where HIV had been most prevalent.

The increased life expectancy of those with HIV brings with it the usual challenges of managing an ageing population, and UCL researchers are now addressing concerns that people with HIV may experience a form of 'premature ageing', by investigating the relative contribution of treated HIV to the development of markers of ageing and comorbidity development. We are also working to generate evidence for new ways of managing HIV alongside other major lifelong chronic conditions, nationally and internationally. For example, in Africa, research has been conducted into new sustainable approaches to the delivery of HIV care along with care for hypertension and diabetes, with promising results. We also continue to work with people with HIV with advanced disease in these settings, to find new ways to prevent deaths in this group.

UCL researchers have also played a substantive role in global efforts to try to ensure that the quality of care for HIV in low-income settings (such as in Africa) is as close as possible to that in high-income settings. For example, our modelling work on HIV drug resistance to a previously widely used drug, efavirenz, led to new World Health Organization guidelines in which it was replaced by a newer drug for which the risk of resistance is much lower, dolutegravir. We continue to focus on investigating new approaches with the aim of sustaining or even accelerating declines in HIV incidence in Africa.

Shabbar Jaffar is Director of the Institute for Global Health.

Patients attending a chronic care clinic in Tanzania, as developed and evaluated by our researchers working in partnership with policymakers, healthcare providers and patient groups. This is the first clinic of its kind showing patients living with HIV sitting alongside patients living with hypertension or diabetes.

The resulting increase in the number of people who are receiving antiretroviral treatment has been fundamental to achieving a sustained decline in the number of new HIV cases worldwide.



Transforming the prostate cancer pathway

Caroline Moore and Mark Emberton

For just over 100 years, physicians have been treating prostate cancer without being able to see the cancer they were treating. Historically, examination with a finger might have detected a lump in the prostate and the presence of cancer would be inferred. Later, it became possible to direct a needle at such a lump and obtain some tissue which could be looked at down a microscope. By the 1980s ultrasound technology had evolved to the point that the prostate gland could be visualised – at least in outline – but the presence or absence of prostate cancer could not be determined using sound waves alone.

By the early 2000s MRI was beginning to be used for evaluating the brain and spine, but it was cumbersome and expensive to run, so access to the technology was carefully controlled and very few prostates were being scanned anywhere in the world.

At around this time we were evaluating the action of a light-activated drug on prostate tissue as a possible future treatment. In order to assess whether we had achieved the desired effect on the prostate (without having to remove it), MRI was tried, as ultrasound provided very little information. To everyone's surprise, the MRI showed areas of dead (or non-perfused) tissue surrounding the needles that had delivered the light to the prostate, as near-perfect cylinders of treated tissue. We believe that this was the first time MRI had shown the effect of treatment on the prostate anywhere in the world.

This simple but exciting observation of being able to see changes in prostate tissue that were caused by treatment led us to ask the next natural question – 'Could we, with a bit of fine tuning, use MRI to discriminate prostate cancer from normal prostate tissue?' The answer was an emphatic yes, but in order to be relatively sure that we were seeing cancer, we needed to use the full extent of MRI capability and interrogate the prostate with a range of MRI sequences that when evaluated

together could identify these cancers with a degree of precision. In 2004, very few specialists believed that prostate cancer could be seen, and they challenged our early findings.

We then set out on a phased plan of building the evidence to prove that the data we were generating were sound and could be replicated by others. The scepticism was hard to dispel. To do so required the publication of two large, multi-centre studies called PROMIS and PRECISION. In summary, PROMIS showed that an MRI-based diagnostic process was twice as accurate as an approach without MRI (93 per cent versus 48 per cent). PRECISION showed that despite fewer men being biopsied, fewer important cancers were missed with the MRI approach compared to the then-current standard of care. In April 2019, NICE (the National Institute for Health and Care Excellence) declared that all men should have an MRI prior to biopsy. From this statement the world followed.

The many additional benefits of being able to see prostate cancer are now being realised. Tumours that can be seen can be monitored, can be sampled with precision and can be selectively treated. The latter (known as focal therapy) means that patients can have their cancer treated as a day-case procedure and largely avoid the traditional consequences of sexual dysfunction, rectal symptoms and urinary

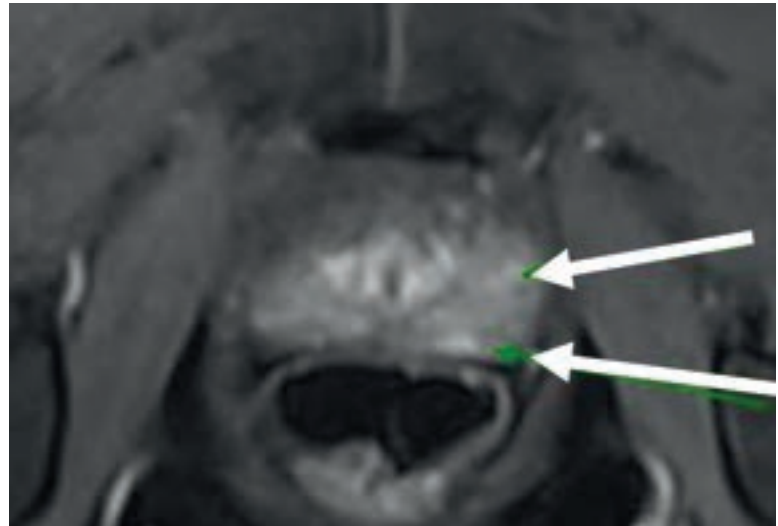
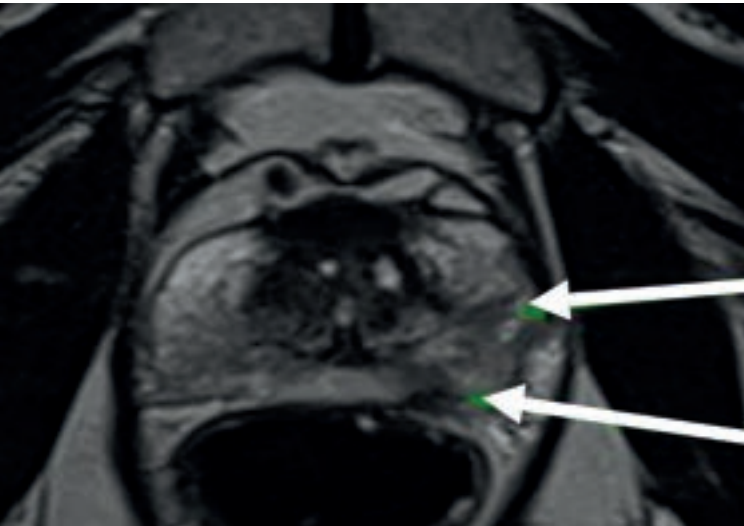
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leakage associated with the standard treatments of surgery and radiotherapy.

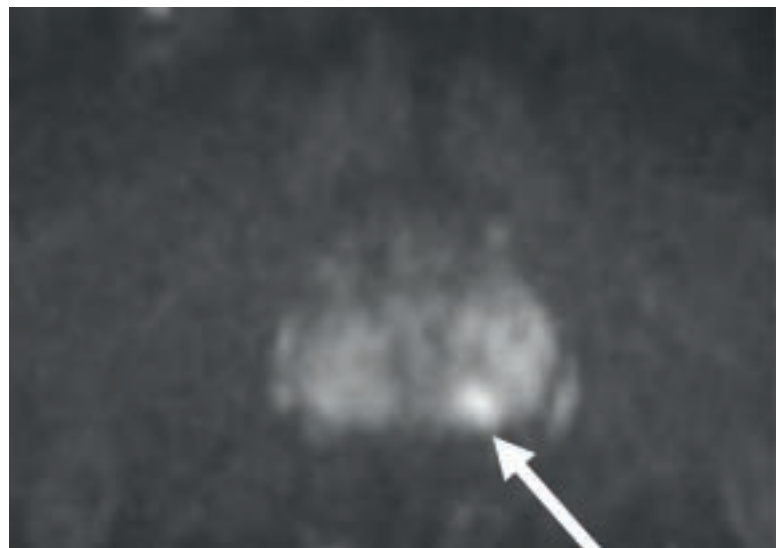
Our research continues. We are inventing and testing new and shorter MRI sequences. We are exploring the use of MRI as a population screening tool. We are working on methods to improve MRI quality around the world. We are incorporating artificial intelligence into the interpretation of the images. We are exploring the degree to which MRI can replace biopsy in the future.

We are deeply indebted to all the study participants who gave so generously of their time in order to help us improve the situation for those that would follow. Without them none of this would have been possible.

Caroline Moore is Professor of Urology. Mark Emberton is Professor of Interventional Oncology.



Prostate MRI scan showing two tumours on the left of the prostate viewed on anatomical T2 imaging as 2 dark areas, as bright after contrast injection and one of the two areas looking bright on diffusion weighted imaging indicating restriction of water movement.



New medicines to restore hearing loss: from molecular discovery to world-leading clinical trial

Anne G. M. Schilder

In the early 2000s, a team of UCL Ear Institute researchers unravelled a key molecular pathway to hearing loss. Ten years later, an international consortium led by UCL took this discovery into the clinic and delivered the first trial worldwide of a drug treatment aimed at restoring hearing. This new treatment was found to be safe and promising.

In adults, hearing loss most commonly occurs due to a progressive loss of sensory hair cells in the inner ear. In humans these hair cells do not naturally regenerate, so hearing loss progresses with age. Current treatment with hearing aids helps people communicate, but these devices do not restore natural hearing or treat the underlying cause. UCL Ear Institute researchers were among the first to explain the role of a protein called Notch that plays an important role in inner-ear sensory hair cell loss and regeneration. Understanding this molecular pathway paved the way for researchers and companies to identify therapeutic targets and develop drugs that promote hair cell regeneration.

In 2014, the REGAIN (REgeneration of inner ear hair cells with GAMma-secretase INhibitors) Consortium, a group of hearing researchers and clinicians from the UK, Germany and Greece, teamed up with the US company Audion and successfully applied for a European Commission grant to develop a highly potent so-called gamma secretase inhibitor. This drug stops the Notch protein working and thereby 'turns on' the inner ear-supporting cells to develop into new hair cells and restore hearing. The UCL team went on to design and lead the first ever in-human trial of a regenerative hearing drug. Fifty-nine adult patients with mild-to-moderate hearing loss recruited from across the three countries were given three doses of the drug by an injection into one ear through the eardrum and were followed up with detailed hearing assessments for 12 months.

The treatment was found to be safe and well tolerated. Although the hearing changes seen in the trial did not reach the ambitious target the REGAIN Consortium team had set to establish the impact of the drug, some patients showed small changes in various hearing tests. This suggests that the drug has some activity in the inner ear, which is a first step towards clinical use.

There were important lessons from this study which have guided consecutive studies of its kind. The study highlighted that new and more precise hearing tests need to be developed that help select the patients who may benefit from these new and highly targeted hearing treatments. The UCL team also developed a framework that applies health economics and behavioural science to help healthcare services prepare for the future implementation of novel drug, cell and gene therapies for hearing loss. The researchers found that these new hearing treatments can be cost-effective and improve hearing care; we showed how scientists and industry best work together with clinicians and patients to pave the way for these innovations.

The trial highlighted the demand among patients to participate in hearing loss research. More than 5,000 patients with hearing loss worldwide contacted the REGAIN team requesting to take part, illustrating the large unmet clinical need for better hearing treatments.

Anne G. M. Schilder is Professor of Otorhinolaryngology.



Examination of the ear as part of the REGAIN study at the UCLH Royal National ENT Hospital, London.

These new hearing treatments can be cost-effective and improve hearing care; we showed how scientists and industry best work together with clinicians and patients to pave the way for these innovations.

Gene therapy revolution: UCL's pioneering role in treating haemophilia

Amit C. Nathwani and Edward G.D. Tuddenham

Together with Pratima Chowdary we spearheaded pioneering work at the Department of Haematology, UCL's Cancer Institute, that led to ground-breaking developments in gene therapy for haemophilia, a group of life-threatening, inherited bleeding disorders. This revolutionary approach employs a modified virus to deliver a functional gene into patients' liver cells, the primary site of clotting factor production, enabling them to produce the critical clotting proteins required for blood coagulation. This offers the potential for a cure, a long-sought goal for the haemophilia community.

Our international collaboration with St Jude Children's Research Hospital, Memphis, Tennessee, initially focused on a gene therapy for haemophilia B. An innovative approach to deliver the replacement gene for factor IX, the deficient clotting factor in this form of the disease, was developed and tested in patients in the UK and USA. These landmark studies showed for the first time an ability to achieve stable expression of functional factor IX in patients with haemophilia B. This breakthrough galvanised the field, inspiring numerous studies conducted by both academia and pharmaceutical companies, ultimately benefiting hundreds of patients worldwide. A key outcome of these early trials, conducted at St Jude and UCL, was the development of Hemgenix, the first gene therapy for haemophilia B. With minor modifications to the original approach, the biotech companies UniQure and CSL Behring brought Hemgenix to market. It is now the first gene therapy for a bleeding disorder available on the NHS.

Building on this success, the UCL team turned its attention to the more complex challenge of haemophilia A. Overcoming significant technical hurdles, we engineered a viral vector capable of delivering the larger and more intricate factor VIII gene. Through innovative genetic engineering, the team significantly enhanced the expression of the

factor VIII protein. This research underpinned the development of Roctavian, the first gene therapy for haemophilia A to receive regulatory approval in Europe and the United States. Like Hemgenix for haemophilia B, Roctavian offers a one-time treatment that provides long-term protection for haemophilia A patients against bleeding episodes, potentially freeing them from the need for regular injections.

The impact of UCL's research extends far beyond the laboratory. Our work has catalysed significant investment in gene therapy research, stimulated the growth of new biotech companies (including Freeline Therapeutics, a UCL spinout) and transformed the treatment landscape for haemophilia patients worldwide. These achievements align closely with UCL's mission of advancing human health through innovation and interdisciplinary collaboration.

An eye-opening aspect of this story is the speed at which these discoveries have been translated into clinical applications. Within a decade, pioneering trials have led to the availability of life-changing treatments on national healthcare systems such as the NHS. The work of the UCL team is a shining example of how academic research can directly improve patients' lives on a global scale.

Amit C. Nathwani is Professor of Haemophilia and Honorary Consultant in Haematology. Edward G.D. Tuddenham is Emeritus Professor of Haemophilia.

This offers the potential for a cure, a long-sought goal for the haemophilia community.

Catheter-tip electrode for continuous oxygen measurement in newborn babies

Dawood Parker

Pulmonary illnesses are common in newborn infants and are the principal cause of death in the first week of life. Most affected infants need to breathe a concentration of oxygen often as high as 100 per cent to survive. However, a high oxygen concentration can, in preterm infants, result in blindness, and a low concentration may result in permanent brain damage or be fatal.

For many years it was customary to obtain arterial blood samples for analysis from a catheter passed via the umbilical artery into the descending aorta. The oxygen concentration was adjusted to give a satisfactory oxygen level. However, intermittent sampling depletes the infant of blood and provides no information about blood-gas concentrations between samples.

The development in the Department of Medical Physics and Engineering at UCL in 1974 of an umbilical-artery catheter-tip oxygen sensor which continuously measures and displays oxygen concentration provided very useful information in the management of infants with breathing problems. For use in vivo, the sensor we developed is a bi-lumen polyvinyl catheter of 1.65 mm diameter. Blood samples are drawn from an entry port in one lumen for comparative oxygen concentration measurements. The second lumen contains the electrical connections to the sensor.

Our technique is completely dry and inactive after manufacture and, in this condition, has a long shelf life. When inserted in the aorta, the catheter-tip sensor becomes active by water vapour diffusing across the membrane-covered tip to form the electrolyte, so the sensor is activated from water in the blood in the artery of the baby.

The commercial version was subsequently in routine use by the clinical staff of the Neonatal Unit at UCL Hospital. The use of these sensors, particularly in the UK and the US, together with

improvements in medical management, contributed to the increase in the survival rates of preterm infants from near zero in the 1950s to over 90 per cent by 1980.

Dawood Parker is a former member of the Department of Medical Physics and Biomedical Engineering.

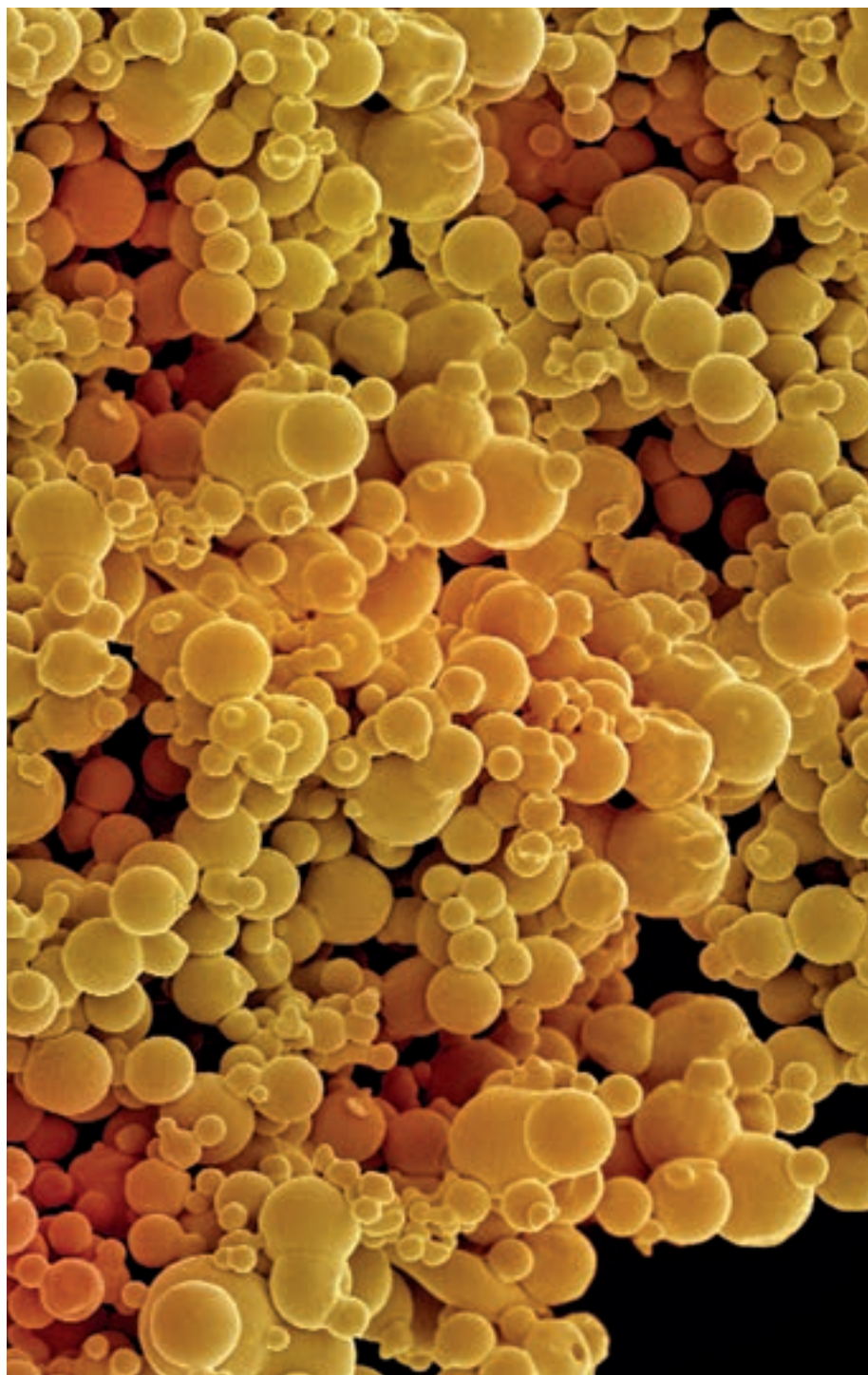
The use of these sensors . . . contributed to the increase in the survival rates of preterm infants from near zero in the 1950s to over 90 per cent by 1980.

Liposomes and lipid nanoparticles for drug and vaccine delivery: a 50-year-old solution for a once-in-a-century pandemic

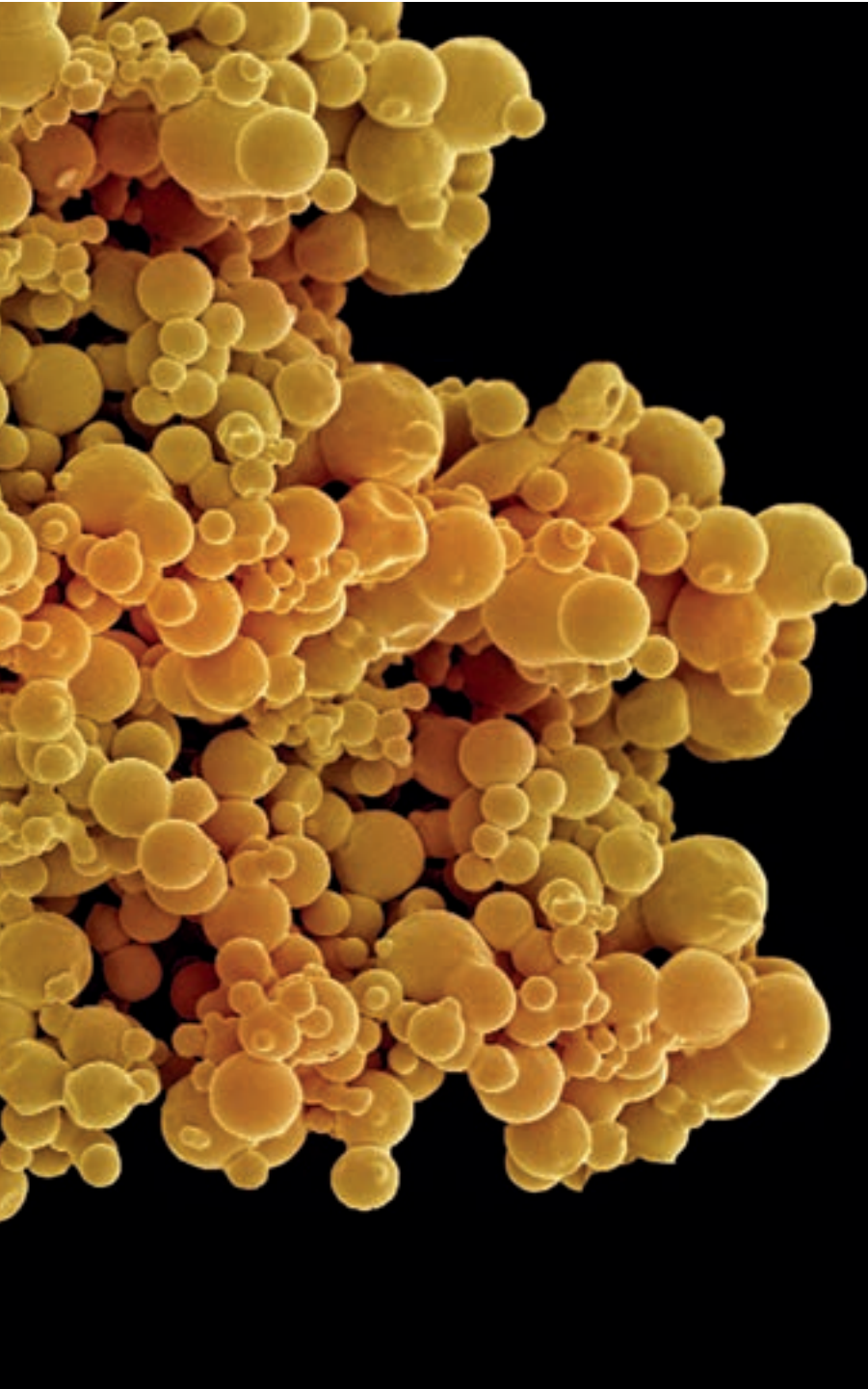
Pratik Gurnani

The outbreak of a new virus, Covid-19, in late 2019 caused significant disruption to global economies, major health burdens on the population, social challenges through lockdowns, and a complete shift in the way we lived our lives. Our only way out was to achieve a scientific breakthrough, by developing a functioning vaccine against this new disease at breakneck speed. To realise this immense challenge, researchers were able to utilise an emerging technology called messenger RNA or mRNA, which is based on genetic material, to expedite vaccine development. Owing to mRNA's high susceptibility to degradation in the body and inability to enter cells on its own, a vital aspect of these new vaccines was the use of a carrier system, in the form of lipid nanoparticles. These are tiny bubbles made of fat-like molecules called lipids, also found in our own cell membranes. The lipid nanoparticles can encapsulate the mRNA molecules, protecting them from degradation and aiding delivery to cells. This critical innovation for the Covid-19 vaccines can trace its roots, at least partly, to UCL.

In the early 1960s Alec Bangham, a researcher at the Babraham Institute in Cambridge, realised that, when wetted, isolated lipids would form into hollow spherical particles, which could be used to mimic the membrane of cells. He initially named these 'Bangha-somes' after himself. However, this name did not catch on and instead the particles were termed liposomes, an early iteration of the more general term 'lipid nanoparticle'. Gregory Gregoriadis and Brenda Ryman, researchers from the then Royal Free Hospital School of Medicine (now part of UCL), hypothesised in the early 1970s that liposomes could be used as nanoscopic delivery systems for drugs and vaccines. Their early breakthrough research showed that they could integrate therapeutic proteins and enzymes into the core of liposomes, overcoming previous challenges of immunological responses and poor



A cluster of liposomes.



stability after injection. Gregoriadis later moved to the London School of Pharmacy (now UCL School of Pharmacy) and continued to exploit liposomes for medicinal applications, finding that insoluble drugs, which cannot be administered naked, could be incorporated into liposomes' lipid compartments to improve their solubility, targeting and circulation time. He and his team also pioneered work to demonstrate liposomal encapsulation of vaccine antigens, finding that this drastically boosted the immune response to them, enabling lower doses to be given and stronger immunity to be built.

This fundamental work spanned physics, chemistry, biology and pharmaceutical science and has had huge impacts on modern medicine. It has directly led to the development of more than 15 liposomal delivery systems such as Doxil®, a formulation of the insoluble cancer drug doxorubicin, which was the first approved 'nanomedicine'. It also ultimately paved the way for the successors of liposomes, a critical element in the vaccines which led our recovery from a once-in-a-century pandemic and are credited with saving tens of millions of lives.

Pratik Gurnani is Lecturer in Pharmaceutical Science.

This fundamental work spanned physics, chemistry, biology and pharmaceutical science and has had huge impacts on modern medicine.

The Baldwin–Farmer chamber for measuring radiotherapy dose

Robert Speller

The Middlesex Hospital opened in 1745 in Windmill Street; in the 1980s it merged with UCL Medical School so that its story is part of UCL's history. By 1792 the Middlesex had opened a ward entirely devoted to the treatment of cancer, and the discovery of X-rays in 1895 and radioisotopes in 1896 made the use of ionising radiation for treating cancer one of the primary options. Initially radium was used to treat tumours close to the surface. It was soon realised that the curative effect was very dependent upon how much radiation was received by the patient and hence the science of radiation dosimetry was started. Early work monitored colour changes to the skin caused by irradiation, but the biggest change in quantifying dose came with the development of the Bragg–Gray cavity theory in 1936. The theory relates the dose in a small cavity (i.e. a detector) to the dose in the patient, provided the presence of the detector does not alter the radiation beam. As radiation passes through the cavity it generates electric charge that can be collected in the form of an electrical current to measure dose. This type of detector is called an ionisation chamber. They had been built since the discovery of radioactive materials, but relating the measured current to radiation dose received by the patient required careful application of the Bragg–Gray cavity theory and the development of techniques that allowed accurate measurement of the current.

In 1940, Frank Farmer took up an appointment as assistant physicist in the Middlesex Hospital Medical Physics Department. At the Middlesex, he combined his interest in radiation and his flair for electronics to design instrumentation for the accurate measurement of X-ray doses by applying the Bragg–Gray cavity theory. Measurements made in air can be related to doses in tissue, and so, using a carefully selected combination of materials, ion chambers were designed so that their average chemical

signature was the same as air. The second problem to solve was the accurate measurement of the very small electrical current generated in the chamber when irradiated. Farmer made seminal contributions in both these areas to develop an instrument that became the standard dosimeter for precise dose measurements. Calibrating these Farmer dosimeters against the national standard (in the UK this is held at the National Physical Laboratory, Teddington) allowed accurate dose measurements to be made in any hospital. The Baldwin Instrument Company took over manufacture of these instruments and they became known as Baldwin–Farmer ion chambers. Sold throughout the world, they became the standard instrument for radiotherapy dosimetry and are still in use today.

Robert Speller is Robert Speller is Emeritus Professor of Medical Physics and the current holder of the Joel Chair in Physics Applied to Medicine.

Early work monitored colour changes to the skin caused by irradiation, but the biggest change in quantifying dose came with the development of the Bragg–Gray cavity theory in 1936.



An early Baldwin-Farmer ion chamber connected to a high-sensitivity electrometer.

Pioneering medical AI for real-world impact

Pearse Keane

In 2015, I realised that artificial intelligence (AI) had the potential to shape the future of ophthalmology – a light-bulb moment that eventually helped lay the groundwork for a new field of scientific discovery called oculosics.

I was aware that across the NHS, 25 million images of the eye were being created every year during routine appointments. At the same time, AI was maturing with the rise of deep learning, famously demonstrated in 2015 with AlphaGo, an AI system developed by the British tech company DeepMind (now Google DeepMind). Trained on millions of online game moves for the complex board game Go, the AlphaGo algorithm outplayed the reigning European champion and then beat the world champion. I began to wonder: what if a similar technique could be applied to the huge collection of NHS eye health data to detect biomarkers of disease in retinal images? This question led to a formal partnership between Google DeepMind and Moorfields Eye Hospital NHS Foundation Trust in 2016. Our aim was to develop AI algorithms for the earlier detection and treatment of retinal disease.

In August 2018, the first results of our collaboration were published in the journal *Nature Medicine*. The paper described an AI system, trained on a million de-identified images from Moorfields, that could recommend the correct referral for more than 50 eye diseases with 94 per cent accuracy. A second paper outlined an early warning system for age-related macular degeneration, by far the most common cause of blindness in many countries.

Building on the Google DeepMind experience, I helped coordinate a bid in 2019 to establish the UK's first health data research hub for eyes, INSIGHT. An NHS-led initiative based at Moorfields, INSIGHT has grown to become the world's largest bioresource of routinely collected eye images linked to clinical data.

Drawing on this valuable eye imaging resource, I now lead a multidisciplinary AI research lab at the UCL Institute of Ophthalmology. The lab brings

together data scientists and clinicians across UCL and Moorfields, focused on developing and implementing AI systems in healthcare. The two institutions enjoy a long-standing partnership and represent the largest co-located site for eye research, education and care in the world. In 2023, Yukun Zhou, one of our PhD students, led the development of RETFound, the world's first foundation model in ophthalmology. Available open-source, the model is being used by researchers worldwide, spearheading local efforts to prevent blindness. One example is a mobile eye health service deployed in remote outback Australia, leveraging RETFound to build an AI system for on-the-spot detection of eye and systemic conditions.

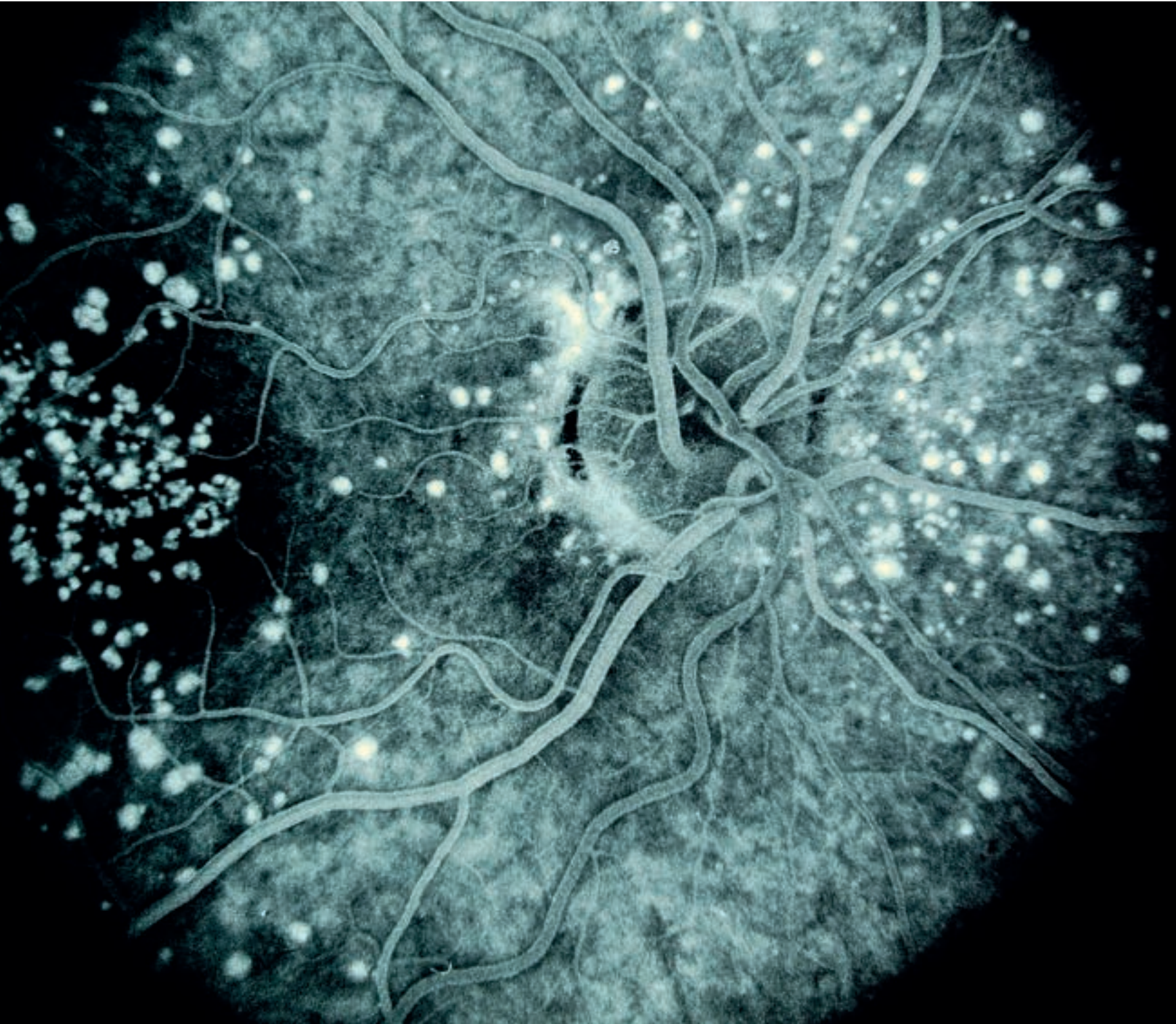
Pioneering work at the lab includes a significant programme on oculosics – the science of using ocular biomarkers to detect systemic disease. Siegfried Wagner is at the forefront of the field, leading the largest study to date on eye imaging to detect Parkinson's disease. The research, published in 2023, used AI to identify retinal markers indicating the presence of Parkinson's disease in patients, on average seven years before clinical presentation.

Research at the lab continues to expand into other areas of oculosics, alongside complementary programmes tackling some of the most pressing issues in applying AI to healthcare. These include secure, cross-border data sharing, evaluation of training data, and clinical validation of AI as a medical device.

Collaborative in spirit and rigorous in approach, our AI lab is on a mission to deliver real-world impact by tackling the challenges and exploiting the potential of AI in healthcare for the benefit of all.

Pearse Keane is Professor of Artificial Medical Intelligence.

I realised . . . that AI had the potential to shape the future of ophthalmology – a light-bulb moment.



Fluorescein angiogram showing atrophic macular degeneration in the right eye.

From Covid to CAVE: reducing risks of airborne hazards to the health of the public

Liora Malki-Epshtein

In early 2020, in the face of the unprecedented public health challenge of the Covid-19 pandemic, public health advice focused on recommending severe limitations on social or professional gatherings indoors, in buildings and on public transport. As the role of airborne transmission of the disease became clear, a primary strategy to reduce risk of transmission was to improve indoor air quality (IAQ) by ventilating with fresh air indoors. A multidisciplinary group from the Department of Civil Engineering collaborated on several projects, working to understand how people could spend time in public spaces indoors while keeping safe. We carried out modelling and field studies on public transport and public events that provided quantitative evidence of the state of indoor air quality in the UK in a wide range of real-world settings, responding rapidly during a major public emergency under challenging conditions.

We worked with Transport for London (TfL) and Veolia to identify and implement protection measures for bus drivers and waste collection crews, key workers who kept vital services running throughout the pandemic. We also worked with TfL on reducing risks of transmission among passengers on the London transport network. The mitigation measures we proposed were found to improve air quality on London buses and waste vehicles through better ventilation and fresh air.

Soon after the start of the pandemic, mass-gathering events, such as live music, sports, theatre performances, business events and weddings, were prohibited in the UK for over a year. The Events Research Programme (ERP) was a large-scale multidisciplinary research programme established by the government to assess risk factors for Covid-19 transmission at mass-gathering events and evaluate the feasibility of public health risk-reduction measures. The Environmental Study of

the ERP, led by the UCL team in collaboration with several institutions, was a rapid evaluation of IAQ, ventilation and airborne transmission risk conducted at 10 large venues during live events all around the UK between April and July 2021. The study, which was the largest of its kind worldwide, developed a significant evidence base on environmental risk factors at events and produced national guidance for event operators and venue managers. Following the programme, the UK government allowed the return of live events in July 2021, and this was followed by a reopening of society.

These projects led to a valuable and lasting legacy. UCL, which has a proud history of supporting public health in crowded urban environments, identified the need to build a large-scale experimental facility dedicated to air quality and building design focused on safety, health and wellbeing for occupants. The Controlled Active Ventilation Environment (CAVE) laboratory first opened in April 2023 and has since been developed into a full-scale 'building-within-a-building' facility. It was designed to enable air quality experiments at full scale under carefully controlled conditions which are monitored at a high resolution. It also allows us to conduct experiments with dozens of human participants so that their impact on the environment and on each other can be studied and quantified. The CAVE team carries out research on how to protect the public from a wide range of airborne hazards such as vehicle-related air pollution, wildfire smoke, smog, industrial accidents and airborne diseases, through better building ventilation and building design.

Liora Malki-Epshtein is Professor of Urban Air Quality and Fluid Mechanics.



The CAVE facility, opened in 2023.



Inside the CAVE 'building-within-a-building'.

2

Culture and creativity

Putting UCL on the map

James Cheshire

UCL has a unique place in the history of map making. Henry Brougham, who was integral to founding UCL, also started the Society for the Diffusion of Useful Knowledge (SDUK) in 1826. The SDUK's mission was to share educational publications in an affordable way with the growing population of a rapidly industrialising Britain. There was a staggering breadth to the SDUK's works (including a 'Penny Magazine' and a 'Penny Cyclopaedia'), which all benefited from contributions from leading thinkers of the day. They included a subscription atlas featuring maps that were intended to support their other literature and to help broaden the horizons of readers. Its quality and affordability meant the atlas became one of the most successful series of maps ever created, with more than 3 million maps printed before the SDUK wound up in 1848. It had helped to create a mass market for maps and to establish them as an essential – and accessible – tool that we take for granted today.

The closure of the SDUK, however, was not the end of the story for the maps. Remarkably, they continued to be in print in some form or another until the start of the twentieth century, since the steel printing plates used in their production were bought and sold by a succession of publishers. They even made it as far as the United States, where Theodore Roosevelt opted to display an SDUK globe in his office during his term as vice president. The SDUK's archives are held at UCL, and a copy of the pioneering atlas is in the UCL Department of Geography's map library.

Fast forward to the 1970s, and UCL was at the forefront of the revolution to develop Geographic Information Systems (GIS), the basis of the digital maps we take for granted today. A former RAF pilot named Roger Tomlinson developed the Canada Geographic Information System (CGIS), which became the basis for his PhD at UCL, the first ever on the topic and one that was foundational to the geospatial revolution that led to the powerful maps

we now routinely use for research, but also carry around in the phones in our pockets. This revolution was further powered by new approaches to mapping online, with UCL researchers creating some of the most successful web maps of the first two decades of the 2000s.

It was a UCL student – Steve Coast – who had the extraordinarily ambitious idea of creating a world map entirely from volunteered data. In July 2004, OpenStreetMap (OSM) was born and its data was hosted on UCL's servers. OSM was conceived as a community-based map where people would collect their own data and input it into a web map that anyone could download. Today a huge range of companies and platforms depend on OSM for their data and its volume continues to grow, with hundreds of organisations donating data, bolstering the efforts of millions of users.

James Cheshire is Professor of Geographic Information and Cartography.

Fast forward to the 1970s, and UCL was at the forefront of the revolution to develop Geographic Information Systems (GIS), the basis of the digital maps we take for granted today.

One of the most innovative and popular maps from the SDUK subscription atlas was this map, published in 1834, of the world's rivers flowing outwards from an imaginary pole.

The living heart of UCL: libraries

Paul Ayris

As soon as UCL was founded in 1826, one of the first things the College did was to establish a library, which opened in 1829. The original library was the room built by Donaldson in 1849, currently known as the Donaldson Reading Room. Collections and services are now offered from 19 sites in and around London. UCL libraries currently hold 2 million print books, 2.1 million e-books, 240,000 e-journals, 160,000 rare books and 4.6 km of archives and manuscripts.

In 1829, the first Library Regulations stipulated that 'The Library is accessible from *Ten* in the Morning until *Four* in the Afternoon'. Mirroring changing social expectations, the learning spaces

in the UCL Student Centre are now open 24 hours a day, every day of the year. In 2023/4 we received 3.84 million physical visits to all our library sites.

The Library holds the UNESCO-designated archive of the English novelist and poet George Orwell, books from the personal library of Jeremy Bentham (see pp. 185–7) and items from the personal library of Oscar Wilde. In Science and Medicine, the Library has three copies of the second edition (1555) of Vesalius's *De humani corporis fabrica*, the beginning of true scientific anatomy.

Libraries today are far more than collections of paper books and journals. In the twenty-first century, libraries provide centrally managed learning spaces,



A fire-damaged bookcase in the Library after an air raid, 1940.



Page from Vesalius, *De humani corporis fabrica libri septem* (1555 edition). The first book of scientific anatomy, with exceptional engravings.

In the twenty-first century, libraries provide centrally managed learning spaces, which are the home for students on campus when not in lectures or labs.

which are the home for students on campus when not in lectures or labs. The UCL repository of Open Access (OA) publications has received over 50 million downloads or accesses, and UCL authors currently deposit around 1,675 outputs in the repository every month. UCL Press, founded in 2015, publishes research monographs, textbooks and journals which have been downloaded or accessed over 20 million times in 242 countries and territories. UCL Press Play is now the film and media arm of UCL Press, making films and podcasts to open up UCL research to a global audience.

One very significant development is the creation of the UCL Open Science Office, which has a leadership role in supporting and developing UCL's Open Science/Scholarship agenda. Open Scholarship aims to make publications, research data and software code freely available to a global audience. It also advocates for reproducibility, collaboration and transparency in the way research is performed. Approaches to pursuing transparency may include exploring multiple conclusions that could be drawn from evidence; publishing research methods, manuscripts or data; or disclosing the approach used when interpreting a text or research evidence. Reproducibility of research methods is required for research to be replicated, essential in research contexts where findings must be robust and reproducible in order to form a solid foundation on which to build further knowledge.

Libraries are at the heart of the modern university, preparing UCL's academic and professional services staff and students to make their future contributions to society.

Paul Ayris is Pro-Vice-Provost for Library, Culture, Collections and Open Science.



The Student Centre from the Japanese Garden.



The Slade Collections: an exceptional resource held by UCL Art Museum

Andrea Fredericksen

UCL Art Museum's Slade Collections comprise more than 3,000 works of art, collected from 1897 to the present day via a long-established prize system at the Slade School of Fine Art. A unique historical resource documenting art education at the school since its foundation, the collection contains works by more than 1,000 former students and staff and is unmatched by any other English art school collection. Here examples of prize-winning pieces by popular artists such as Gwen John, Augustus John, Stanley Spencer, Richard Hamilton and Paula Rego sit alongside those by lesser-known artists. As the Slade was the first art school to admit women alongside men, women's achievements are well represented in the collection, making it an invaluable aid to restoring the reputations of artists lost in the gaps of history.

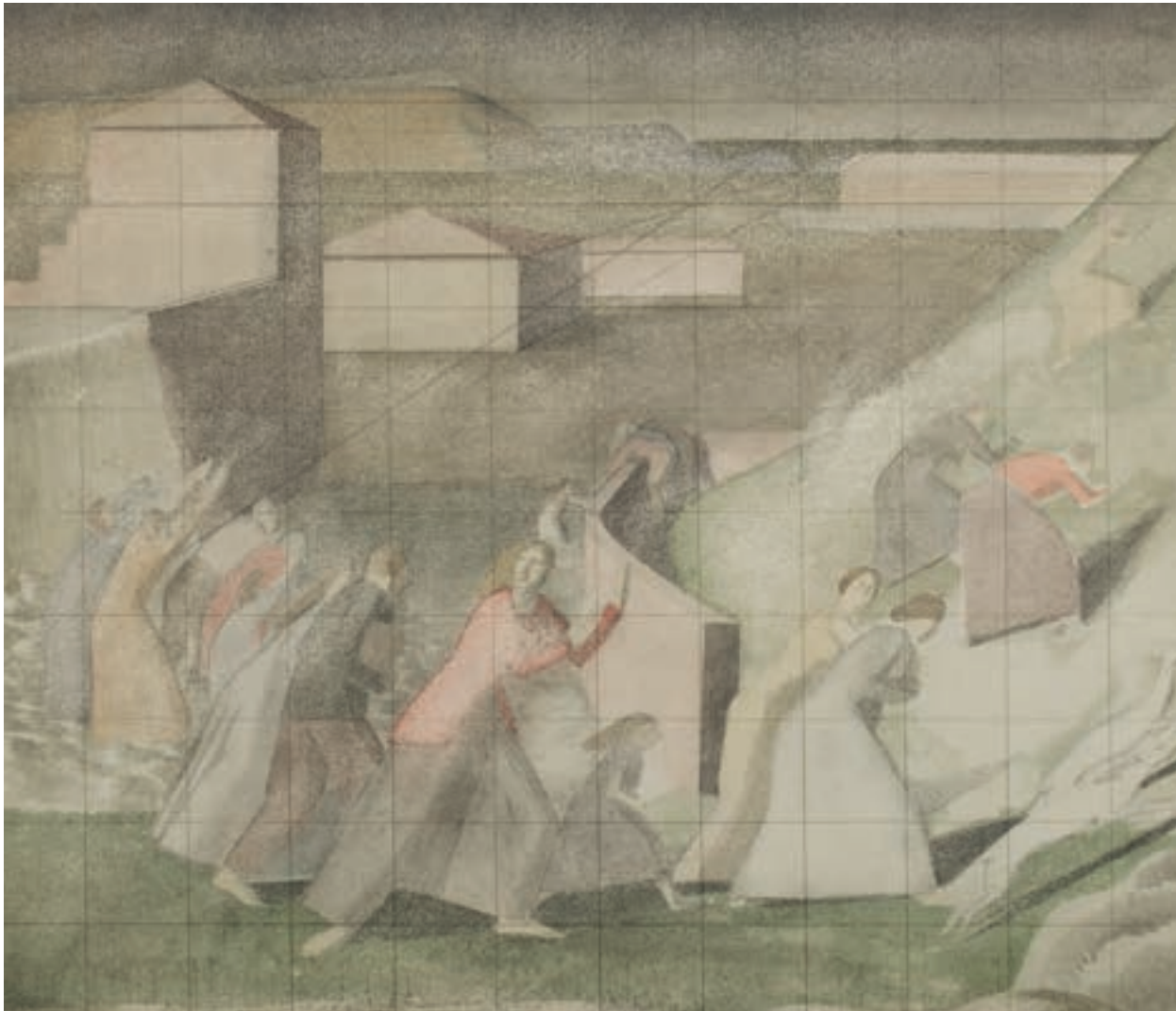
Preserved in a traditional Print Room on the Bloomsbury campus, UCL's works on paper are consulted by researchers and art lovers alike. A study drawing by Gwen John (1876–1939), aged 19 when she entered the Slade, shows the student artist looking closely at Old Masters as part of an exercise most likely set by her tutors. The detail of a male figure in red chalk gives proof that John had walked the short distance to the British Museum, where she copied and reworked a preparatory drawing by the Italian Renaissance artist Raphael. Important donations of art collections to UCL, such as the Grote Collection in 1872 of early Northern European drawings, meant that John and her fellow students also had a wealth of historical artworks at hand for inspiration, a way of learning still popular at UCL today.

Winifred Knights (1899–1947), the recipient of multiple prizes, most prominently the prestigious Summer Composition Prize in 1919, is well represented in the Slade Collections. She embraced





Gwen John, *Studies after Old Masters*, c.1897-8, black and red chalk on pencil (UCL Art Museum, LDUCS-3451v).



Winifred Knights, *Study for 'The Deluge'*, 1920, watercolour over pencil (UCL Art Museum, LDUCS-6647).

drawing as essential to her practice, producing a multitude of studies in a variety of media to prepare for her paintings. This drawing is one of many preparatory works at UCL Art Museum, made for *The Deluge* (now at Tate Britain), her submission for the British School at Rome Scholarship in Painting. Knights would go on to become the first woman to win the Rome Prize. Her award-winning works have been acquired along with those by other emerging artists, many of which are now being rediscovered.

Because women artists and other marginalised groups have been systematically overlooked, remaining outside the collecting policies of British museums and galleries, the Slade Collections have

become an important destination for recalibrating art-historical narratives and radiating new knowledge. This unique and significant contribution is demonstrated by way of the number of exhibitions that increasingly draw on the collection, including recent retrospectives on Dora Carrington, Ithell Colquhoun, Diana Cumming, Gwen John, Amy Nimr, Paula Rego, Ethel Walker and many more to come.

Andrea Fredericksen is Curator, UCL Art Museum, LCCOS.



Ivy MacKusick, *Portrait of a Man in His Shirtsleeves*, 1919, oil on canvas. Recipient of First Prize for Head Painting, 1919 (UCL Art Museum, LDUCS-5090).

The UCL PEARL facility: fusing arts and sciences to make a better world

Nick Tyler

'It's not the falling that bothers me, it's the gravity.' In the UK around one in three adults over 65 and half of people over 80 will have at least one fall a year. Hip fractures alone cost the NHS around £1.8 billion per year. Falls are a serious problem. Previous research on falls had concentrated on the fall itself and examined the trip hazard and the musculoskeletal, vision or balance characteristics of the person involved. At UCL we took a different view. My team and I applied systems thinking to view a fall as the end of a process consisting of a sequence of decisions and actions, any one of which could lead, if recovery were not possible, to a fall. This led

us to create PEARL (Person-Environment-Activity Research Laboratory), which opened in 2022. PEARL enables researchers to create a variety of worlds at life scale under controlled conditions, and then to bring people in to see how they interact with these environments. PEARL is unique in that it can create an illusion of reality in light, sound, smell, appearance and touch, sufficient to convince a person's brain that they are in the kind of world researchers need to study with their brain scanners, physiological sensors and physical monitoring systems.

Researchers at PEARL base their approach on active inference, the idea that the brain predicts



The main facade of the UCL PEARL building is patterned to represent pedestrians, or a murmuration of birds, or the swirling of different ideas influencing each other to create new ones as they fly towards the entrance door.



Four London double-decker buses inside PEARL during an experiment for Transport for London related to passenger responses on thermal comfort in buses.

the future world to which it must respond in order to survive. We see this for real: people lean forward when the train they are sitting in slows down and stops (even though the train is not moving), or they start to feel warmer, even removing their jacket or coat, when researchers turn off the sound of air conditioning. The team studies the evolution of human sensory and physical systems and the anthropological aspects of culture and how we can design environments to enhance sociality, so that people can find it easier to communicate, cooperate and collaborate with others. The expertise and

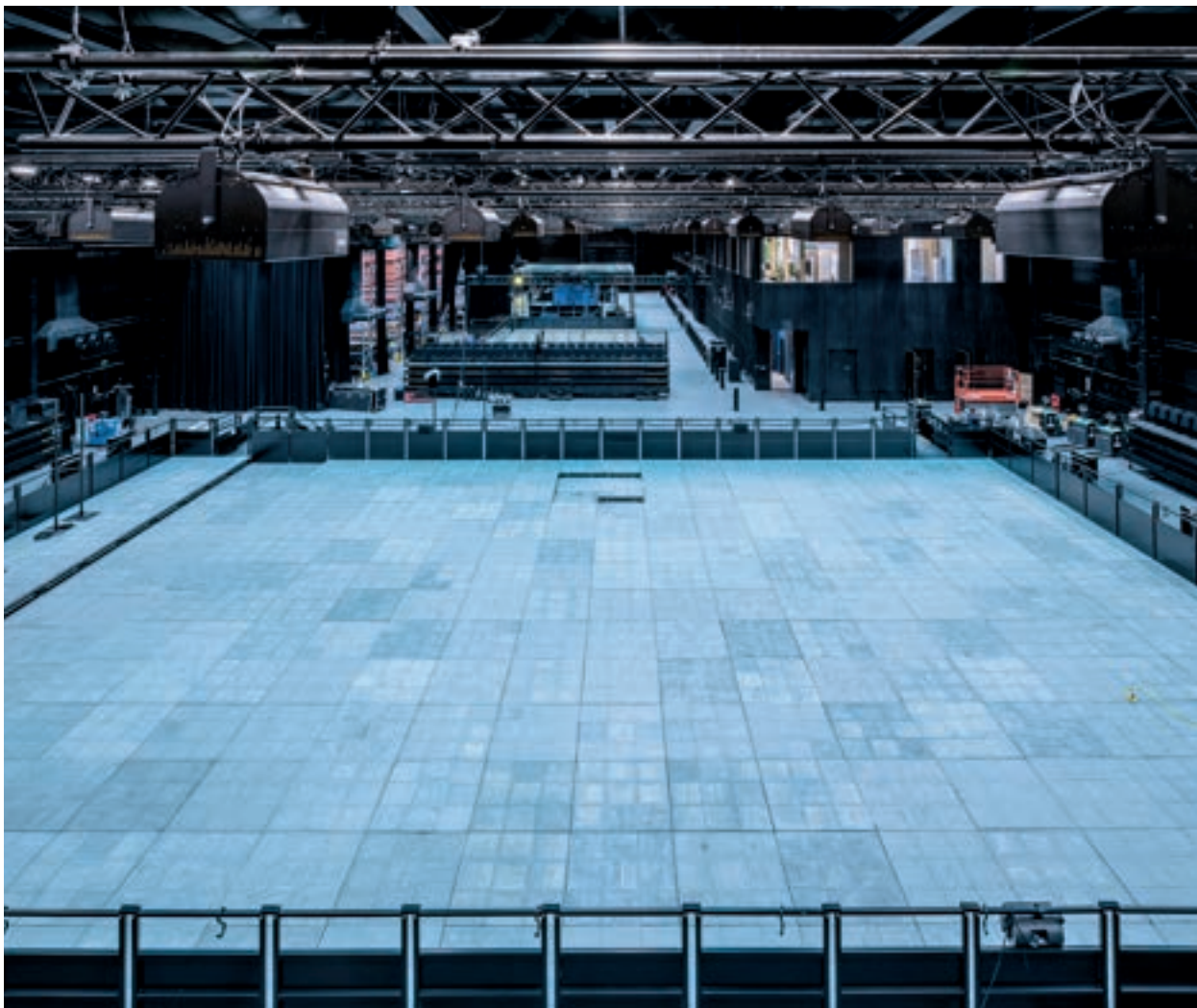
fine control used by dancers, musicians, sculptors or painters to create artistic works are brain (and body) functions evolved for our survival, but taken to an extreme for the sake of art. This teaches the researchers how people who have not achieved this level of performance function in the simpler tasks involved in walking. London Underground used the results of these experiments to inform the design of the platform–train interface, including door vestibules in the trains and the platform-edge door systems for the new Piccadilly Line trains that came into service in 2025, thus easing the journey

for millions of passengers and reducing the risk of tripping or falling during this manoeuvre.

PEARL embraces the founding principles of UCL in that it fuses the arts and sciences (the first Professor of Engineering at UCL, John Millington, was appointed in 1826 as the 'Professor of Engineering and the Application of Mechanical Philosophy to the Arts'). In PEARL there is no boundary: the team works with researchers and educators in the Slade School, the School of Creative and Cultural Industries, the faculties of the Built Environment, Brain Sciences, Engineering Sciences, Arts and Humanities, and

Social and Historical Sciences and the IOE so that we can indeed help to create a better, safer, more equitable and healthy world, allowing people and planet to thrive together.

Nick Tyler is Chadwick Professor of Civil Engineering.



The interior of PEARL, showing one of the experiment stages in which multisensorial worlds are created for research, education and community engagement.

Literary journalism and UCL

Mark Ford

Scour the bylines accompanying articles published in the *Times Literary Supplement (TLS)*, the *London Review of Books (LRB)*, the *Literary Review*, the *Guardian* or the *New York Review of Books*, and time and again you will read that the author 'teaches in the English Department at UCL'. Scroll through the contributors to literary episodes of Radio 4's flagship cultural programme, *In Our Time*, and again you'll keep coming across the names of current members of the department such as Charlotte Roberts, Helen Hackett, Linda Freedman and John Mullan (see p. 90), or of illustrious predecessors such as Rosemary Ashton and John Sutherland. The UCL English Department has always been committed to making its expertise as widely available as possible. By forging links with editors of literary magazines and radio programmes, with trade publishers and with innovative enterprises such as Dead Poets Live, it has consistently managed to embed itself in the heart of literary London.

The department's most significant and lasting contribution to the world of literary journalism had its origins on the second floor of Foster Court itself: in 1978 a strike closed down all the *Times* newspaper titles, including the *TLS*, and in June of the following year a former head of the department, Frank Kermode, suggested in the *Observer* that the time was right for a new magazine to fill the gaping void. Kermode's successor as the department's Lord Northcliffe Professor (a chair, not entirely coincidentally, endowed by a newspaper magnate) was Karl Miller, former literary editor of the *New Statesman*, the *Listener* and the *Spectator*, and into the void he leapt, founding (with Mary-Kay Wilmers) the *LRB*, whose first issue appeared four months later. There was no better-connected mover and shaker on the literary scene at that time, and the *LRB*'s roster of early contributors included such luminaries as William Empson, Ted Hughes and Seamus Heaney.

Since the *LRB* was founded, numerous members of the department have contributed to its pages. The novelists Dan Jacobson and A.S. Byatt, the great

scholars of Victorian literature John Sutherland, Danny Karlin, Michael Mason, Rosemary Ashton and Philip Horne, and the astonishingly prolific and versatile Frank Kermode, whose views on how an English literature course should be run still permeate our approach to the teaching of undergraduates, all demonstrated how a 3,500-4,000-word review of a book could enchant, inform and create a sense of belonging to a vibrant literary culture. The *LRB* made – and continues to make – new novels, new volumes of poetry, new interpretations of history, fresh approaches to canonical writers, feel interesting and important: it makes reading *matter*, and in this it reflects the UCL English Department's dominant pedagogical beliefs. *Troilus and Criseyde* may have been written a long time ago and include lots of unfamiliar words, but a good tutorial, lecture or seminar can make it feel like a vital, living story, a heartbreaking tragedy, something to brood upon, even shed tears over.

By the time I first taught in the Department in 1988, the *LRB* had established itself as the nation's most influential and respected literary magazine. Karl divided his time between Foster Court and the *LRB*'s tiny office in Tavistock Square. When I visited for the first time, almost shaking with nerves, to deliver a review of the facsimile edition of Allen Ginsberg's *Howl*, I felt, to borrow a phrase from Roland Barthes, 'in the crucible of meaning'. Karl was a keen follower of football, and wrote a piece that unexpectedly became famous about Paul Gascoigne's performances in the World Cup in Italy in 1990; like a great football manager, he knew how to get the best from his carefully chosen team of writers, demonstrating more successfully than any other editor of his era how academia and journalism could play on the same pitch, to the benefit of both.

Mark Ford is Professor of English Literature.

Small Press Collections

Elizabeth Lawes

The Small Press Collections (the Little Magazines, Poetry Store and Alternative Presses) held by UCL Special Collections are globally important collections of independently produced and distributed literary magazines, experimental art and poetry, countercultural publications, and associated bibliographic and archival material. Established in 1965 in response to a burgeoning international culture of self-publishing, this was one of the first institutional collections of small press publications and developed despite the myriad challenges presented by such unpredictable, ephemeral and bibliographically erratic material.

Small presses have provided a launchpad for many major poets and a platform for experimental writers, while mid-century avant-garde artists used distributed print material as an alternative site for documenting and exhibiting transient, conceptual and textual artworks. Underground newspapers from alternative presses, featuring an amalgam of political and cultural commentary, record the activities of under-represented groups and focus on topics such as feminism, Black rights, LGBTQ+ equality, the peace movement and radical ecology. Publications are characteristically a hybrid of literature, art, culture and politics, illustrating the complex networks of cross-disciplinary activity that were enabled by increasingly affordable mid-twentieth-century print technologies: while commercial offset printing became viable for those on a tight budget, many artists, writers and activists needed nothing more than access to a stencil duplicator or photocopier.

UCL, with its foundational philosophy of radicalism and free thinking, was the perfect home for a collection of such consciously independent material; that it flourished was due to the support of Deputy Librarian Ian Angus and the knowledge and dedication of the Subject Librarian for English, Geoffrey Soar. Recognising a lack of appetite within the wider library community to acquire the material emerging from the so-called 'mimeograph

revolution', Soar was tasked with developing the collection and secured funding from various sources. The project was ambitious: total coverage of UK little magazines, along with significant acquisition from Europe, the Commonwealth and the United States. Thus the collection was global in scope from the outset, and UCL can boast holdings of rarities from, among others, India, Japan, Nigeria, Ghana, Barbados, Jamaica and Brazil. The challenge of acquiring self-published material from across the globe in the pre-internet age, from initial discovery to subsequent purchase, was considerable, and his endeavours placed Soar at the vanguard of institutional collecting.

Today the collections extend to approximately 20,000 items in the Poetry Store and 4,500 little magazines and alternative newspapers. The diverse profile evolves in response to an independent publishing scene that continues to promote those not always represented by the mainstream. Work by writers and artists of colour is actively sought, and recent acquisitions from LGBTQIA+ presses feature trans and non-binary authors. It is now more than 60 years since the first little magazines arrived at UCL, and the collections continue to thrive in an institution with an appetite for experiment, driven by interdisciplinarity. The Small Press Collections are of ongoing relevance to teaching across UCL, and in a progressive, global research institution they play a primary role as the source material of new literary and cultural histories.

Elizabeth Lawes is Subject Liaison Librarian for Fine Art, History of Art and Film Studies, and Collection Manager, Small Press Collections, UCL Special Collections, LCCOS.



Erica Van Horn, *A Healthy Rosemary Plant*. Published by Coracle, Clonmel, Tipperary, Ireland, 2013.



Global Tapestry Journal, 'Homage to Patchen' issue. Edited by Dave Cunliffe and Tina Morris; published by BB Books, Blackburn, 1972.



Ezra, no. 4. Edited and published by Arvind Krishna Mehrotra, Bombay, 1968.

The classical past now

Miriam Leonard and Maria Wyke

The UCL Department of Greek and Latin is committed to exploring the enduring impact of antiquity in the modern world. The projects described below highlight how the ancient world played a crucial role in two revolutionary inventions of the early twentieth century: psychoanalysis and cinema.

I (Miriam Leonard) have been developing a collaboration with the Freud Museum in London over a number of years. The museum is the final home of Sigmund Freud, the founder of psychoanalysis, and his daughter Anna Freud, a pioneering child psychoanalyst, who fled to London in 1938 after the Nazi invasion of Vienna. At the heart of the museum's display is Sigmund Freud's personal collection of more than 3,000 antiquities which were crucially important to the formulation of many of his key ideas such as the Oedipus complex and the concept of narcissism. I curated an exhibition entitled *Between Oedipus and the Sphinx: Freud and Egypt* in 2019. In 2023 I co-curated *Freud's Antiquity: Idea, Object,*

Desire. This project helped the museum host its inaugural hybrid exhibition, featuring both a physical installation on site and a digital exhibition. The physical exhibition featured well-known objects in Freud's collection as well as artefacts that had never been displayed to the public before. The digital exhibition – a permanent multimedia resource containing podcasts, photographs and text panels which trace the connections between Freud's most important theoretical breakthroughs and his collection – remains accessible online.

The exhibition pursued several pressing intellectual lines of enquiry: it explored how archaeology impacted the evolution of psychoanalysis during the late nineteenth and early twentieth centuries; and it aimed to deepen insights into the ways Freud's collection of archaeological objects informed his perspectives on gender, sexuality, race and the historical construction of personal identity. On display in the exhibition were several objects depicting Oedipus and his encounter



Museum of Dreamworlds film screening at Silents by the Sea by Northern Silents. Morecambe Winter Gardens, 30 November 2024.

with the Sphinx. In 1896 Freud wrote to his friend Wilhelm Fliess, 'I have found, in my own case too, [the phenomenon of] being in love with my mother and jealous of my father, and I now consider it a universal event in early childhood.' This insight led him to embark on an analysis of Sophocles' play *Oedipus Rex*, which would begin a career-long engagement with the Oedipus myth that would lead to his formulation of the 'Oedipus complex'.

Oedipus' encounter with the Sphinx, in which he solves the famous riddle, is richly represented in Freud's collection. As patients entered Freud's consulting room, they would be met with several Egyptian, Greek and Roman Sphinxes, as well as a print of Ingres' *Oedipus and the Sphinx*, depicting Oedipus in the very act of riddle-solving, suggestive perhaps of the psychoanalyst unravelling the riddle of the hysteric's symptom. The project culminated in January 2025 with a conversation between Miriam Leonard and Robert Icke, the award-winning playwright and director of a successful West End production of *Oedipus*, on the impact of Freud on the arts today.

I (Maria Wyke) am leading a research project called *Museum of Dreamworlds*, which will be largely completed by the end of the UCL at 200 year. We ask: how did early cinema design its beautiful Greek and Roman dreamworlds (often in ways never taken up by later cinema)? What did cinema gain from recreating the distant past? What did that past gain from being recreated in moving images? In May 1913, for example, the internationally successful Italian feature film *Quo vadis* was exhibited with full orchestral accompaniment for four weeks in the prestigious surroundings of the Royal Albert Hall. It led the way in establishing cinema as an art form acceptable to the middle classes. Critics admired its accomplished adaptation to screen of a novel about Nero's persecution of the Christians and burning of Rome, its spectacular realism (based largely on the sumptuous antiquarian detail of nineteenth-



Terracotta sphinx from Sigmund Freud's collection. Southern Italian, fifth–fourth century BC.

century paintings representing ancient Rome) and its apparently religious and pedagogical significance.

To answer our questions, we are working in partnership with the British Film Institute National Archive to investigate the treasure trove of silent film prints that survive there, including a little-known British epic about Boadicea, queen of the Iceni, that has been languishing in pieces for a century. Our goal is to establish a website where many of these films will be made accessible, accompanied by essays that explain their significance. The project has also made the films available through public screenings across the UK. We are developing teaching resources to ensure a future use for the films beyond academia and the archive – in cinemas, schools, heritage sites and museums. A final exhibition in UCL is due to showcase student responses to the films in the form of sketches, models or new moving images, bringing our investigations right up to date.

Miriam Leonard is Professor of Greek Literature and Its Reception. Maria Wyke is Professor of Latin.

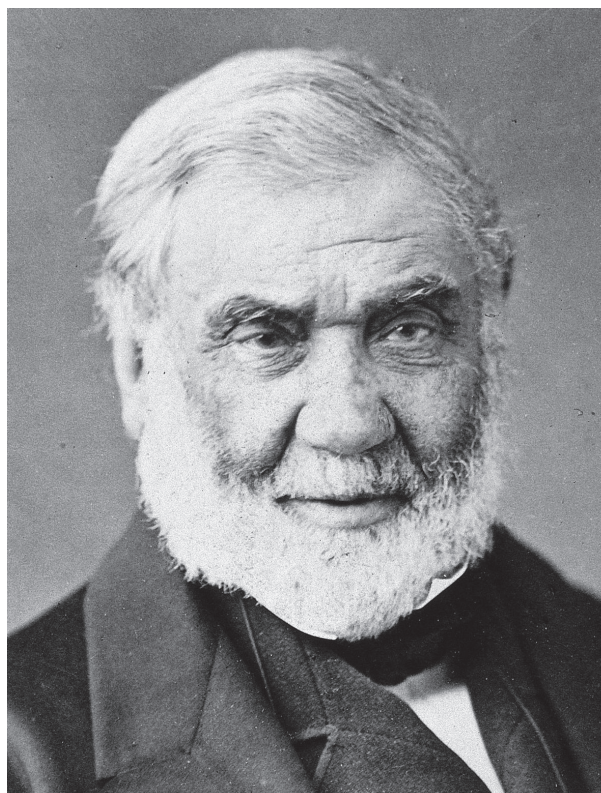
The radical origins of modern foreign languages at UCL

Ulrich Tiedau

Among the most radical innovations at UCL's foundation was not only the new institution's often-quoted openness to students from denominations and religions other than Anglicanism, but also the introduction of subjects not previously taught at university level – foremost among them modern foreign languages (MFL). Many of the earliest university chairs in these disciplines in England (and often in the Anglophone world at large) were established here and filled with political refugees from their respective countries of origin. In doing so, the founders of London University, as UCL was known at the time, deliberately sought to distinguish the new institution from Oxbridge, where, with the exception of French, only classical languages formed part of the curriculum. By appointing exiles from continental Europe, the founders also made a public statement about the revolutionary ideas espoused by these scholars, enabling UCL to cultivate its identity as a radical counter-institution to England's traditional seats of learning.

The most enduring fame of these appointments would be acquired by Antonio (from 1869 Sir Anthony) Panizzi (1797–1879), the first incumbent of the Chair of Italian. A member of the *Carbonari*, clandestine cells of liberal, republican and anti-clerical revolutionaries striving for the unification of Italy, he was arrested in 1822. After escaping to Switzerland, where he published a pamphlet denouncing the regime in his native Duchy of Modena, he was sentenced to death *in absentia*, before making his way to London, where Henry Brougham, one of UCL's founders, secured his appointment to the newly created professorship, as well as, somewhat later, to the post of assistant librarian at the British Museum. Panizzi held both positions concurrently until 1837, when he was promoted to Keeper of Printed Books (and later Principal Librarian in 1856). Proposing a 'uniform

programme be adopted for the study of all modern languages and literatures' at UCL, his most notable contributions as a librarian include the establishment of systematic cataloguing rules in 1841, which remain foundational to international bibliographic standards today, and the design of the iconic circular reading room. The British Library, as the former museum library has been known since 1973, continues to hold an annual lecture in his memory. Panizzi's successors at UCL were refugees from pre-unification Italy as well: first Carlo Pepoli (1796–1881), author of several opera libretti for Rossini and Bellini, who in 1831 had served in the short-lived revolutionary government of the Romagna; followed in 1848 by Antonio Gallenga (1810–1895), a member of Giuseppe Mazzini's Young Italy and would-be regicide of King Charles Albert



Photograph of Anthony Panizzi by Elliott & Fry.



Portrait of Antonio Alcalá Galiano by Vicente Palmaroli, c.1866-70, oil on canvas.



By appointing exiles from continental Europe, UCL's founders also made a public statement about the revolutionary aspirations of these scholars.

Portrait of Ludwig von Mühlenfels by Wilhelm Hensel, 1829, pencil drawing.

of Piedmont–Sardinia, who had become Italian correspondent of *The Times*.

The Chair of German was first occupied by Ludwig von Mühlenfels (1793–1861), son-in-law of Friedrich Schleiermacher and friend of Felix Mendelssohn. Mühlenfels had studied law in Greifswald and Heidelberg, where he emerged as a leading figure in the early German student fraternities, at that time known for their liberal-revolutionary aspirations. After entering the civil service in 1816, he became a target of the crackdown on liberal supporters of the unification of Germany by the Prussian government. Arrested in 1819, Mühlenfels was persecuted as an enemy of the state, with the author E.T.A. Hoffmann,

though sympathetic, being his interrogator. Incarcerated and dismissed from office, he managed to escape from prison in 1821 and fled by boat to Sweden. In 1827, while en route to join fellow Prussian exiles in Mexico, Mühlenfels passed through London and was instead appointed by UCL. A jurist by training, he became England's first Germanist. Although he eventually returned to Prussia after securing his rehabilitation at home, his syllabus, published in the 1831 UCL calendar, continued to be used by his successors and a Chair of German has been filled almost continuously ever since.

Like Panizzi and Mühlenfels, Antonio Alcalá Galiano (1789–1865) was known for revolutionary activities

in his home country. Born in Cádiz, the prominent politician and man of letters had supported the liberal Spanish Constitution of 1812 and participated in the *Trienio Liberal* (1820–3), which aimed to establish a constitutional monarchy. Forced into exile after the restoration of absolutist rule by Ferdinand VII, he became UCL's first Professor of Spanish in 1828. His scholarly work included critical writings that helped introduce Spanish Romanticism to a broader audience, alongside extensive publications on Iberian history and politics.

French, of course, was taught at UCL from its inception as well, by Pierre-François Merlet (1785–1866). Born to a curator of the French royal art collection, he had been smuggled out of France as an infant during the Revolution and in 1836 was promoted to a full professorship.

In the early twentieth century, these foundational chairs were followed by the establishment of the first departments for Scandinavian (1917) and Dutch studies (1919). This expansion of MFL provision was shaped by the post-war climate, which was, as Pieter Geyl (1887–1966), the first Professor of Dutch Studies, recalled in his 1942 memoirs (written in a Nazi internment camp in the occupied Netherlands), 'very much in favour of international cultural exchange between the peoples, and London back then tried to become a large international centre in this respect'. Enabled by donations from Anglo-Dutch business circles in London and initially co-located at UCL and Bedford College, this was the first such programme in the Anglophone world, and Geyl, famous for his reinterpretation of the history of the early modern Dutch Revolt, and, after 1945, for his BBC debates with Arnold Toynbee, managed to give it 'the aura of controversy, the lifeblood of the Humanities'.

Two years previously, in 1917, Scandinavian studies had been established at UCL. Although the appointment in 1828 of Mühlentfels, born in Swedish Pomerania, had already been for 'German and Northern literature', in practice he focused primarily on German. The teaching of Scandinavian languages and culture was now formally institutionalised, largely due to the initiative of the renowned Scottish essayist and Quain Professor of English Language

and Literature William Paton Ker (1855–1923). Having taught Icelandic to students of English for years, he became director of the first Department of Scandinavian Studies in Anglophone academia and devoted himself to 'the thing dearest of all to him, the study of what Scandinavia had contributed to the world'.

Numerous other so-called 'foreign' chairs were founded in London around the same time, many under the auspices of the School of Slavonic and East European Studies (SSEES), originally affiliated with King's College (1915). Having operated as an independent college within the federal university from 1932, SSEES joined UCL in 1999, complementing the range of MFL subjects taught at the School of European Languages, Culture and Society (SELCS), into which the six foundational language departments were merged in 2010, as well as the departments of Hebrew & Jewish Studies, and Greek and Latin, both integral parts of UCL since its foundation. Together with the School of Oriental and Asian Studies (SOAS), a separate institution across the road (founded in 1916; the Chair for 'Hindustani', modern-day Hindi and Urdu, was transferred from UCL to SOAS on the occasion), Bloomsbury arguably boasts one of the largest, if not *the* largest, range of MFL subjects taught anywhere in higher education.

Ulrich Tiedau is Professor of European History.

Slade Material Research Project and Network

Jo Volley



The Pigment Timeline, by Jo Volley, 2014. The Pigment Timeline is a visual timeline of natural and manufactured colour and a unique, innovative display of quantitative information. It is made from 180 pigments bound in gum arabic, ordered chronologically, from the Neolithic to the contemporary, as they emerged onto artists' palettes.

The Slade Material Research Project (MRP), established in 2010, aims to promote the investigation and advancement of material knowledge and develop the relation between thinking and making for all Slade students. Based in the Methods Room, which acts as a materials laboratory, it provides weekly workshops, guided exploration and a methods surgery to resolve

material-related problems, such as painting supports and surfaces, pigments and dyes, and the properties of industrial paints and varnishes. MRP's activities are also supported by a network of honorary research fellows, scientists in residence and conservators in residence who provide their expertise through a lunchtime lecture series, advisory sessions and specialist activities.

A significant outcome of the MRP is the Pigment Collection of more than 1,000 specimens that span the history of natural and manufactured colour, with samples from a range of sources including a major contribution of historic specimens from the Winsor & Newton Archives. The collection has spurred collaborative research projects between academics across and outside UCL, including 'Colour & Emotion: A Non-Verbal Wellbeing Measure', an interdisciplinary project looking at colour, sensation and emotion. It brought together artists, a human geographer, a speech and language therapist, and a group of adults with acquired communication difficulties (aphasia) in a series of co-production workshops in 2017. The workshops explored how we can use colour to create a visual language for expressing feelings and emotions. The 'Colour and Emotion Toolkit' was co-designed out of the workshops, and five prototypes of the toolkit were produced. The broader aim of the research was to think through how colour can be used to establish a non-verbal approach to measuring wellbeing creatively.

Since 2019 the MRP has held an annual international cross-disciplinary symposium, 'Colour & Poetry', including an exhibition and publication to celebrate International Colour Day, World Poetry Day and World Pigment Day. The symposium hosts a range of speakers representing the arts and humanities, science and industry. Drawing upon knowledge from within and outside the UCL community, it includes presentations, readings, performance and practical workshops. It is a place for artists, scientists, historians and conservators to collaborate, experiment and analyse materials.

The latest MRP initiative is the Pigment Farm, which aims to propagate plants in order to explore the world of natural dyes and develop an understanding and low-tech practical knowledge of growing and manufacture. The farm also aims to enrich the environment and create an everyday opportunity for the UCL community to experience the cultivation of colour and engage in wellbeing activities. UCL logo planters can be viewed on the Wilkins Terrace.

Jo Volley is Coordinator, Material Research Project and Network.



Samples from the Material Research Project Pigment Collection.



The UCL Pigment Farm planters were made possible by the UCL Campus Experience Team.

English language and literature: the 'great reigns'

Dennis Duncan

There was a feeling that we were slightly different from other English departments in having more immediate contact with a wider world of letters.

Frank Kermode

On the evening of Monday 21 January 1828, the Council of the new London University (as UCL was then known) convened for its weekly meeting. A terse line in the minutes records the first item of business: 'The Council proceeded to fill up the Chair of English language & literature when the Revd Thos Dale AM [i.e. Master of Arts] of Corpus

Christi College Cambridge was elected.' With this, not only did the new university become the first in England to have a Professor of English, but the two-pronged arrangement of the discipline – language and literature – was formalised. Two centuries later, we are a whole department rather than a single professor, but we are still 'language and literature', and so is everywhere else.

Dale's appointment was not a long one. Accounts vary over whether he left because of the university's godlessness or because it didn't pay him enough, but by 1830 he had moved on, and it would be a couple of decades before any of his successors stuck around for more than a short spell. The change came with the appointment of David Masson in 1853. Masson, taking over from the poet Arthur Hugh Clough



Members of the UCL English Department in 1917. Four teaching staff are in the front row: Elsie Chick; Gregory Foster; W.P. Ker (Quain Professor); R.W. Chambers. (A further two – J.H.G. Grattan and A.C. Wood – were absent on war service.)

(who managed only two years), was the first of our Great Reigns. It was Masson, too, who initiated the connection between UCL English and the literary magazines which remains one of the department's distinguishing characteristics (see p. 73). He was an established journalist when he arrived, and became editor of *Macmillan's Magazine* while in post.

When, after 12 years, Masson left us for Edinburgh, his replacement was Henry Morley, another journalist, who had worked with Dickens on *Household Words* and *All the Year Round*, as well as editing the radical weekly *The Examiner*. Morley was indefatigable, both as a writer and as a campaigner for the expansion of literacy. On top of his teaching, he wrote essays and biographies, the vast *First Sketch of English Literature* and the 10-volume *English Writers*. In the wake of the Education Acts of the 1870s, his short prefaces to the 200 or so cheap and cheerful editions of the classics in the Cassell's National Library series introduced the English canon to a newly literate public. Morley was also heavily involved in UCL's drive towards admitting women. The college's fee books show that in the first three years of the 1880s nearly 200 women were registered for Morley's classes, many of whom became prominent themselves in the movement for women's education.

It was late in Morley's tenure that the department received its first endowment for a named chair. Henceforth there would be a Quain Professor of English Language and Literature. Then, in 1928, the family of the newspaper magnate Alfred Harmsworth provided funds for another, the Lord Northcliffe Chair of Modern English Literature, cementing the link between the department and the broader literary world by adding the proviso that its holder should be 'an eminent man of letters'. In practice, the two chairs have come to represent the lang/lit duality that was first set in place with Thomas Dale: the Quain Professor is typically a philological or linguistic appointment, while the Northcliffe

represents what John Sutherland (a recent occupant) referred to as our 'journalistic/belletristic tendency'. There is, nevertheless, a looseness to this convention: Rosemary Ashton was a recent Quain, while others like Stephen Spender and A.S. Byatt have been more famous for their writing than their teaching, without occupying the Northcliffe.

In the late 1960s, the department was presided over by Frank Kermode (Northcliffe) and Randolph Quirk (Quain). Between them, these two redesigned the undergraduate English degree: a thicket of option modules branching out from a compulsory core of Chaucer, Shakespeare and the Renaissance. With one eye on the post-war universities, the revised syllabus aimed at a balance between old and new, maintaining the 'traditional concerns' of UCL English while presenting an overall offering 'appropriate to a modern honours school'. Naturally, this being UCL, Kermode and Quirk wrote up their new model and its rationale in an article for the *Times Literary Supplement*. 'We should not care to repeat the experience of remodelling the programme at any early date,' they groused. 'But we are not under the illusion that this new structure can avoid the fate of the old: it will suffer the unimaginable touch of time and, sooner or later, decline like its predecessor into obsolescence.' Maybe so, but I wonder whether the authors' modesty disguises their awareness of tradition within UCL English. Would they really be surprised that the degree they designed, like the character of the department as a whole, should be altogether recognisable at so many years' distance?

Dennis Duncan is Associate Professor in English.

Contemporary Hasidic language and culture

Lily Kahn, Naftali Loewenthal and Sonya Yampolskaya

Contemporary Hasidic language, culture and society is a unique interdisciplinary research area developed by scholars in the UCL Department of Hebrew & Jewish Studies. Hasidism is a variety of strictly Orthodox Judaism centred on the figure of the *rebbe*, or spiritual leader, and incorporating Jewish mystical teachings. The Hasidic movement originated in late eighteenth-century Eastern Europe and became hugely popular among the Jewish population in that region over the following century. Hasidism exemplifies a striking aspect of modern Jewish history in that even though its main pre-war centres, and populations, in Eastern Europe were destroyed in the Holocaust, it has succeeded in regrouping and rejuvenating itself in new locations such as the UK (London's Stamford Hill), Israel (Jerusalem and Bnei Brak), the US (the New York area), Belgium (Antwerp) and Canada (the Montreal region).

UCL scholars have made particularly groundbreaking contributions to research on the role of women in Hasidism. While for many years it was claimed that women have always had only a peripheral role within Hasidism in general, and none at all in the Hasidic leadership, the late Ada Rapoport-Albert's research highlighted womanhood as fundamental in the vision of the sixth and seventh *rebbe*s of the Habad Hasidic dynasty (1880–1950 and 1902–1994 respectively), further demonstrating that women can be not only full followers in the Hasidic movement, but also *tsaddikim*, i.e. spiritually exalted individuals, the pinnacle towards which Hasidim strive. Rapoport-Albert's research on women dovetails with that of Naftali Loewenthal, who has interrogated the popular conception of the Hasidic enclave as an insular society isolated from the wider world, demonstrating that some Hasidic groups such as Habad have expansive relationships with society at large while maintaining their own traditionalism.

Lily Kahn and Sonya Yampolskaya have examined Hasidic society from a sociolinguistic perspective, with a focus on the communities' use of Yiddish and Hebrew. Yiddish is the traditional language of Ashkenazic (Central and Eastern European) Jews, but

most speakers were murdered in the Holocaust and it is now highly endangered in most of the Jewish world. Only in Hasidic communities does Yiddish continue to flourish as an everyday language of speech and writing. Despite its remarkable endurance, Hasidic Yiddish has been ignored by most Yiddish specialists. Kahn and Yampolskaya, in collaboration with a team of researchers from UCL Linguistics led by Kriszta Eszter Szendrői, recently transformed this narrative by conducting a major research project on Hasidic Yiddish worldwide. The project found that contemporary Hasidic Yiddish exhibits its own features of pronunciation, grammar and vocabulary and should be regarded as its own independent variety of the language. The project also led to the world's first research on contemporary Hasidic Hebrew, which resembles historical Ashkenazic varieties of the language and is fundamentally distinct from modern Israeli Hebrew. In addition, PhD researcher Keren Rubner is the first to conduct sociolinguistic fieldwork on the unique variety of English spoken in the Stamford Hill Hasidic community.

Finally, Kahn and Yampolskaya are conducting research on contemporary Hasidic Yiddish-language literature, a thriving area which includes thrillers, family dramas, comics (see opposite), popular science, Jewish and Hasidic history, Yiddish language-learning manuals and more. This vibrant and largely unknown body of literature offers an intriguing insight into Hasidic culture and society as well as serving as a rare case study of a minority-language publishing industry that has achieved great levels of success in the twenty-first century in the total absence of state subsidies or other top-down support.

Our research on the Hasidic Jewish community – a central yet poorly understood element of the contemporary Jewish world – highlights UCL's legacy of fostering intercultural understanding through its research, a legacy which dates back to its very founding in 1826 as the first university in England to admit Jews.

Lily Kahn is Professor of Hebrew and Jewish Languages. Naftali Loewenthal is Associate Professor (Teaching) in Hebrew & Jewish Studies. Sonya Yampolskaya is Research Associate in Hebrew & Jewish Studies.



Page from *The Quarrel*, a Hasidic Yiddish comic. Text by Noyech Rubin, art by Dan Bar-Lev.

What was Stonehenge?

Mike Parker Pearson

Archaeologists and geologists have been working together to find out where Stonehenge's stones came from. The results may be more than just a matter of record; they may be an important clue for discovering the purpose of Stonehenge and the very reason why it was built. The famous monument is unique among stone circles for its raised lintels and also for the majority of its stones being shaped. But there is a third reason why it is unique.

Unlike all other prehistoric stone circles, Stonehenge was built entirely out of stones brought from far away. Around 80 standing stones – known as 'bluestones' – were brought 140 miles from the Preseli Hills in west Wales, probably shortly after 3000 BC when Stonehenge was first constructed as a henge – a circular ditched enclosure – which served

as a burial ground as well as a stone circle. A few stones of sarsen (a silcrete or hard sandstone) may have also been erected at this time. Fragments of broken sarsen stones that may derive from this first Stonehenge reveal origins as far away as Brighton.

The second Stonehenge was built around 2500 BC, largely taking the form in which we see it today. Its 80 or more sarsen stones, some weighing as much as 30 tonnes, were hauled 15 miles from West Woods to the north, not far from Britain's largest stone circle at Avebury. Laid horizontally within the centre of Stonehenge, the Altar Stone is the furthest-travelled, having been transported over 450 miles from northern Scotland.

UCL researchers have been working with geologists and archaeologists from other universities



Stonehenge, looking towards midwinter solstice sunset.

to find out what was so important about these distant places that they should provide stones for Stonehenge. The Preseli Hills appear to have been particularly significant, lying within a Neolithic monument complex centred in the valley of the River Nevern in Pembrokeshire. Among the dozen sources of the bluestones in Preseli, three were outcrops where monoliths were extracted by Neolithic quarry-workers. As well as investigating an unfinished stone circle at Waun Mawn, the UCL-led team has been excavating a group of four henges at Crosswell which may have been where the bluestones were first erected as stone circles before being dismantled and taken to Stonehenge.

For Neolithic people, megalithic stones had ancestral significance, binding people to place and

origins, and signifying the eternal in contrast to the transient world of the living. Sometimes they were associated with the actual remains of the dead, as at Stonehenge. They might also be incorporated into monuments with significant astronomical alignments, notably the rising and setting of the Sun at the solstices, as in passage tombs such as Newgrange in Ireland as well as at Stonehenge. Ultimately, Stonehenge may have had a political as much as a religious purpose – as a monument of unification for the people of Britain, celebrating their eternal links with their ancestors and the cosmos.

Mike Parker Pearson is Professor of British Later Prehistory.



Excavations of one of four henges at Crosswell, Pembrokeshire, looking towards the Preseli Hills where many of Stonehenge's bluestones are sourced.

Breaching the fourth wall: literary criticism and 'the common reader'

John Mullan

In the 1980s, when I was a PhD student, academic literary criticism turned away from what Dr Johnson and Virginia Woolf called 'the common reader'. It was the era of Theory in literary criticism (comically skewered in the campus novels of David Lodge, who had studied for both his BA and his PhD in the English Department at UCL). Academics adopted the lingo of structuralism and deconstruction, learning to write in ways that only the initiated could understand.

We had all heard of the literary theory seminar run in the English Department at UCL by its then head, Frank Kermode, where luminaries like Roland Barthes came to explain themselves. Yet when I arrived in Foster Court in 1991, I found that my new UCL colleagues presumed that literary criticism was open to all curious readers, not just those with PhDs. The visits of those star theorists had, in fact, been but one aspect of the department's engagement with cultural debate beyond the university. As part of this, participation in the wider world of journalism, publishing and broadcasting was encouraged, as was reaching out to that 'common reader' (see p. 73).

Being in London gave you the chance for this; it was possible to meet editors and broadcasters. I started writing about literature for newspapers, eventually contributing a weekly column to the *Guardian*, in which I tried to show how critical terms and concepts could throw light on particular contemporary novels. Each month I took a recent novel (by J.M. Coetzee or Zadie Smith or Margaret Atwood) and tried to show how it worked. I was allowed to do lit. crit. on popular fiction too: on John le Carré or Ruth Rendell or Nick Hornby. The newspaper just gave me a word limit and asked me to trust the intelligence of its readers.

Academics invariably date the high point of literary culture to their own middle age. Me too. I look back on the late 1990s and early 2000s as halcyon days for popularising literary criticism. Once a week, the *Evening Standard* had four pages of book reviews and

features. The *Guardian* seemed hungry for literary content. When Steve Coogan, for instance, starred in a film of Laurence Sterne's zany eighteenth-century novel *Tristram Shandy*, the paper commissioned me to write a 3,000-word piece explaining the attractions of the novel. When the features editor on G2 heard of the shortlist for the T.S. Eliot Prize for poetry, he asked for an equally long piece surveying contemporary British poetry: who were the leading lights? What were their stylistic idiosyncrasies?

Even TV still did culture seriously. On *Newsnight Review*, which shared the studio with BBC 2's *Newsnight* every Friday, critics argued about a mix of films and plays and exhibitions – and always a new book (usually a novel). Often the compere was Mark Lawson, who had also read English at UCL. Soon I was one of the regular guests. The test of doing literary analysis for a non-academic audience is severe. Anyone who has been asked to summarise the qualities of a great writer live on Radio 4's *In Our Time* knows how severe. It is the tougher as the host, Melvyn Bragg, has strong views about English literature. The quantum physicist gets only respect; the literary critic (me!) gets told that he is wrong about Jonathan Swift.

My time at UCL coincided with the rise (but now perhaps dwindling?) of the literary festival. The burgeoning of these events would never have been possible without a growing audience for literary fiction and literary debate. For the *Guardian*, my column on 'Elements of Fiction' also turned into a live event with leading writers, mostly novelists. The trick was that we discussed not their new book – which no one had yet read – but the book that readers knew (and usually loved) best. This meant quizzing Hanif Kureishi about *The Buddha of Suburbia* or taking Doris Lessing back almost half a century to *The Golden Notebook* (her recall was total). From the early 2000s until Covid, I conducted over 150 of these. Having started off as an eighteenth-century specialist, I found myself, almost

by mistake, becoming an expert on contemporary fiction. In 1999, my head of department, John Sutherland, had been a judge of the Booker Prize (in 2005 he was chair of the judges). In 2012, I too was a Booker judge and read over 130 novels that year. (Hilary Mantel won for the first time, and certainly had my vote.)

While newspapers have faltered and TV abandoned books, there remains an appetite for literature beyond the classroom and lecture hall. One of my areas of academic interest has always been the fiction of Jane Austen, who attracts more non-academic interest than any other great British writer. Over the last 20 years, perhaps half the talks that I have given outside the university, from Hay-on-Wye to Moscow, have involved Austen's novels. I even found that it was possible to publish a serious book

of literary criticism for the general reader – if it was about Jane Austen. I only hope that students from my UCL Jane Austen seminars down the years, who recognise in it their own insights, disguised as my own, will be flattered and not indignant.

John Mullan is Professor of English Literature.



Jane Austen, a popular subject of serious criticism for the general reader.

While newspapers have faltered and TV abandoned books, there remains an appetite for literature beyond the classroom and lecture hall.

Pioneering fieldwork: from rescue archaeology origins to commercial excellence

Louise Rayner

UCL Archaeology South-East has an enduring legacy at the forefront of British archaeology. Since 1974, the Institute of Archaeology has been home to a professional archaeological practice. The 'Sussex Archaeological Field Unit' originated both as a response to coordinate what was then known as rescue archaeology – excavations taking place before development – and as a way to train the Institute's students in archaeological fieldwork. The policy and funding basis for our work has evolved considerably over the last 50 years, and Archaeology South-East, as we have been known since 1996, is now a leading provider of developer-funded commercial archaeology and heritage services, predominantly working with construction and development clients on projects required as part of the UK planning system. Our commitments to undertaking high-quality research work, developing professional standards and training the next generation of archaeologists have remained constant.

We work on hundreds of projects each year, from individual buildings to multi-hectare housing and infrastructure developments. We have a multi-disciplinary team of more than 100 archaeologists skilled in excavation, historic building survey, artefact studies, illustration, conservation, archiving, public engagement and much more. We ensure the archaeological remains we uncover, not seen for hundreds, sometimes thousands of years, are carefully recorded and preserved for future generations.

Our excavations have transformed the understanding of southern England's archaeological story and unearthed internationally significant discoveries, from 300,000-year-old giant handaxes from Kent, to excavations that have revolutionised understanding of prehistoric settlement across the Sussex Downland, Coastal Plain and the Weald. From 'warrior burials' that capture elite mortuary rites on the cusp of the Roman conquest, to richly furnished



Field archaeologists clean up the remains of a rectangular timber structure, identified as the remains of the stage at the Elizabethan Red Lion playhouse, found during excavations in Whitechapel, London, in 2019.



Historic buildings specialist Michael Shapland at work ahead of redevelopment and restoration at the Brighton Corn Exchange, April 2017. Part of the Brighton Pavilion complex, this structure was originally built as a riding school for the Prince Regent, c.1805.

Anglo-Saxon cemeteries with beautiful personal belongings that tell of complex movements of people and goods from Europe and beyond. From the timber remains of the lost Red Lion in Whitechapel, the earliest purpose-built Elizabethan playhouse in Britain, to the highly personal unsent love letter written in 1918 by a soldier convalescing in the Brighton Pavilion complex, found within a wall cavity during survey work.

Our work also places us at the forefront of responses to climate change. We've been involved in recording archaeological monuments before they're lost to the sea through coastal erosion, like Seaford Head's Iron Age hillfort in West Sussex, and making recommendations for their future management. Our excavations as part of the largest flood management scheme in Europe, near Selsey, West Sussex, uncovered evidence for thousands of years of human

activity and habitation from the Mesolithic through to the post-medieval period.

Our archaeological work is about creating social value – making a positive impact on people, places and the environment. Archaeological stories enable people to connect with their past, improve their wellbeing and celebrate places that mean something special to them. Archaeology can be an evocative and inspiring catalyst for creative outputs, and by providing opportunities to engage with the past we aim to inspire local communities not only to share in the knowledge our work creates, but also to use it to shape their own futures and the world around them.

Louise Rayner is Director, Archaeology South-East.

Poetry at the Slade

Sharon Morris

The Slade memorial to those who lost their lives in the First World War bears the name of Isaac Rosenberg, who studied at the Slade from 1911 to 1914; his first searing poem from the trenches was published in 1916. Testament to how art and poetry may go hand in hand, Rosenberg opened the path for artist-poets at the Slade, a tradition that continues.

The filmmaker Derek Jarman, for example, was a Slade student in the 1960s. His work *Blue* (1993), together with his other films and writing, lays out the formal and conceptual possibilities of the spoken and written word within art of many forms: film, video and installation; painting and sculpture; artists' books, zines and poetry objects.

I was a student at the Slade in the 1970s and am currently a member of staff at the school. The image (opposite) from my artist's pamphlet *Gwales/Wales* (2013), set in west Wales, follows two collections of poetry. Juxtaposing photographs and poetry, the work addresses place through geology, *Mabinogion* myths, history, climate, and the use of both English and Welsh:

There are those who don't believe
in their existence –
Pryderi and his men of *Y Mabinogi*

caught in the eternal . . .

forgetting their losses and grief
until they opened

the one forbidden door,
to the flood of memory, history
fresh and bloody . . .

Sean Borodale (a Slade alumnus and teaching fellow 2002–7), printmaker and poet, whose book *Bee Journal* was shortlisted for the T.S. Eliot Prize in 2012, wrote his first collection *Notes for an Atlas* (2003) based on his daily walk into the Slade. This

fluid and innovative work articulates a visual straining at the alliterative poetics of the flaneur: 'See pylons and wires on sunset like skeletons of cinder. Read SCARE WAS. Air brown as mackerel. See the eye of a chestnut. See grey leaves on bone stems . . .' Borodale continues to make large-scale text prints and also writes for performance.

Recent Slade alumni include artist-poets Mataio Austin Dean and Lily Petch. Dean explores voice, songwriting and printmaking as part of an activist practice addressing colonialism. Petch continues her research into histories of the book and material inscription; her first pamphlet, *From Stone to Clay, to Butter*, was published in 2024.

The Slade Poetry Shed, a fulcrum for poetry workshops, which I run with Slade staff member and alumna Christine Kirubi (2014–18), brings together students from across the Slade.



Isaac Rosenberg, self-portrait, 1915.



Pages from *Gwales/Wales* (2013), by Sharon Morris.

Kirubi's first collection, *Wildplassen*, was published by the87press in 2024; her writing glides between English, French and Flemish, drawing translations into a centripetal force articulating an abyss:

een dwang
second movement
dat ik niet nodig heb

die niet van mij is

fear arpeggaic. The sounds they must
 have heard,
 believing it to be descent & macropolitic's
 fine mist
 particles of their damp colour.

Slade Poetry Shed participants have contributed to the Newcastle Poetry Festival; to Slade 'Colour & Poetry' events, organised by Jo Volley (see p. 82); and to the 'Spineless Wonders' network of artists,

writers, librarians and others researching small press collections.

Poetry and creative writing remains a central practice at the Slade, drawing on various traditions and cultural inheritances and continuing to innovate across languages and the visual.

Sharon Morris is Professor of Fine Art.

**The Slade Poetry Shed,
 a fulcrum for poetry
 workshops, brings
 together students from
 across the Slade.**

'Design is visualisation of emotion': Yolanda Sonnabend, fine artist, theatre and film designer

Liz Rideal

Yolanda Sonnabend (1935–2015) was the archetypal Slade artist: multi-faceted and multi-talented, recognised internationally as a brilliant portrait artist with a knack for capturing likeness and as a world-class ballet and stage set designer.

I first encountered Sonnabend's work at her Serpentine Gallery retrospective in 1986. The show was brimming with ideas: Venetian-style leather masks, paintings, drawings and stage design work. It was a fascinating, avant-garde, cross-media cultural celebration that broke subject boundaries and made vibrant original visual connections. Consequently, I invited her for a residency/open studio that I was curating at the National Portrait Gallery, and was impressed by her friendly enthusiasm and natural abilities. Her commissioned portraits of Kenneth MacMillan, director of the Royal Ballet, and Stephen Hawking, theoretical physicist and cosmologist, are among seven works now in the NPG collection. The Hawking portrait has attained iconic status. Sonnabend made three further interpretations of the sitter, now in the Science Museum and the universities of Oxford and Cambridge. In her portrait of MacMillan one senses the close bond of their thirty-year creative partnership, and her portrayal of Steven Berkoff is a masterpiece of compressed energy; one feels his personality about to unfurl like a wound-up spring. Of her sitters, she remarked, 'Dancers do exactly what you want. . . actors want to be like something. . . captains of industry always sit the same way, glancing sideways.'

In 1990, we met again when I started working at the Slade and Sonnabend was teaching alongside Peter Snow and then Philip Prowse on the stage design course. This had been set up in 1929 by Vladimir Polunin, who had designed for Diaghilev and the Ballets Russes. I was struck again by her relaxed personality, petite frame, dark eyes and long black hair. She exuded warmth and glamour. She was of

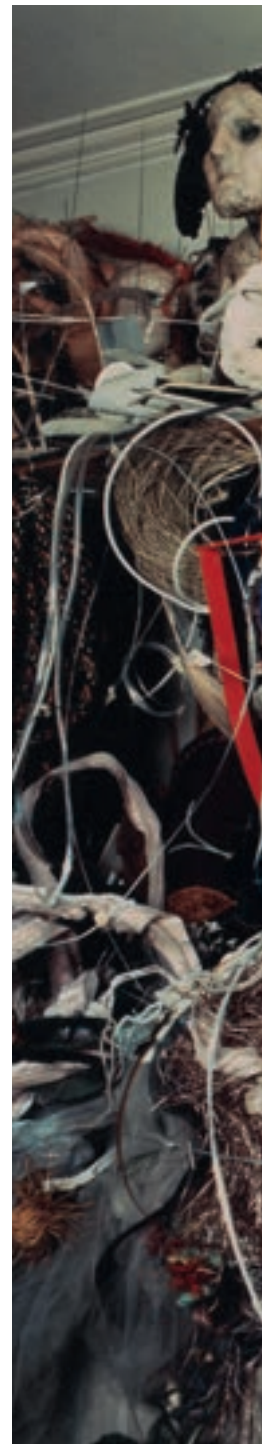
German and Russian descent; her parents had met at Padua University and in 1930 they had emigrated to South Africa. Yolanda came to study at the Slade (1955–60), winning joint first prize in painting in 1957. That same year, her first ballet design was produced, and in 1963 she created the first of many designs for MacMillan, all at the Royal Opera House. She also designed *Swan Lake* (Dowell's production, 1987) and *La Bayadère* (Makarova's production, 1989). For ex-Slade student Derek Jarman's film *The Tempest* (1979), she evoked a decaying mansion house. Yolanda said that design was not decoration, that this hybrid art form needs to be arresting and vibrant. She recalled Diaghilev's challenge to Cocteau, 'Etonne-moi!' ('Astonish me!'); in response, he created the scenario for the ballet *Parade* (1917), designed by Picasso and composed by Satie.

In 2005, her brother Joseph, a world-renowned AIDS physician, returned from New York to care for her, and their nephew Thomas Burstyn made a film, *Some Kind of Love*, about their complicated relationship. Set in their St John's Wood house, the film is poignant and raw, documenting Sonnabend's dementia as well as her passion for life.

Her paintings, drawings, designs and maquettes are in the Victoria and Albert, Fitzwilliam, Wellcome, British and UCL Art museums. Her archived work is held in the Royal Opera House, the University of Bristol Theatre Collection and the University of Edinburgh; this latter is devoted to her collaborative work with the biologist and embryologist C.H. Waddington.

Sonnabend was modest about her achievements. I remember asking her one evening where she was going. She replied that she was off to take the 24 bus down to Trafalgar Square in order to watch the live-streaming of *Swan Lake*.

Yolanda Sonnabend photographed by Mayotte Magnus, 1977.





Design is not decoration – decoration is something added on. Design is visualisation of emotion, so that the dancers’ bodies illuminate and add to the drama. It’s also about beauty, showing something that people haven’t seen before. Good ballet design should have what great art has, and that is ‘shock’. Diaghilev said, *Etonne-moi!* [surprise me!]. It should slightly change you to see it, make you say, oh, I didn’t expect that, how beautiful.

Yolanda Sonnabend

Liz Rideal is Professor of Fine Art, Painting.



Tournier: Masks and Reflections, by Yolanda Sonnabend, oil on canvas, 2000.



3

Environments

The detection of H_3^+ in the aurora of Jupiter

Steve Miller and Jonathan Tennyson

It was formed in the early universe before the first stars switched on some 100–200 million years after the Big Bang. Reckoned to be abundant all over the cosmos, it was not until 23 September 1988, however, that H_3^+ showed up in an astronomical object, and then not at all where it was expected but in the auroral light shows of the giant planet Jupiter.

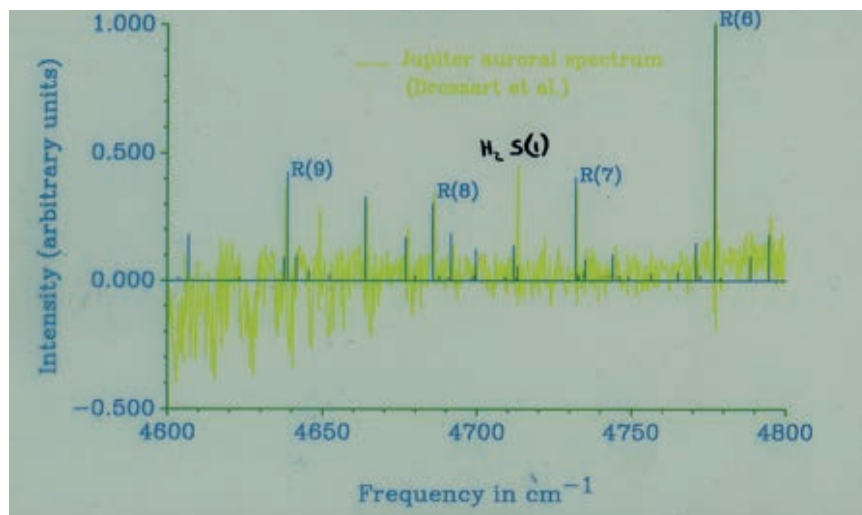
The simple triatomic molecule H_3^+ is most definitely primitive. It consists of three positively charged hydrogen nuclei (protons) held together in a roughly triangular formation by just two negatively charged electrons. The surplus positive charge gives H_3^+ the 'plus' in its name. It was first detected in the laboratory by the eminent British physicist J.J. Thomson in 1911 when he passed a high-voltage spark of electricity through pure hydrogen gas.

Chemistry in 1911, however, had difficulty believing that H_3^+ could possibly hang together. But the new science of quantum mechanics, developing alongside Thomson's pioneering experiments, finally recognised H_3^+ as a stable molecule in the decades after its first detection leading up to the Second World War.

Given that so much of the universe is hydrogen gas pervaded by powerful starlight and strong electrical currents, astronomers felt sure that H_3^+ should show up sooner or later in the vast molecular clouds, known as the Interstellar Medium or ISM, that fill our Milky Way and other similar galaxies. But later was getting later and later, despite the sterling efforts of many astronomers.

To find and identify a new molecule you really need its spectrum, a set of fingerprint emissions through which chemicals announce their presence. Often this is in a wavelength region known as 'infrared', wavelengths longer than red light – heat waves. To do that required high-precision laboratory measurements *plus* accurate computer calculations of individual spectral frequencies and the strength of each emission. That is where our team came in.

There was intense discussion among astronomers about finding H_3^+ 'somewhere out there'. Its laboratory



Spectrum of Jupiter's southern auroral region taken on September 23, 1988 (yellow). Superimposed, the H_3^+ spectrum of the higher energy $2\nu_2(l_2=2)$ overtone spectrum calculated by Miller and Tennyson (blue) in October 1988.

spectrum was finally measured at the University of Chicago, in 1980. Between 1986 and 1990, we then worked out just what the full spectrum should look like in the spectral regions where it was measured and others where it was not. But it was still a complete surprise when, in 1988, a group of astronomers, led by Pierre Drossart of the Observatoire de Meudon outside Paris and using the Canada–France–Hawaii Telescope on the summit of the extinct Hawaiian volcano Maunakea, found a series of unidentified emission lines in the auroral atmosphere of Jupiter.

Drossart and his colleagues had been looking for infrared emissions from the neutral hydrogen molecule H_2 – the most abundant molecule in the universe by far. They found it. But the lines they found in addition to H_2 initially defied identification. Finally, via Ottawa and Chicago, the spectrum arrived at UCL in London. We were able to identify it as the elusive H_3^+ through our calculations – not the original laboratory spectrum but a higher-energy version that had been seen but not previously identified. The result was announced in 1989 in the prestigious science journal *Nature*.

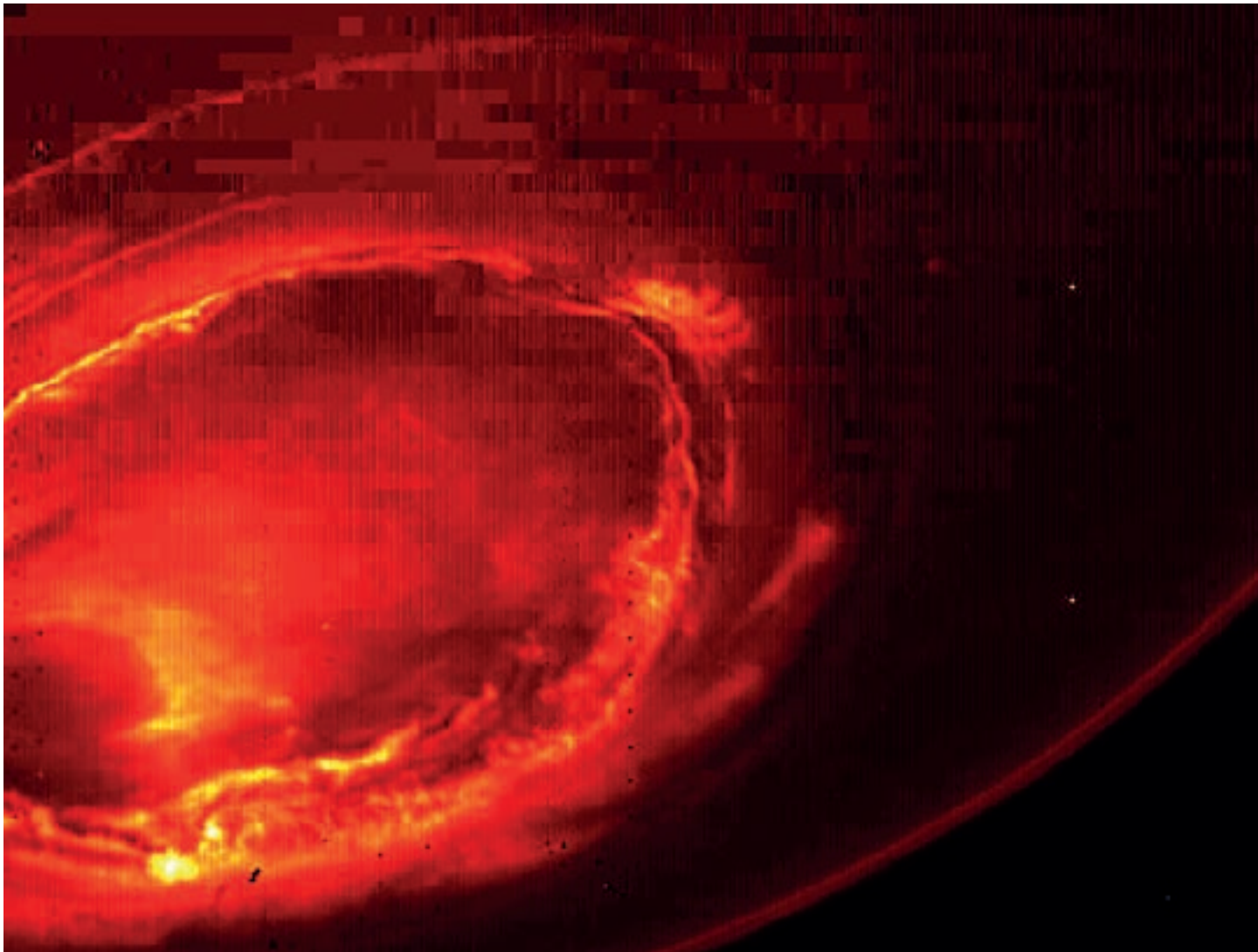
The resulting *Nature* paper even managed to give a temperature of the gas, thanks to the line intensities that the UCL team calculated – ‘in the range 1,000–1,200K’ – and proposed: ‘Such strong H_3^+ lines could be used in future ground-based monitoring [of Jupiter’s aurorae] and to search for this molecule in the interstellar medium.’

Quite: nowadays, H_3^+ telescopes from Hawaii to Chile and in situ and Earth-orbiting spacecraft are routinely measuring and mapping H_3^+ emissions from Jupiter, Saturn, Uranus and – soon – Neptune in our own solar system, and from giant interstellar gas clouds in the Milky Way including the violent regions right at the galactic centre. With new spacecraft and observatories, what we have learned from our

own astronomical neck of the woods can be applied to exoplanets orbiting stars other than the Sun and galaxies ‘far, far away’.

Not only that, but the computational and theoretical techniques of the UCL group have also now been applied to over 100 other molecules of astronomical significance in the ExoMol project, providing scientists with vital data for understanding global warming, the functioning of the Sun, plasma physics applications and many other uses.

Steve Miller is Emeritus Professor of Science Communication and Planetary Science. Jonathan Tennyson is Massey Professor of Physics.



Jupiter’s southern aurorae imaged by the JIRAM infrared camera on board NASA’s JUNO mission on 27 August 2016, at wavelengths between 3.3 and 3.6 microns sensitive to H_3^+ .

Particle physics: discovering and understanding bosons

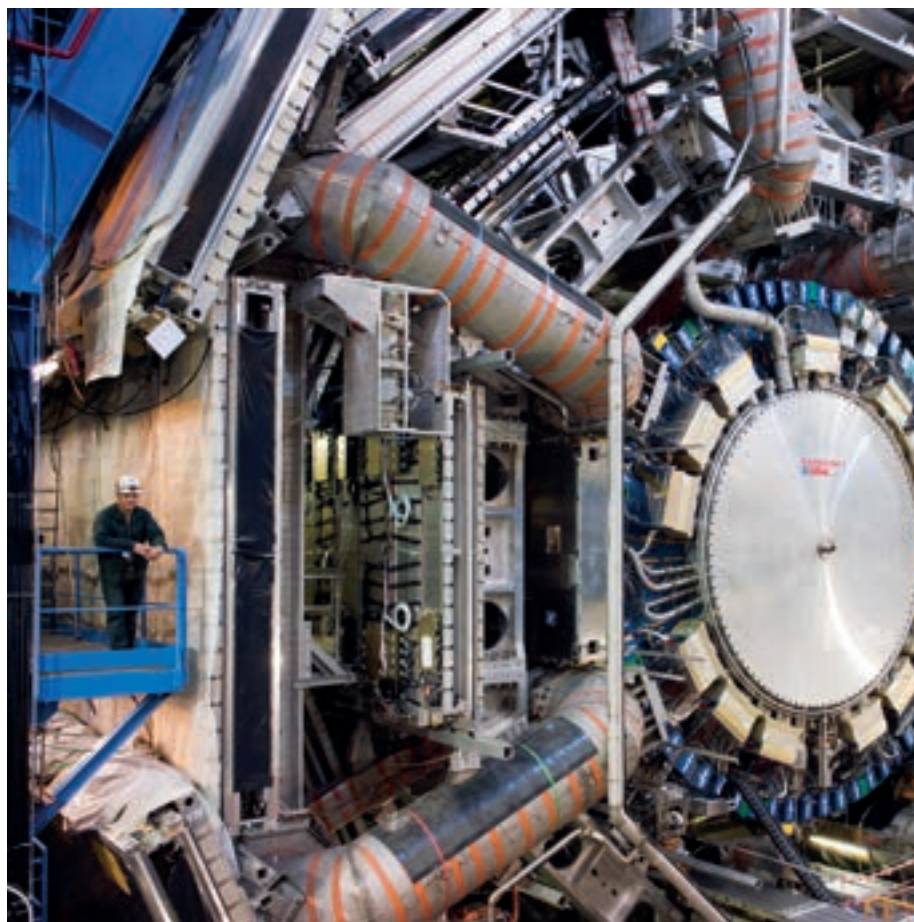
Jon Butterworth

Bosons are a class of particle playing a key role in our current understanding of the smallest constituents of matter. They are named after the Indian physicist Satyendra Nath Bose, and are defined by the fact that they carry an integer quantum unit of angular momentum. Classically, angular momentum is a measure of how much an object is spinning around an axis; the quantum version of this comes in discrete amounts, and whether a particle has a half unit or an integer unit of 'spin' has a profound effect on its behaviour. Matter particles such as the electron have half units, whereas the particles which carry forces, such as the photon, are bosons, with an integer spin.

In the 1970s UCL was the only UK member of Gargamelle, an experiment collaboration at CERN, the European Organisation for Nuclear Research in Geneva, which discovered 'weak neutral currents' – mediated by the Z boson. Along with the W boson, the Z carries the weak force, one of the three forces in the 'Standard Model', our current best theory of particle physics. UCL was also a member of the OPAL experimental collaboration at the CERN Large Electron–Positron Collider (1990–2000), which made the most precise measurements of the Z boson and the first measurements of the production of pairs of W bosons. In 2012, as members of a collaboration at the Tevatron in Illinois, we led the most precise measurement of the W boson mass. These measurements pointed the way towards the last remaining, and crucial, undiscovered component of the Standard Model – of which more shortly.

First, however, the other two bosons: the photon and the gluon.

The photon carries the electromagnetic force. It is ubiquitous in science and in everyday life, yet it contains multiple mysteries. At high energies it undergoes quantum fluctuations into pairs of quarks, which then interact with each other via the strong nuclear force, carried by another boson: the gluon. UCL physicists in the ZEUS experiment, a collaboration at the HERA particle collider at



The ATLAS Detector at CERN.

the DESY laboratory in Hamburg, made the first measurements of this complex phenomenon in collisions between photons and protons in the 1990s, while colleagues on OPAL made related measurements in photon–photon collisions. The distribution of gluons inside the proton was also determined at HERA, with UCL leadership, and we remain global experts in the theory behind this fundamental feature of one of the basic building blocks of the universe.

The W and Z measurements, and knowledge from HERA, were crucial for the next, and current, highest-energy particle collider: the Large Hadron Collider at CERN.



The Gargamelle bubble chamber at CERN.

In the 1960s, Peter Higgs was a lecturer in mathematics at UCL. Shortly after leaving us for Edinburgh, he wrote breakthrough papers explaining how fundamental particles could acquire mass. This mechanism, proposed independently by François Englert and Robert Brout in Belgium, became an integral part of the Standard Model, predicting the existence of one final boson, carrying no angular momentum – the Higgs boson.

Forty years on, we were at the forefront of the ATLAS experiment, one of two at CERN that discovered the Higgs boson in 2012, finally proving Higgs, Brout and Englert right. UCL physicists led early ATLAS measurements, and developed a new

way of identifying the Higgs via its most common decay products.

Higgs accepted an honorary doctorate from UCL in 2010 and, with Englert, a Nobel Prize in 2013. UCL experimentalists are now working towards observing pairs of Higgs bosons, to probe currently untested aspects of the mechanism.

These breakthroughs were achieved via wide collaborative networks, which continue to develop new technologies, techniques and theoretical advances to expand the frontiers of knowledge.

Jon Butterworth is Professor of Physics.

Automatic speech recognition

Catherine Holloway and Richard Cave

Automatic speech recognition (ASR) technology is transforming how we communicate both with people and with devices. It can improve understanding through real-time captioning of speech, and can enable hands-free computing such as dictating emails, finding information online, automatic language translation and many other uses. It can also be used for environmental control, such as changing the channel on a television, and adjusting lighting and heating.

Using ASR to interact with devices is ubiquitous: at the time of writing, more than 8.4 billion devices enable voice interaction – larger than the world’s population and double the number of devices with this capacity in 2020. However, for people living with impaired speech, ASR technology is frequently too inaccurate to be of functional benefit. This is a large group that is being excluded from the benefits of ASR technology: as many as 28–49 per cent of people with disabilities worldwide experience difficulties with communication at some point in their lives.

With specific training, ASR technology has been demonstrated to better recognise the unique natural speech patterns of individuals with impaired speech speaking in English, including people living with amyotrophic lateral sclerosis/motor neurone disease (ALS/MND), cerebral palsy, cleft palate and many other conditions, providing an opportunity for them to be better understood by others in daily life.

Additionally, if impaired speech can be used to interact with devices, it can support increased autonomy in daily life. People with impaired speech are more likely to have concurrent physical limitations – for example, almost all people with ALS/MND eventually have physical as well as speech change, and up to 65 per cent of people with traumatic brain injury may have impaired speech, as do over 70 per cent of people with Parkinson’s disease and up to 50 per cent of people living with multiple sclerosis.

With specific training, ASR technology has been demonstrated to better recognise the unique natural speech patterns of individuals with impaired speech speaking in English.

To date, however, few ASR models have been adapted for people living with non-standard speech in non-English-speaking populations, and none for African languages. ASR technology may be particularly beneficial in Africa due to the lack of speech and language therapy services and the poor availability of assistive technologies to support communication, as well as the stigmatising cultural beliefs that label disability as a curse. The result is that people with communication difficulties are frequently marginalised in society due to existing barriers and discriminatory attitudes.

To change this, UCL’s Centre for Digital Language Inclusion led by the Global Disability Innovation Hub has partnered with the University of Ghana to collect the first dataset of non-standard speech. We’ll be collecting up to a further 10 African languages across 3 countries, working with local partners and communities, and supported by Google and the AT2030 programme.

The goal is to build ASR models for each language and to co-develop applications to enable people to be better understood in the language they use. We are writing an open-source step-by-step ‘Cookbook’ – a guide of best practices for any local community across Africa (and elsewhere) to collect and transcribe non-standard (and standard) speech data in the languages of their choice and subsequently



A group of people engaged in a mobile phone training session, with a trainer assisting a visually impaired user in using a smartphone in Kenya.

build open-source ASR models and applications for the local community.

We are building sustainable local skills and innovation by providing training and ongoing mentoring of university students and other groups in each country for data collection, data transcription and the development of AI-based ASR models. We sponsor hackathons to encourage local innovators to ideate use-cases for the datasets and ASR models to better meet practical community needs, and provide opportunities for ongoing mentorship and seed funding to productionise local initiatives. In this way we foster skills creation and autonomy that enables the development and use of ASR technology in ways that may work better for local communities and in the language they prefer to speak.

Our approach adopts a 'community-up' approach to utilising and applying AI technology that includes

the language and cultural needs of impaired speakers from the start. This approach may meet local needs better than relying on the current 'top-down' one-app approach that is unlikely to be able to recognise the granularity of many local requirements and is less likely to empower local communities to innovate to their specific needs.

Catherine Holloway is Professor of Interaction Design & Innovation, and co-founder and Academic Director of the Global Disability Innovation (GDI) Hub. Richard Cave is Research Fellow at the GDI Hub and Co-Director of its Centre for Digital Language Inclusion.

Genetics and eugenics: UCL's legacy

Adam Rutherford

Genetics is a field not much more than a hundred years old, which makes it a newcomer in the grand pantheon of scientific enquiry. The word 'gene' was only coined at the very beginning of the twentieth century. Yet genetics has come to dominate the entire world of biology, the study of life. This is simply because genetics underlies all living things. After all, it is merely the study of sex, families, inheritance and disease, and these have been the preoccupations of humans since long before the discovery of DNA.

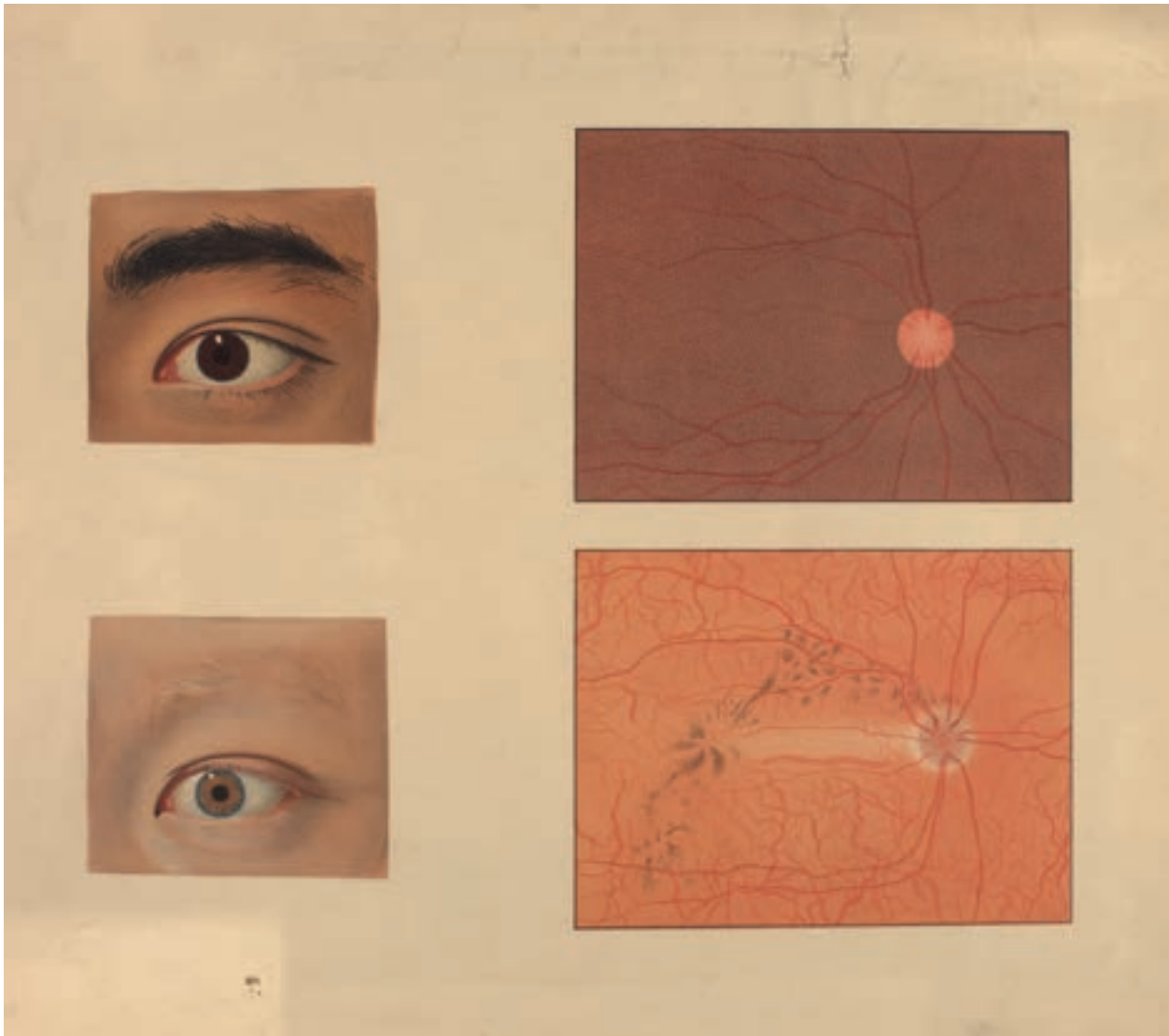
While physicists have been straining to come up with a 'grand unifying theory' for the last 3,000 years or so, biologists nailed ours in the space of about 150 years: cell theory states that all life is made of cells, which are only ever born of other cells; evolution

by natural selection needs little introduction, as it's arguably the best idea anyone ever had; chemiosmosis, less well known, but also fundamental to all life, states that all life relies on maintained energetic imbalances in cells; and universal genetics says that the instructions for all living things are written in DNA. Life, powered by chemicals, is made of cells derived from other cells and evolves via modified descent. That's it; everything else is details.

UCL's role in these grand unifying theories is fundamental. Charles Darwin was an independent scholar, though he spent time living in digs on Gower Street where our labs and offices are named after him. Cell theory and chemiosmosis were developed in Germany and Cambridge respectively, though the quintessentially collaborative and international



Francis Galton's anthropometric laboratory, South Kensington, 1884.



Watercolour illustrations of human eyes from the Galton Collection, 1915.

nature of science means that it is not sensible to pin them down to one location. UCL's biggest role in this story is in genetics and evolution. There is much to be proud of in our history: we hosted some of the most significant contributors to modern biology, notably in the fusion of Darwinian evolution with Mendel's discovery of the particular nature of inheritance in his famous pea plant experiments. In labs that were the direct ancestors of the current Department of Genetics, Evolution and Environment, men such as Karl Pearson, Ronald Fisher and J.B.S. Haldane crunched the numbers, invented new statistics and even did some experiments that revealed the mechanism for natural selection. In

doing so, they resolved how evolution works, and gave to the world a raft of statistical techniques that are fundamental to our contemporary understanding of how the world works.

Pearson and Fisher were incredible scientists and also virulent eugenicists. Pearson was quite explicit that much of his scientific work was in service of the political ideology of eugenics, and Fisher was committed to research and promotion of eugenics policies from at least the age of 18 until he died. Their views, not at all atypical for their time, are not palatable to ours, and their names were removed from UCL's estate in 2020 following a two-year Provost's inquiry.

They were the first two Galton professors, a role that still exists today, and was founded as part of the legacy to UCL of Francis Galton, Darwin's cousin, and a man of huge significance in shaping the twentieth century. As well as inventing many statistical tools himself, devising the weather map, doing pioneering work in forensic fingerprinting and inventing a new way to cut round cakes, his main legacy was as the founder of eugenics – the political ideology that encourages societies to impose restrictions on reproduction in order to improve the health and wellbeing of the people. That phrasing makes it sound positive, but of course the underlying question is: who gets to decide? What characteristics are desirable and which are not? What type of person is granted reproductive rights, and who is not? Who gets to decide who lives and who does not?

Eugenics was broadly supported by the political left and right (Pearson was a socialist, Fisher very conservative; Churchill was a driving advocate, as was Beveridge). First-wave feminists were often keen eugenicists, not least another UCL alumna, Marie Stopes, now best known for the clinics that bore her name, which provided reproductive healthcare, advice and abortions for tens of thousands of women. She was also a virulent eugenicist and racist whose interest in reproduction in women was at least in part due to her extreme hostility towards Jews, the Irish and other groups of people. She wrote love poetry and sent it to Hitler in 1938.

Eugenics is one of the central ideas of the twentieth century. The UK never had any formal eugenics policies, but the United States, influenced directly by Galton, had enforced sterilisation on the books of the majority of states for much of the twentieth century. More than 70,000 Americans were sterilised against their will or knowledge under the guise of some very misplaced and misunderstood genetics. Eugenics was also a central pillar of the Holocaust in Nazi Germany, where policy was influenced legally, scientifically and financially by US eugenicists, and the founder of Nazi eugenics, Alfred Ploetz, was another disciple of Galton.

Reproductive control is an old idea, a way of thinking that pre-dates eugenics, and hasn't gone away since it became a toxic idea. Nevertheless,

Reproductive control ... was an ideology from which the legitimate science of genetics emerged. UCL is central in this story.

Galton is the central figure in rejuvenating and 'sciencifying' it. It was an ideology from which the legitimate science of genetics emerged. UCL is central in this story, but we mustn't overegg our role. Many of the scientific ideas of inheritance found root in our labs, because we hosted some of the scientists and thinkers in the cultural milieu in which genetics and evolutionary biology flourished. Did that research influence eugenics policies globally? Yes, but no more than dozens of other establishments around the world.

We like to think that science is free from the psychological and cultural baggage we all lug around as people in society. The saga of eugenics at UCL and well beyond is a case study in our failure to see those biases. Science is not above the grubby worlds of politics and personalities, even if the ideal is. Perhaps in a hundred years' time, our intellectual descendants will look at our work today and condemn us – our inaction on climate change, how we eat, our views on mental health or sex and gender. Who knows what we will be judged for? But we study these histories and expose them in order to minimise the risk of repeating the sins of our forebears. I was an undergraduate in the same department where I am now a lecturer, once called the Galton Laboratory, and teach the courses I attended as a first year. We should be proud that we learnt this history in the first weeks of the first term, taught by Steve Jones. This teaching was unique: the histories of eugenics and genetics are inextricably entwined, but many if not most universities kept the science separate from the politics.

Celebrating science without contextualising it is cheerleading, not history. In the field of genetics,

we have plenty to be both proud and ashamed of, for we have a pernicious history. But the trajectory of that history is worth celebrating. The role of science historians is to analyse past events and people, not merely to lionise our intellectual forebears. UCL's role in the story of eugenics is important, and will continue to be scrutinised as these ideas continue to percolate in today's world. Pearson, Fisher and Haldane were unequivocally brilliant scientists, and profoundly flawed. 'Men of their time' is sometimes how we casually grant them immunity, though I don't know how anyone can not be a person of their own time.

Our ongoing responsibility is intellectual honesty. We must teach their politics as well as their science,

for they are inseparable. Haldane, initially a supporter of eugenics, evolved into a major opponent, on learning of the poor-quality science being used to justify hateful policies in the US and Germany in the 1930s, and wrote in 1938, 'I do not believe our present knowledge of human heredity justifies such steps.' But perhaps we should all and always heed the words of the man in whose light all biologists toil, in whose building we work: Darwin wrote in 1871 that 'Ignorance more frequently begets confidence than does knowledge'.

Adam Rutherford is Lecturer in Biology and Society.



Women working in the Galton Laboratory, early twentieth century.

The structure of benzene: Dame Kathleen Lonsdale and Sir Christopher Ingold

River Riley

Benzene is one of the iconic molecules of chemistry. The sweet-smelling hydrocarbon was first discovered by Michael Faraday at the Royal Institution in 1825, and while chemists soon established that the molecule consists of six carbon and six hydrogen atoms, its structure was a mystery. For the rest of the century chemists would argue over the structure as they tried to explain benzene's baffling mix of simplicity and chemical inertness.

One proposed structure, a flat hexagon of linked carbons each bearing a single hydrogen, proposed by the German chemists Josef Loschmidt and, more famously, August Kekulé, seemed to explain many of its chemical properties. Yet it would not be for 100 years after its discovery that the structure of benzene would be confirmed experimentally by two brilliant and academically diverse UCL chemists: Kathleen Lonsdale (1903–1971) and Christopher Ingold (1893–1970).

Irish by birth, but educated in London, Lonsdale had caught the attention of William H. Bragg, UCL's Quain Professor of Physics, who offered her a PhD studentship. Bragg (with his son) had won the Nobel Prize for pioneering the use of X-rays to interrogate the structures of solids. Lonsdale would later recall the offer as 'a luxury' and one she 'jumped at'. Over the next few years, she would develop the mathematical basis of this technique and began to focus her attention on organic molecules.

In 1927, when her husband secured an academic position, she moved to Leeds. Combining a part-time position with various pots of funding, she assembled an X-ray kit of her own. In Leeds she met Christopher Ingold, then Professor of Chemistry, whose work was focused on the chemistry of benzene and its derivatives. Ingold provided Lonsdale with large crystals of hexachloro- and hexamethylbenzene, suggesting that with them she might be able to resolve the controversy over the structure

of benzene itself, which was liquid rather than a crystalline solid.

With her new kit, Lonsdale passed beams of X-rays through the crystals and took a series of careful photographs. From these she observed more than 100 X-ray 'reflections' or photographic spots as the X-rays scattered through the regular arrays of molecules. After endless and repetitive calculations that Ingold would later say 'must have been dreadful', Lonsdale showed that cores of these molecules were indeed planar and hexagonal. From the vantage point of today, when computer-assisted crystallography allows the structures of large molecules to be determined from scratch in a matter of an hour, it was an astonishing achievement. The tediously repetitive calculations were done by hand with the aid of tables of logarithms and trigonometric functions. Her work on these and other molecules would lead to an exhaustive tabulation of mathematical shortcuts that would start to make crystallography more accessible.

In 1930, Ingold had been appointed to one of two chairs of chemistry at UCL. By 1933, he was starting to unravel the detailed mechanisms of the reactions of benzene. To do this he began to use some of the new spectroscopic techniques that were becoming available, especially infrared and Raman spectroscopy, methods that are attuned to the vibrations of the molecules, and exquisitely sensitive to their symmetry. Might these methods provide yet more evidence for Loschmidt–Kekulé–Lonsdale structure?

Ingold and his students began to record the spectra of ordinary benzene but also a series in which the hydrogen atoms were replaced with the heavier isotope deuterium. This substitution does not change the geometry or the internal forces of the molecules, but it reduces the frequency of the absorption bands observed in these spectra. To do this work, Ingold's students separated water from heavy water by using a distillation column that ran from the basement to the

top of what is now the Kathleen Lonsdale Building. It reportedly baffled a visiting inspector from HM Customs and Excise, but provided a steady supply of what was then a material available only from Norway. The work was conducted in the basement with apparatus so sensitive that some measurements could only be done during the night when the Circle Line trains didn't run. We still have some of these precious samples, while the Hilger spectrometer is in the Science Museum.

By combining force-field calculations with symmetry rules, Ingold and his students methodically assigned the bands they observed in their spectra to specific vibrations in each of the molecules and by 1946 could report that they had unpicked the

internal force system of the benzene molecule. It was now the turn of quantum chemists to provide a theoretical explanation for benzene's symmetry, but the structural questions were solved.

In 1944, as the Blitz faded, Ingold was appointed Vice Dean for Science, putting him in pole position to shape the reconstruction of UCL, which had suffered badly in the bombing. Ingold was equipped from the outset. Crystallography was central to Ingold's strategy and in 1946 he appointed his former Leeds collaborator as Reader in Crystallography. Two years later the deal was sweetened with a £2,500 grant to pay for the latest X-ray equipment.

Today, the Chemistry Department occupies labs in buildings named after both Ingold and Lonsdale. While historians may highlight the solutions to the mysteries of benzene, this story is about so much more. It reflects the true strength of UCL's community and its basis in the meeting of minds, interdisciplinary collaboration and especially collegiality.

River Riley is Associate Professor (Teaching) of Chemistry.



Kathleen Lonsdale in the lab.

The work was conducted . . . with apparatus so sensitive that some measurements could only be done during the night when the Circle Line trains didn't run.

Separation and turbulence

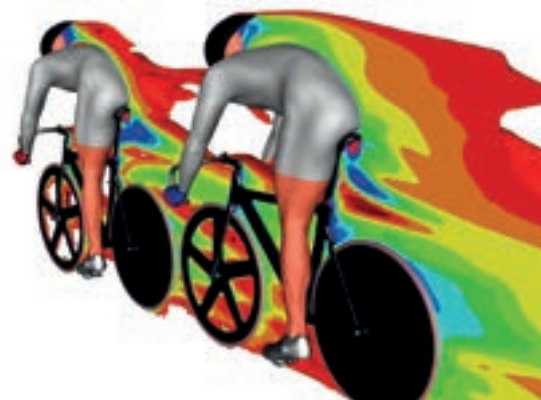
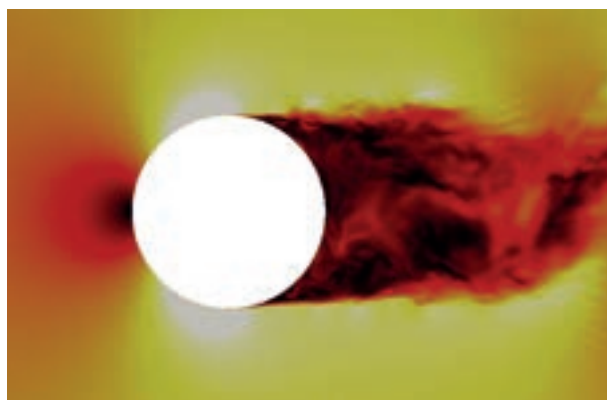
Frank Smith

If the air flow past a plane wing is not streamlined enough, the lift force falls and the plane may crash. Research into this phenomenon was originally about helping to make flight safer and more efficient by careful mathematical prediction; similar aims apply to land and sea travel. Throughout the nineteenth century and most of the twentieth century researchers struggled to model separation, where the air flow past the wing begins to deviate enormously from being streamlined. Modelling this deviation mathematically on a correct physical basis is crucial to the prediction of lift and drag forces in many real applications, such as for blood flow in biomedical applications. The breakthrough came in a seminal 1969 paper by Keith Stewartson and Peter Williams of UCL Mathematics. They originated triple-deck theory, explaining with mathematical precision the separation from the underlying wing surface. This had vast repercussions. It meant that researchers could go on to deal with non-streamlined flow at last. Examples are: the safe flight of supersonic and hypersonic vehicles; dynamic stall, showing how jet fighters could execute rapid tight turns safely and passenger aircraft manoeuvre better; and predicting blood flow through constricted vessels. The development has also led to a wider explosion of insight and development by UCL, its partners and many international contacts. The main centres were, and are, in the USA, Russia

and the UK, especially UCL, involving multidisciplinary teams of applied mathematicians, engineers and experimentalists supported by government and companies in terms of aerodynamic applications. The mathematical reasoning is still a hot topic because it admits fundamental physical understanding and predictions, complementing numerical simulations.

The very same triple-deck theory also explains the behaviour of the famous Tollmien-Schlichting instability waves (first observed in the 1930s) in fluid dynamics, along with the subsequent onset of deep transition to turbulence. An offshoot, vortex-wave interaction, again developed at UCL in collaboration, is fundamental to the structure of turbulence itself. Also exciting in execution and impact are the latest topics, which range widely over such diverse arenas as sports applications, ice formation, biomedical applications, stone skipping and the behaviour of honeybees. The image below left shows our mathematically modelled separation with turbulence for a spherical body, while that on the right illustrates the application to modelled cyclists in Olympics preparation, where separation and turbulence crucially affect the body positions and clothing. Similar effects are in aero, car and ship travel, swimming, F1, nature and more.

Frank Smith is Emeritus Professor of Applied Mathematics.



Separation and turbulence: a mathematical model, and a real-world application.

If the air flow past a plane wing is not streamlined enough, the lift force falls and the plane may crash. Research into this phenomenon was originally about helping to make flight safer and more efficient by careful mathematical prediction; similar aims apply to land and sea travel.



Understanding separation is crucial to the rapid tight manoeuvres undertaken by jet fighters.

Pioneering the communication revolution

Polina Bayvel and John Mitchell

UCL has played a pioneering role in transforming how we communicate since the field emerged in the nineteenth century. Our academics have revolutionised how information is transmitted using electromagnetic waves in different media: over air, copper and optical waveguides and optical fibres. In 1884 Ambrose Fleming joined UCL as Chair of Electrical Technology, the first role of its kind in England. He recalled in his autobiography that the only equipment provided to him was a blackboard and a piece of chalk.

However, in 1896, the International Submarine Telegraph Memorial Committee (of which Fleming was a member) made a decision to commemorate the contributions of Sir John Pender, the Scottish submarine cable pioneer. The committee donated £5,000 to UCL to be 'devoted to the advancement of technical education', and this fund was used to establish the Pender Chair of Electrical Engineering and to start the Pender Laboratory. The Pender Chair is now one of the most prestigious chairs in electronic/electrical engineering; Ambrose Fleming was its first incumbent and the head of what is now the Department of Electronic and Electrical Engineering. He was followed by many giants in the field, including Harold Barlow, Eric Ash, D.E.N. Davies, John Midwinter and Hugh Griffiths, all of them pioneers in communications.

When Guglielmo Marconi decided to attempt transatlantic radio communication he contracted Ambrose Fleming in 1899 as a consultant to Marconi's Wireless Radio Company. Marconi had come to Britain from Italy, hoping the Royal Navy would become a customer. But the navy was not convinced by Marconi's wireless technology and the ability of radio waves to travel 'over the horizon', requesting a 'proof of principle' demonstration.

In 1901 Fleming designed the transmission station at Poldhu in Cornwall, which in December that year would transmit the first radio signals over some 3,000 km from Poldhu to St John's in Canada,

a feat that many had predicted was impossible. Although Fleming was responsible for the design, Marconi's company had made Fleming agree that 'if we get across the Atlantic, the main credit will be and must forever be Mr Marconi's'.

Accordingly, the worldwide acclaim that greeted this landmark accomplishment (and a Nobel Prize in 1909) went to Marconi. This incident was an early precursor of the challenges of technology exchange. Fleming went on to invent and patent the thermionic (diode) valve, regarded as the basis of modern electronics, and the now universal 'left- and right-hand rules' to determine the direction of forces and currents in magnetic fields for motors and generators.

Following work during the Second World War to develop radar stations at RAE Farnborough, Barlow and Alexander Cullen conducted groundbreaking research on microwave waveguides, including the development of the circular H10 waveguide. During this period, Barlow supervised an external PhD student working at the famous STL labs in Harlow, Charles Kao, who was awarded his doctorate in 1965 for a thesis entitled 'Waveguides for millimetric and submillimetric electromagnetic waves'. Kao became known as the 'father of fibre optics' for demonstrating in 1966 the light-conducting properties of fine strands of glass and proposing that it should become the universal telecommunication transmission medium, an audacious proposal at the time. Kao was awarded the Nobel Prize for Physics in 2009 in recognition of his achievements in optical communications. This area, which has enabled the growth of the internet, has become one of the signature strengths of the Department of Electronic and Electrical Engineering, as has the area of computer networks.

In 1973, Peter Kirstein joined UCL and led a team from the then Department of Statistics and Computer Science to work on connecting

the UK to the fledgling internet – then called the ARPANET – and to undertake many of the earliest networking experiments including the first European implementation of the Transmission Control Protocol (TCP), which ensures the reliable delivery of data across a network, and the first ever international test of TCP between UCL and Stanford.

In 1993, I (Polina Bayvel) joined the then Pender Chair, John Midwinter (who led the first optical fibre systems development in BT Research Laboratories), as a Royal Society University Research Fellow with the brave goal to start the first academic systems engineering research group in multiwavelength optical communications. Thus the Optical Network Group was born in 1994. With my team I established the first state-of-the-art, multiwavelength high-speed recirculating optical fibre systems and a network test-bed, used in academic and industrial collaborations throughout the world. The test-bed advanced the use of all properties of light to increase the rates of data transmission, from 2.5 gigabits per second in 1997 up to several hundred terabits per second during 2024, an increase of some five orders of magnitude or 100,000 times. The current rates would allow a user to download the entire Netflix library in less than a second. In the wireless domain, UCL teams have successfully sent data over the air at a speed of almost 1 terabit per second over a record frequency range of 145 gigahertz, and have pioneered developments in antennas and radar research for climate, sensing and defence applications.

In the past 140 years, communications research appears to have come full circle: from the Pender Laboratory and the work of Fleming to today, UCL has led the world in communications research, advising government and industry on the way forward. Optical fibres underpin the critical national digital communications infrastructure and the cloud and must provide ubiquitous high



Fleming's right-hand rule, depicted on a glass slide used in teaching and probably drawn by Fleming himself.

bandwidth when and where it is needed. The next phase of UCL research will focus on exploring future optical networks to meet the demands of AI-driven applications by pushing bandwidth boundaries, increasing network resilience, while reducing complexity and energy consumption. I (John Mitchell) am proud of the world-leading role that the department and the Faculty of Engineering Sciences have had in training the next generation of communications engineers, and in innovating in and revolutionising the way engineering is taught.

Polina Bayvel is a Royal Society Research Professor and Professor of Optical Communications & Networks, Department of Electronic & Electrical Engineering; John Mitchell is Professor of Communications Systems Engineering and Head of Department.

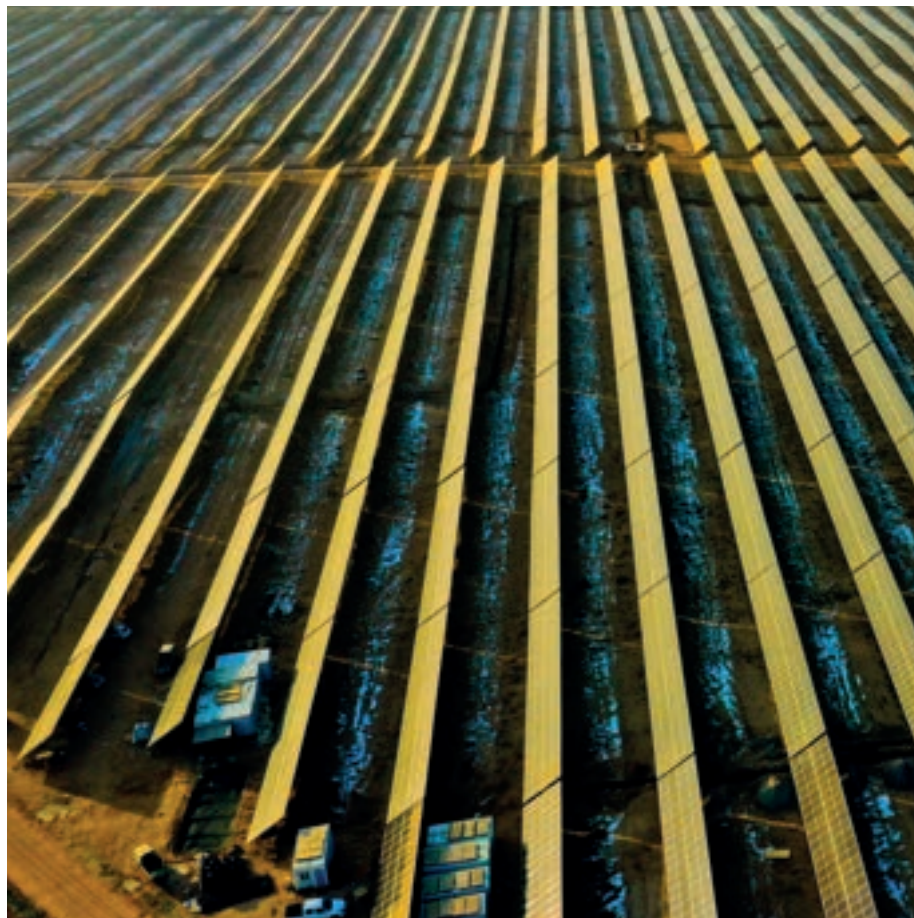
Reforming electricity markets for net zero

Michael Grubb

Electricity market reform does not sound like a hot research topic, but consider this. Between 2014 and 2020, CO₂ emissions from UK electricity more than halved, the output from renewables grew from 5 to 35 per cent of generation, and the cost of renewables plummeted. In September 2024, the country once dubbed 'an island of coal in a sea of oil and gas' closed its last coal plant, with a record of emissions reduction outstripping any other major economy. The major reason was electricity market reforms enacted in 2013 – drawing on the academic research of previous years.

If that was such a success, why is the UK now embarking on another major programme of market reform? The answer, quite simply, is because of the success. The energy crisis that erupted late in 2021 laid bare the reality of a marginal-cost electricity market in which gas still set the price, even though half the generation was from non-fossil sources. We are just starting to see periods in which renewables set the price, based on operating costs and historic subsidies – with electricity prices suddenly dropping to zero, or negative – or in which they are paid not to generate, when the grid can't cope. This is unsustainable. As renewables start to dominate the system, issues of time, location, transmission and storage all start to matter hugely. So does demand-side flexibility, including the possibilities for local solar PV or electric vehicles to sell back and hence help balance the grid.

Building on prior research into industrial electricity pricing at the UCL Institute for Sustainable Resources, a series of influential Working Papers in 2022 on the theme 'Navigating the Energy–Climate Crises' highlighted the central need for a joined-up approach to electricity market design and regulation which recognises and supports this future. This drew interest from companies which now recognise the net zero transition as an opportunity – but only with an intelligent market design to facilitate the huge range of investments required across the system.



An aerial view of a solar power plant under construction in the desert in north-west China's Gansu province. Plants grown under solar panels will reverse desertification in the area.

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We proposed a new venture designed to help the UK solve the unprecedented challenges posed by the move towards a 'net zero' electricity system, based heavily on renewables. The engineering itself is but one element: I had become convinced that no one (including myself) knows how to organise relevant markets, regulate such a system well, or design and sequence the policies required to get there.

During 2023 we developed proposals for a new 'UCL Centre for Net Zero Market Design'. Relevant research needs some flexibility, to apply underlying knowledge to the challenges arising in a timely way. Industry engagement and data are also crucial to ensure informed research and inject independent ideas for tackling barriers that industry faces –

we needed good working relationships with the energy industry, as well as government. So a key challenge was to secure core funding, in a structure that protects our independence while allowing our research to pivot to the areas of greatest impact.

Spurred by initial collaboration with the energy company SSE Services plc, we collaborated with UCL's Office of Vice-President (Advancement) to develop an innovative corporate partnership seed-funding model. In 2024, we achieved the critical number of philanthropic partnerships to enable the Centre to formally launch. A research plan has been agreed to focus on the emerging challenges of surplus renewables generation, storage investment, and the issues and opportunities arising as the first major tranche of renewables come to the end of their support contracts in 2027. Other research has focused on inconsistencies in European strategy towards natural gas and resulting implications for gas prices. A related project explored the complexities of securing investment in 'hybrid' offshore assets, which combine North Sea wind with connection between the UK and the continent.

In 2024, we also secured funding for research on electricity market reforms for Chinese electricity – an electricity system 30 times the size of the UK's, which is facing many similar underlying challenges as it moves towards a liberalised market. Meetings with project partners and government agencies in Beijing confirmed that the ongoing lessons from the UK transition are not some spurious venture on a modest island, but a national spearhead of potentially global significance.

With our profile and impact increasing, we look forward to welcoming new corporate partners who wish to engage with and accelerate net-zero electricity market design and reform.

Michael Grubb is Professor of Energy and Climate Change, Institute of Sustainable Resources, and Director, UCL Centre for Net Zero Market Design.

The Lancet Countdown

Marina Romanello, Anthony Costello, Hugh Montgomery and Ian Hamilton



Fighting the West Mims Wildfire at Okefenokee Refuge, Georgia, 2017.

In 2015, the UCL-Lancet Commission on Health and Climate Change concluded that climate change is the greatest global health threat facing the world in the twenty-first century, but also the greatest opportunity to redefine the social and environmental determinants of health for the better.

The Lancet Countdown on Health and Climate Change, based at UCL, is a global research initiative that tracks the evolving connections between climate change and health. It brings together experts from various disciplines to provide annual, evidence-based assessments on the health risks of climate change,

the benefits of climate change actions and the progress of global policies.

Since its inception in 2016, the Lancet Countdown has become an authoritative voice in the field of climate change and health science. It is contributed to by nearly 300 experts from around the world and supported by 112 partner institutions, including world-leading academic institutions and United Nations agencies, and in close partnership with the World Health Organization. It is dedicated to ensuring that health becomes central to decision-makers' understanding and response

to climate change. The Lancet Countdown brings together climate scientists, engineers, energy experts, economists, political scientists, public health professionals, doctors and social scientists to update more than 50 scientific indicators annually, covering five key areas:

1. The health hazards, exposures and impacts of climate change
2. Adaptation, planning and resilience for health
3. Mitigation actions and their health co-benefits
4. Economics and finance
5. Public and political engagement with health and climate change

Each year, the Lancet Countdown publishes its findings in *The Lancet*, the world's leading medical journal, in the lead-up to the United Nations' annual climate change conference. Through data, it aims to clearly demonstrate how climate change affects our health, the consequences of delayed action and the health benefits of strong response measures. Each report is a crucial resource for understanding the connection between climate change and health. In addition to the annual global report, six regional centres led by local teams regularly publish regional reports to promote region-specific monitoring and engagement.

In its 2024 publication, findings showed that the rapidly changing climate poses record-breaking threats to the health and survival of people in all countries. Ten out of 15 indicators being monitored show an increase in health hazards, while exposures and impacts of climate change continue to reach concerning new records. In 2023, for example, people were exposed to an average of 50 more days of health-threatening temperatures, leading to a two-fold increase in the number of heat-related deaths of people over 65 than would have been expected without temperature change. Extreme precipitation and drought events are also

becoming more frequent, threatening food security. An additional 150 million people are experiencing moderate or severe food insecurity due to heatwaves and droughts compared to the annual average between 1981 and 2010. People around the world still rely on polluting, dirty fossil fuels, which are the major cause of climate change. The impact of this fuel use is record high global energy-related emissions and around two million deaths per year due to particulates from fossil fuels and a further two million deaths related to indoor air pollution from these sources. The reporting from the Lancet Countdown clearly exposes the growing death toll of delayed climate change action, and the soaring threats to people's health and survival of current climate change policies.

From 2025, the Lancet Countdown entered a new phase of work, which involves monitoring at regional and national levels to provide decision-makers with information for action, especially through the expanding network of Lancet Countdown regional centres. In the framing of public good, a deeply held belief of UCL and its partners, the Lancet Countdown continues to act as a call for action that prioritises health in all climate policies and tackles the urgent crisis of climate change.

Marina Romanello is Executive Director of the Lancet Countdown, and Proleptic Principal Research Fellow at the Institute for Global Health. Anthony Costello is Professor of Global Health and Sustainable Development and Co-Chair of the Lancet Countdown. Hugh Montgomery is Professor of Intensive Care Medicine and Co-Chair of the Lancet Countdown. Ian Hamilton is Vice Dean of Research at the Bartlett Faculty of the Built Environment and Professor of Energy, Environment and Health.

Transforming our understanding of biological diversity and its evolution

Jon Bridle and Kate E. Jones

Understanding the evolutionary and ecological processes that shape populations, ecosystems and the biodiversity they contain is one of the most important and urgent challenges of the twenty-first century. Many of these critical areas of research have very deep historical roots at UCL. UCL's first Professor of Comparative Anatomy, Robert Grant, introduced Charles Darwin to the idea that all life is connected during their time at the University of Edinburgh (see pp. 241, 108). From 1827, Grant gave the first university lectures that explicitly explored species transformation and evolutionary ideas in England. This promotion of evolution by natural selection was continued at UCL by Ray Lankester from 1847: he was one of the first to recognise the importance of a separation between cells that maintain organisms' function and those that contribute genetic material to the next generation. This insight was fundamental to the later development of ageing theory at UCL (see p. 218).

As Professor of Botany at UCL from 1890 to 1930, Francis Wall Oliver was convinced that studying organisms in the field was at least as essential as laboratory and museum studies for understanding biodiversity. In 1912, he was crucial in establishing UCL's long-term research presence at Blakeney Point in Norfolk, supporting the National Trust's acquisition of the site as a nature reserve and the construction of a dedicated field research station there by 1913. Oliver was also a champion of female scientists, running some of the first field courses that were open to both women and men. Today, the Francis Wall Oliver Research Centre remains the oldest university-run ecological field centre in the UK, continuing UCL's commitment to field-based research and teaching.

In 1913, the British Ecological Society, the first and oldest of its kind in the world, was founded at UCL, led by Arthur Tansley, who was Assistant Professor in Botany. Tansley later coined the term 'ecosystem', arguing that defining species by their interactions with

other species is fundamental to ecology, identifying biological communities as 'quasi-organisms'. Tansley helped establish the Nature Conservancy in 1949, the UK's first state conservation agency, embedding ecological expertise in public policy for the first time. This agency was the forerunner of today's Natural England, NatureScot and Natural Resources Wales.

UCL biologists in the first half of the twentieth century, especially R.A. Fisher and J.B.S. Haldane, founded the field of population genetics, which seeks to understand when and where genes can spread through populations by natural selection and how the traits that make up organisms evolve over time. They were also among the first to connect this new emerging science with population ecology, showing how the process of adaptation incurs a cost to population growth, and how complex traits like sexual reproduction evolve. Over the following decades, John Maynard Smith, George Price and Bill Hamilton developed crucial theories of social evolution and evolutionary game theory at UCL to predict the conditions where cooperation can evolve and be maintained between genes or individuals that are initially in conflict. At about the same time, Steve Jones used European snail populations to great effect to understand the spatial and temporal scale of natural selection in natural populations. Such research into evolutionary genetics remains a fundamental part of today's world-leading work in the Department of Genetics, Evolution and Environment.

Despite the pioneering role of UCL in promoting habitat conservation, by the second part of the twentieth century, biodiversity conservation tended to focus on large iconic species such as tigers and elephants, whose protection and study was often founded on anecdotal data and individuals' interests. By contrast, Georgina Mace, the founding director of UCL's Centre for Biodiversity and Environment

Research (CBER), championed the scientific and systematic study of the traits and life histories that make species and communities most vulnerable to environmental change. She asked how such non-random extinction drives patterns of biodiversity loss and its consequences for ecological resilience, as well as emphasising biodiversity's critical importance for all human economies, for our development and for social justice. Mace convinced governments to take account of the fundamental importance of biodiversity in their decision-making, and to try to avoid the less resilient, productive and just planet that biodiversity loss leaves behind.

The addition of CBER as a research centre within the Department of Genetics, Evolution and Environment in 2013 placed UCL at the forefront of understanding patterns and consequences of environmental change for biodiversity, and how variation within and among species drives ecological and climate resilience, as well as the benefits of biodiversity for human societies. Output from CBER

has had a major impact across disciplines and on policy, which was extended and amplified by the opening of CBER's People and Nature Laboratory at UCL East in 2022. This expansion of UCL's ecological and evolutionary research comes at a time when scientific understanding of the ecological crisis is both urgently needed and newly tractable, given rapid recent advances in remote sensing, genomics, computation and AI. These technologies, combined with our growing and deeper understanding of the ecology and evolution of biological communities, can help us to develop solutions to create a future we can get to safely, and to begin to live on this planet as if we intend to stay here.

Jon Bridle is Professor of Evolutionary Biology and director of the Centre for Biodiversity and Environment Research in the Department of Genetics, Evolution and Environment. Kate E. Jones is Professor of Ecology and Biodiversity, and director of the People and Nature Lab at UCL East in the Department of Genetics, Evolution and Environment.



Students and researchers at the UCL Francis Wall Oliver Field Station. The low grey building in the background is the original lifeboat house on Blakeney Point, and dates from the nineteenth century. The blue building is the new lifeboat station, which now houses National Trust wardens and exhibits.

4

Community

The UK cohort studies: telling the story of our lives

Ryan Bradshaw and Alissa Goodman

UCL is home to the oldest and longest-running series of national birth cohort studies in the world; they have been called 'the greatest scientific experiment in modern British history' and the 'crown jewels of social research'. Over the past eight decades, the studies have followed multiple generations of people from birth to older age, capturing information on their health and wealth, their education and employment, and their personal and family lives. More than 80,000 people – born in 1946, 1958, 1970, 1989–90, 2000–2 and 2022 – have shared their lives with science. Their contribution has provided evidence to inform scientific and academic debate, and shaped policy and practice in the realms of health, education, employment and social policy, among many others.

Around 7,000 known scientific publications have been published on the cohorts. In 2018–23 alone, evidence from the studies fed into 27 different parliamentary debates and was cited in almost 800 policy documents. They have also been a valuable export internationally, with academic authors from more than 200 countries using them, and inspiring and influencing the creation of numerous similar studies across the globe.

The oldest study participants celebrate their eightieth birthdays in 2026, while the youngest are toddlers. Over their lives, they've answered thousands of survey questions, undertaken detailed biomedical assessments, and given blood, saliva samples and even their baby teeth. They've been asked to perform all sorts of physical and cognitive assessments, from juggling balls and standing on one foot with their eyes closed to seeing how quickly they can pick up matchsticks – all in the name of science. They have shown extraordinary commitment and generosity to share the details of their lives for the benefit of their peers and for future generations.

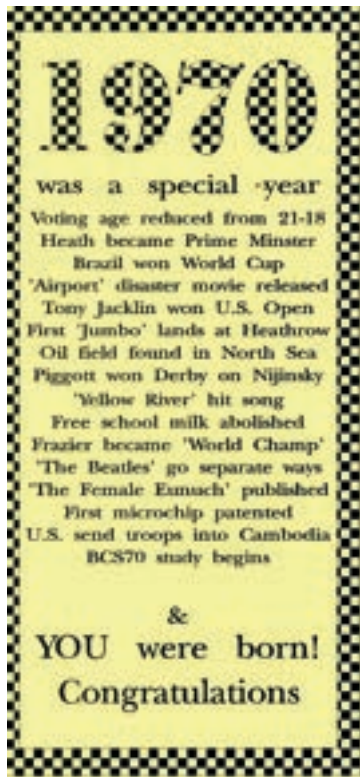
'Being a part of the study makes me feel as though my experiences are being listened to and valued.' (2000–1 study participant)

'I love the fact I am helping to shape the future of others, hopefully for the better. If my contribution in some way helps to make the world a better place, I will have done my part.' (1970 study participant)

None of the cohorts started their lives at UCL, but they were eventually brought together here under one roof. Each of them has its own unique history driven by the determination of the pioneering scientists who first initiated them – including James Douglas, Neville Butler and Heather Joshi – and the input of hundreds of academics, professional staff, fieldworkers and clinicians over the years.

The 1958 and 1970 birth cohort studies were first brought together in the 1990s, with funding from the Economic and Social Research Council. They were transferred into the Institute of Education (IOE) – then an independent university – in 1998 by John Bynner, the founding director of the Centre for Longitudinal Studies. The Millennium Cohort Study (2000–2) and Next Steps (1989–90) cohorts were added subsequently. In its own rich and separate tradition, the 1946 birth cohort study was funded by the Medical Research Council (MRC) over many decades, with the MRC Unit for Lifelong Health and Ageing becoming integrated within UCL in the 2010s. It was the merger of the IOE into UCL in 2016 that brought all the UK's series of national birth cohorts together in UCL for the first time, and this has enabled a flourishing of collaboration between the centres, and in particular the biomedical and social science academic traditions of the different studies. The studies are now based at the Centre for Longitudinal Studies, in the UCL Social Research Institute at IOE and in the Unit for Lifelong Health and Ageing in the Institute for Cardiovascular Science.

Findings from the studies have transformed the practice of doctors, nurses, teachers, psychologists and scientists, helping to improve the lives of millions



Birthday cards sent to participants in the cohort studies.

of people, not only in the UK but across the world. Evidence from the cohorts shaped early NHS maternity services, and later prompted a public health campaign about the dangers of smoking in pregnancy. The New Labour government (1997–2010) cited the studies in a raft of policies, helping to improve early years education with Sure Start and adult learning with Skills for Life. It then backed the funding of the first new cohort study in three decades to mark the millennium. Research on the lives of working families inspired the coalition government (2010–15) to enshrine paternity leave in law. Evidence on young people's skills then provided the impetus for a reform of vocational education.

In recent times, research about the extent of psychological problems among teenagers has been instrumental in increasing children and young people's mental health service capacity.

The UCL portfolio of birth cohort studies is unique in the world and is generating scientific evidence across a wide range of academic disciplines including psychology, economics, education,

sociology, demography, criminology, social statistics, geography, epidemiology, genetics and medicine. A unifying feature of this research is the importance of the life course.

Recent years have seen a welcome expansion of the portfolio. This includes Children of the 2020s, commissioned by the Department for Education to follow babies in England from infancy to age five. Most significantly, 2026 will see the launch of the first UK-wide birth cohort study in 25 years. Generation New Era, supported by the UKRI Economic and Social Research Council, will follow more than 30,000 new babies and their families.

After 200 years of UCL and 80 years of the UK cohort studies, the cycle of discovery and knowledge begins anew.

Ryan Bradshaw is Editorial Content Manager for the Centre for Longitudinal Studies. Alissa Goodman is Professor of Economics in the Social Research Institute and Director of the Centre for Longitudinal Studies.

Free speech

Robert Simpson

UCL emerged as part of a broader cultural ferment in nineteenth-century British society. Its founding made it possible for more people to pursue a higher education without having to make a formal profession of faith, as was required by Cambridge and Oxford universities. But UCL's progressive orientation represented a deeper reaction against Oxbridge conservatism. UCL wasn't just promoting freedom of speech and conscience in a formal sense; it was trying to legitimise new vocabularies for the expression of learned opinion. And while it was still an institution of its time, it was moving academia in the UK towards the idea – famously defended by John Stuart Mill, a few decades after UCL's founding – that we don't

make intellectual progress in an ethical monoculture. Research can't flourish in an environment where everyone is obliged to agree with each other. Research is vitalised by dissent and debate.

Ronald Dworkin and Eric Barendt, who both taught at UCL, were two of the UK's most influential free speech scholars at the turn of the twenty-first century. Both contributed, in different ways, to a defence of the classical liberal interpretation of free speech – Dworkin, for example, in his arguments about how 'upstream' restrictions on debates about our law have an undermining effect, 'downstream', on the democratic legitimacy of those laws; Barendt in his work on libel, and how civil penalties for libel can



A political demonstration by UCL students, 1933.

stifle public debate. George Letsas carries on this tradition today, arguing, in a classical liberal (and forthrightly secularist) vein that people don't have a right to not be offended in relation to their religious beliefs.

One arguable shortcoming, in the classical liberal view of free speech, is its fixation on the relationship between citizens and states, and the secondary significance that it ascribes to how speech is treated by platforms and 'speech intermediaries'. In modern liberal societies, in most cases where people have their contributions to public discourse suppressed, this isn't because the government is directly doing the suppressing. Rather, it's because an intermediary platform or organisation – a media company, a social media platform, a university, an employer or a funder – has used its local authority to penalise speech in line with its commercial or ideological agenda. Our legal rights to free speech can lose their significance, if all our avenues for contributing to public discussion are captured and controlled by intermediaries. UCL researchers have made important contributions to debates about the limits of free speech in these contexts, for example on social media, for employers and for traditional media companies. For example, Jeff Howard has argued influentially for the view that social media platforms have positive duties to moderate and demote harmful speech. Probably the most controversial frontier of free speech policy that implicates this intermediary issue is in contemporary debates on academic freedom. UCL researchers have been active in these debates, with some pushing for stronger free speech protections at UK universities, e.g. Alice Sullivan (Institute of Education) and Alak Sokal (Mathematics), and others defending the legitimacy of speech restrictions under certain conditions, e.g. Letsas (Law), Anthony Julius (Law) and Robert Simpson (Philosophy).

Free speech is a part of UCL's institutional DNA. That doesn't mean UCL has a faultless record

in upholding free speech. And it doesn't mean everyone at UCL agrees about free speech – about its foundations or limits, or how it interacts with other ideals, such as equality and security. It means there's something in UCL's institutional origins that's reflected in our research on free speech today. We're a secular university. So for us, nothing is sacred. Free speech is part of how we understand people's right to criticise sacred cows. But thinking around free speech can also become a sacred cow. UCL academics helped to shape the classical free speech ideal that was a key part of liberal politics in the twentieth century. And UCL academics continue to play a role in defending, complicating and extending that ideal of free speech, in the twenty-first century's evolving communicative conditions.

Robert Simpson is Associate Professor in the Philosophy Department.

Research can't flourish in an environment where everyone is obliged to agree with each other. Research is vitalised by dissent and debate.

Studying actual language use: the Survey of English Usage

Bas Aarts

Have you ever wondered about the kind of data linguists might use to write dictionaries and grammars? In earlier centuries this was often done by using the works of what were perceived to be the 'best authors', such as William Shakespeare, John Milton, Jane Austen and Charles Dickens. Samuel Johnson, in the Preface to his *Dictionary of the English Language*, wrote in 1755: 'I applied myself to the perusal of our writers; and noting whatever might be of use to ascertain or illustrate any word or phrase, accumulated in time the materials of a dictionary.' Grammarians too often used examples from famous authors to illustrate points of grammar.

But there is a serious objection to this practice: the language used by literary authors is always in written form, and mostly not reflective of the language used in everyday settings at work, in families and in (social) media. What kind of data can we use to reliably investigate how people interact linguistically in real social settings?

The middle of the twentieth century saw the advent of a new field of language study called corpus linguistics (CL) whose practitioners aim to collect large databases of actual language use. Randolph Quirk was a pioneer in CL when he founded the Survey of English Usage at Durham, and then moved it to UCL in 1960. Quirk not only collected written language in different genres, but was also one of the first linguists to collect large amounts of authentic *spoken* language in various genres (conversations, radio programmes, lectures, discussions, etc.), on the assumption that this best reflects actual language usage. The so-called Quirk Corpus was developed in the pre-computer age, and involved the manual collection and annotation of spoken and written material on paper. It was the basis for a huge number of publications on the English language, including the 1,800-page

standard reference grammar *A Comprehensive Grammar of the English Language* by Randolph Quirk, Sidney Greenbaum, Geoffrey Leech and Jan Svartvik (1985).

Further corpora were developed at the Survey, namely the British component of the *International Corpus of English* (ICE-GB) by Sidney Greenbaum and the *Diachronic Corpus of Present-Day English* (DCPSE) by Sean Wallis and me. Both corpora were developed using computers, such that the data can be searched using software written by Wallis.

ICE-GB can be used to carry out research into English grammar, but also to study how speakers of English interact with each other in various kinds of (conversational) settings. DCPSE can be used to study language change over shorter periods of time by comparing the spoken usage in the Quirk Corpus with the spoken materials in ICE-GB. For example, our research has shown that in the more egalitarian world we live in, English speakers use the verb *must* much less frequently than they used to, when imposing an obligation. Instead, they use less 'direct' alternatives such as *have to* or *need to*. Compare *You must finish your work by tomorrow* with *You have to finish your work by tomorrow*, and *I need you to finish your work by tomorrow*.

The Survey's corpus resources are used across the world. Recently, the Survey has built a free web-based teaching resource for schools, using data from our corpora, called Englicious (englicious.org), with lesson plans, exercises, a grammatical glossary and much more, which teachers can use to deliver the specifications of the National Curriculum. In this way the Survey's work has had a positive societal impact.

Bas Aarts is Professor of English Linguistics and Director of the Survey of English Usage.



Some of the technology previously used to compile the Survey of English Usage.

Constitution Unit

Meg Russell

The Constitution Unit, based in UCL's Department of Political Science, was founded in 1995 by Robert Hazell. At that time, the Labour Party had ambitious proposals for constitutional reform. As a former civil servant, Hazell realised that these required careful thinking through, but that Labour – then in opposition

– had insufficient resources to do so. He established a small expert team to address this gap. The Unit's early work, including major reports on devolution, House of Lords reform, freedom of information and a Human Rights Act, helped provide the underpinnings of the programme that would be implemented by



The government offices at Whitehall are at the heart of the British constitution in practice.

Tony Blair's Labour government after it gained power in 1997.

Ever since, the Constitution Unit's hallmark has remained high-quality research with a sharply practical focus. Its researchers have worked with policymakers of all parties and none, on a wide range of topics crucial to UK democracy, often drawing on knowledge about the operation of other political systems around the world. This has been communicated through private meetings and briefings, as well as public events and publications of various kinds – and has often resulted in real-world 'impact'. In 2010 the coalition government's publication of a *Cabinet Manual*, setting out core principles of the UK constitution, followed proposals from Robert Hazell informed by experience in New Zealand. He also fed into other debates, for example on judicial independence and the monarchy.

In 2015, 20 years after the Unit's formation, I took over as Director. Previously Deputy Director, I had been based at the Unit since 1998, but also had a background in the policy world. My research – much of it on Parliament – has likewise often had practical policy impact. Examples include reports proposing the legalisation of 'quotas' for women's representation (in 2001) and the establishment of a Backbench Business Committee for the House of Commons (in 2007), and years of commentary and publications on the House of Lords and its reform.

Also in 2015, Alan Renwick – an expert on elections and public participation – was recruited as the Unit's Deputy Director, and he becomes Director in 2026. Our joint interests have shaped the Unit's more recent work. In 2017–18 we ran an Independent Commission on Referendums, following the Brexit vote, which recommended that referendums should be reserved for decisions on clear and well-developed proposals, and should be better regulated. The Unit also held a Citizens' Assembly on Brexit, allowing a representative

In an age of democratic 'backsliding', researchers have worked to emphasise the need to uphold constitutional principles and strong checks and balances.

group of members of the public to deliberate on the best means of implementing the outcome of that vote. In 2021 it ran a Citizens' Assembly on Democracy which, alongside large-scale surveys, assessed public attitudes to governance in the UK. In an age of democratic 'backsliding', researchers have worked – often closely with other expert groups – to emphasise the need to uphold constitutional principles and strong checks and balances, and to promote public trust and participation.

The Constitution Unit continues to have a small staff team, with big real-world impact. It runs an events programme, has a lively blog and social media presence, and its materials (for which a complete archive exists on the Unit's website) are widely used by educators, policymakers and the broader public in the UK and well beyond.

Meg Russell is Director of the Constitution Unit and Professor of British and Comparative Politics.



The vitality of London's LGBTQ+ venues

Ben Campkin and Lo Marshall

UCL has a long history of research and practice in support of fairer cities, and it was at UCL that the sociologist Ruth Glass first coined the term 'gentrification' in the 1960s. In London, a plethora of researchers collaborate with a diversity of communities across the city on the issues that

challenge them during processes of urban change. In the mid-2010s there were escalating concerns that lesbian, gay, bisexual, trans and queer (LGBTQ+) nightlife venues in London were closing rapidly and their survival was under threat. Many valued and long-standing spaces had closed, and campaign



The Royal Vauxhall Tavern, London. Image from a laser scan produced in 2020.

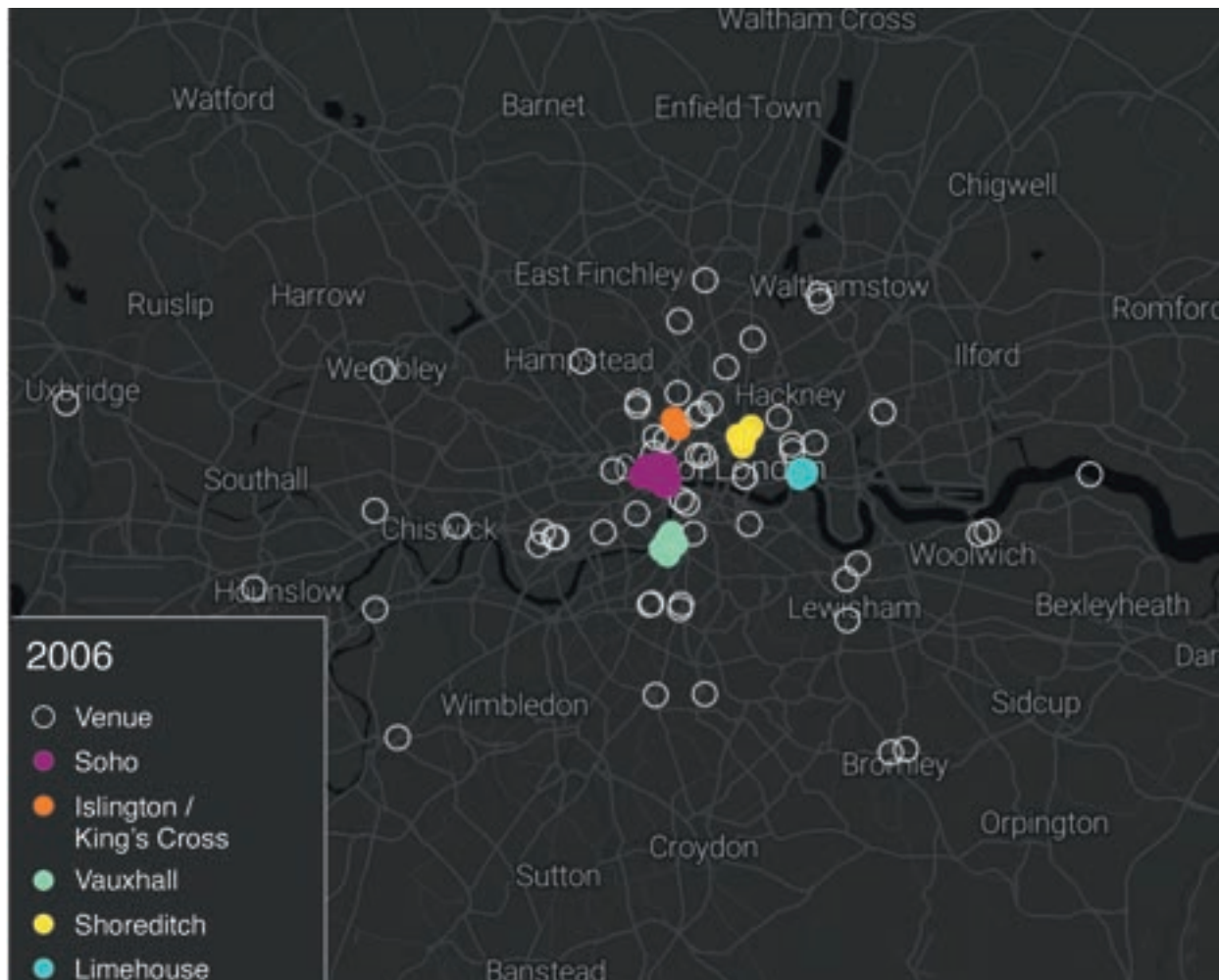
groups and networks had appeared across the city to contest this and to attempt to protect remaining venues. In collaboration with the RAZE Collective – a network of performance artists and creative practitioners – and Queer Spaces Network – a community organisation which aimed

to share knowledge across campaigns – we initiated research to understand and share knowledge about the breadth of London’s LGBTQ+ scenes since the 1980s. The research documented the value of LGBTQ+ night-time spaces beyond their obvious uses for entertainment, as cultural and community infrastructures that had supported wellbeing and livelihoods, providing safety and refuge against the backdrop of exclusion, and which made vital contributions to creative and night-time economies.

Crucially, the research evidenced a 58 per cent decrease in the city’s LGBTQ+ venues between 2006 and 2017. Rather than accepting the myths being reported at the time (including the argument that mobile dating apps had replaced the desire for LGBTQ+ people to meet in person), the research linked the changing provision to neoliberal urban planning and governance approaches, including individual conversion and redevelopment projects, and long-term regeneration schemes that had unfolded over decades. The data was adopted by City Hall and is now maintained by civil servants and informs the Mayor of London’s Cultural Infrastructure Plan. The research findings have been cited widely in key urban planning documents, including in the Mayor’s London Plan (2021) and in local planning decisions and contestations, such as in the boroughs of Camden, Westminster and Tower Hamlets. They informed planning innovations such as the first use of a ‘Section 106’ agreement – a legal



The research documented the value of LGBTQ+ spaces and their vital contributions to creative and night-time economies.

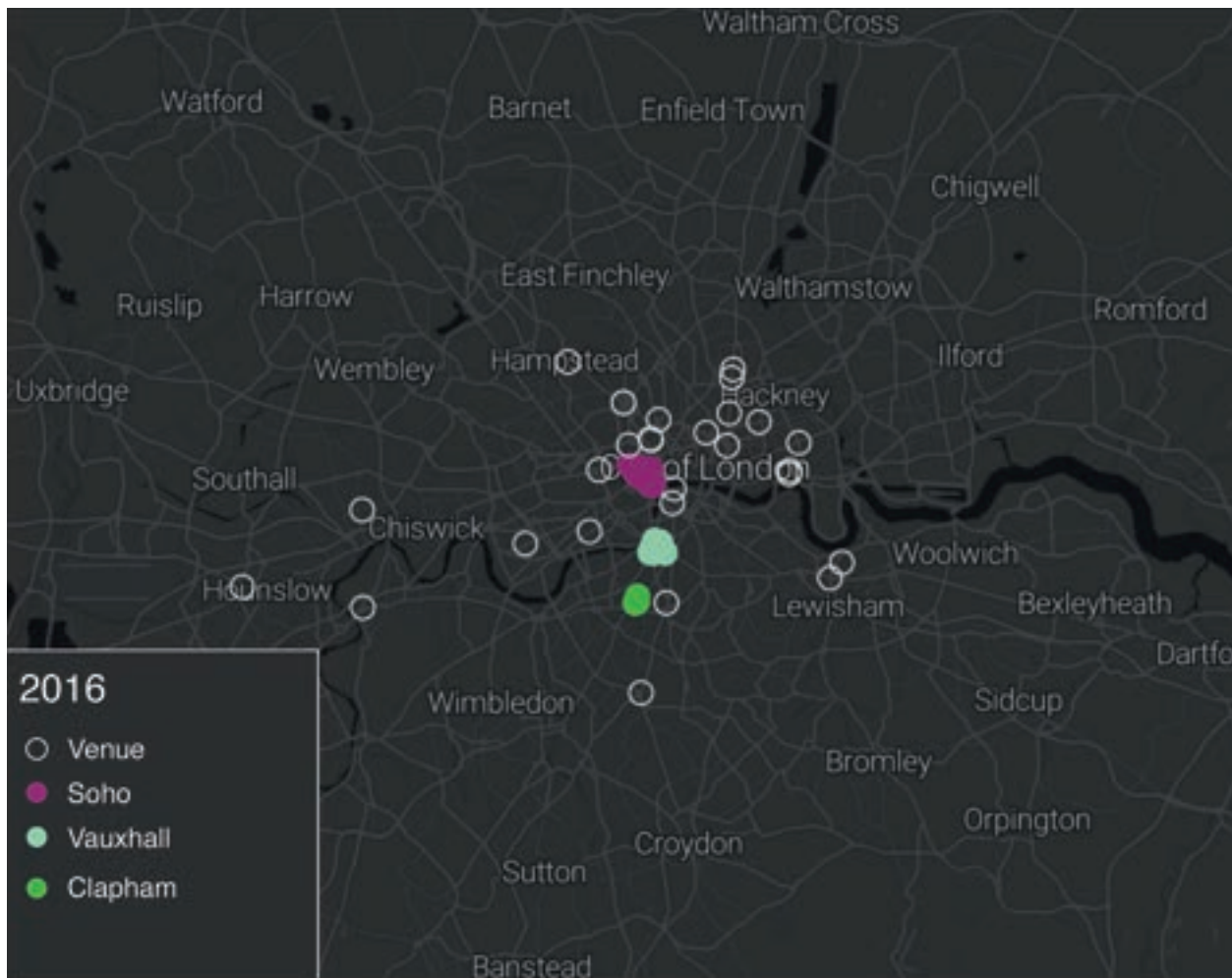


instrument used to mitigate the negative impact of a redevelopment on a community – towards the reprovision of an LGBTQ+ venue, in this case the Joiners Arms in Tower Hamlets. This was an internationally high-profile late-night East London venue, an important node within London’s fashion, music and art scenes, which had closed suddenly in 2015 at the height of its popularity due to a large-scale mixed-use redevelopment. The research was also part of the inspiration for the design of the *LGBT Placemaking Toolkit* (2019) by Planning Out, a professional network of LGBTQ+ urban planners. This toolkit aimed ‘to build on the findings [of the research] and be a resource for members of the LGBT+ community to better navigate the planning system’.

Collaboration and community engagement have been at the heart of this research, which has

Maps showing locations of LGBTQ+ venues and clusters of venues in London, 2006 and 2016.

featured engagements with businesses, queer nightlife campaigns, networks and organisations, as well as the Mayor of London, the Night Czar, the Greater London Authority and London Borough of Camden. Learning from the knowledge and experiences of members of LGBTQ+ communities, nightlife promoters, producers, performers and venue operators was central to this research. From an academic perspective, a transdisciplinary approach underpinned the research process and local, national and global impact of this work, particularly across the fields of urban studies, queer and trans studies, and night studies. Research findings have been cited in media features in local, national and international outlets and outputs from



the research have featured in exhibitions at the Whitechapel Gallery and the Design Museum in London and Université du Québec, Montréal.

The maps shown here document the shifting clusters and sites of established LGBTQ+ venues between 2006 and 2016. What they do not show is the dynamism of informal scenes, the complex diversity of LGBTQ+ populations and the relative provision (or lack) of spaces for different groups. For example, excluded from mainstream formal venues, nightlife that centres women, trans and/or global majority populations has more frequently taken the form of club nights that move between venues. This reflects inequalities within LGBTQ+ communities and the limits of mapping. The image on the previous spread is of the Royal Vauxhall Tavern, produced from the first digital scan of an LGBTQ+ venue, undertaken by the researchers.

This cabaret venue has one of the longest associations with sexual and gender diversity, going back to at least the 1940s, and in 2015 was the first building to be heritage listed for its importance to LGBTQ+ communities following a long campaign.

*Ben Campkin is Professor of Urbanism and Urban History.
Lo Marshall is a Lecturer (Teaching) at The Bartlett School of Architecture.*

What autism has taught us about our social nature

Uta Frith

I have worked as a researcher at UCL since 1968, with funding from the Medical Research Council (MRC). In these decades I have witnessed the dramatic rise of autism from a rare, little-known disorder to a ubiquitous feature of modern life. Autism presents a fascinating puzzle to those studying how the human mind creates and perceives memories, language and emotions. The puzzle is how individuals with autism often excel at some cognitive tasks, such as understanding the physical world, while struggling with the social world.

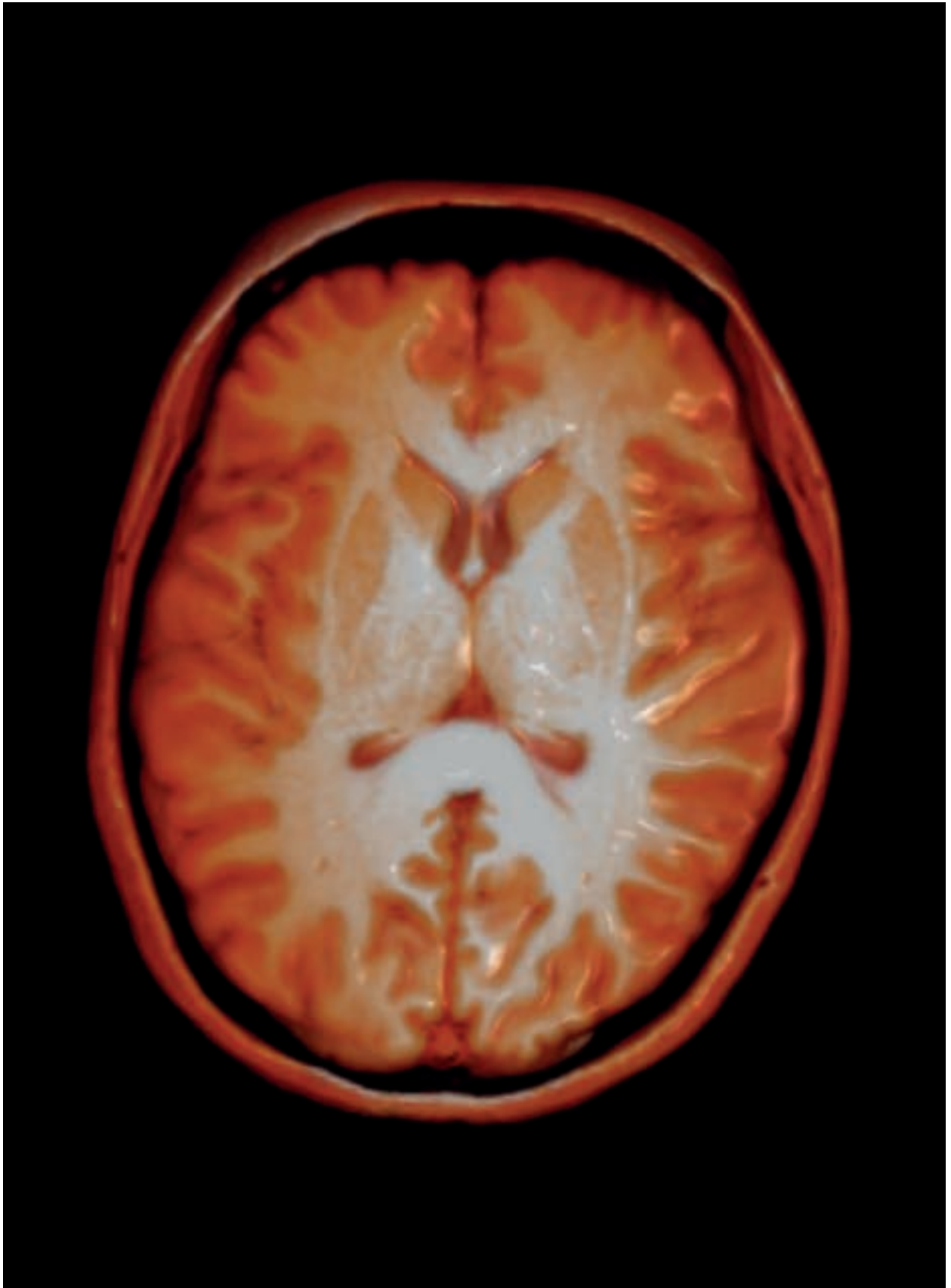
It was not until the 1980s that my colleagues and I at the MRC Cognitive Development Unit achieved a breakthrough in finding a possible cause for the striking failures of social interaction in autism. We discovered a weakness in mentalising, the ability to predict what other people will do next based on their mental states, such as intentions and beliefs. For instance, an autistic girl panicked when a nurse, who was trying to do a simple blood test, said, 'Give me your finger.' The girl had taken these words quite literally rather than inferring the benign intention behind the nurse's request.

In 1994 the Functional Imaging Laboratory opened at the Institute of Neurology with my husband, Chris Frith, as one of the founding members. This was one of the first places in the world where brain imaging was used to explore the neural basis of higher cognitive functions such as consciousness and free will. In collaboration with Chris and other colleagues, we were able to reveal the neural basis of mentalising, a complex network with distinct hubs in frontal and temporal regions of the brain. Tantalisingly, while the connections between these hubs have been found to be weaker in autistic people, a definitive neural biomarker of autism has so far proved elusive. However, neuroimaging studies of mentalising have proliferated, and research in social cognition and its neural basis is now a flourishing field.

There is more to social cognition than mentalising – for instance, trust and reputation, critical for joint action and cooperation. Our experience of academic committees made us keen to learn more about the way people make joint decisions. With colleagues we explored just how and when two heads can do better than one. A key process for enhancing interacting minds is metacognition – thinking about thinking. How does it help when we solve a problem together? It helps when we reflect on the degree of confidence that we can attach to our own answers. If we are not sure, we would do well to rely on the answers provided by our partners. In larger groups the diversity of group members often benefits difficult decisions.

We have presented our work in comic-strip form and in a more academic form in the book *What Makes Us Social?*. We have greatly benefited from UCL's support for full-time researchers and for doctoral students. We look back with gratitude on UCL's bold decision to establish an Institute of Cognitive Neuroscience in 1996, next to the Functional Imaging Lab and other institutions around Queen Square encompassing neuroimaging, psychiatry, neurology and neuropsychology. This greatly fostered collaboration across all these disciplines and enhanced UCL's strength in neuroscience.

Uta Frith is Emeritus Professor of Cognitive Development.



MRI scan of an adult human brain, viewed from above.

From 'place-making' to 'making place': university-led regeneration and the role of UCL Urban Room at UCL East

Clare Melhuish

'Place-making' has become a significant buzzword in urban regeneration and urban design in the twenty-first century. But what is the meaning of place and locality in complex, ever-changing global metropolises like London, in which the impact of accelerated urban development has transformed certain 'opportunity areas' almost beyond recognition in the last two decades? For most of us, 'place' carries connotations of 'community', but community itself can feel like an abstract concept in big, transient cities. And while urban-rural migration, especially since the restructuring of work patterns induced by the Covid-19 pandemic, can be explained in part by the desire of city dwellers to connect with romanticised ideals of community in beautiful natural settings, we might ask how developers and urban policymakers imagine they can deliver place-making and community in regenerated post-industrial sites in neglected and fragmented urban areas.

Yet locality and community are as important to city dwellers as they are in rural areas, and London has long been known as a city of villages at least as far back as the County of London Plan 1943. This has been a fundamental framing for Urban Lab's engagement with the development and opening of UCL East in the Queen Elizabeth Olympic Park since 2012, and the trajectory of the Olympic Legacy regeneration promises since, in which this initiative has been entangled. Starting from a position of advocacy for ethical urban regeneration, and drawing on the critical urbanism and urban theory in which Urban Lab's expertise and scholarship has been embedded since our establishment in 2005, we published a report on the challenges and opportunities for 'university-led urban regeneration' in 2016, and developed a proposal for a new centre of urban research and teaching in the UCL East

campus with a new UCL Urban Room at the heart of the campus, providing a focal point for place-based university-community engagement and exchange.

Urban Rooms were promoted to the UK government in the Farrell Review of Architecture and the Built Environment 2015; the Urban Rooms Network (a working group of the Place Alliance based at UCL) defines one as 'a space where people can come together to help create a future for their local area'. We understand it as a 'room' in an urban neighbourhood designed for ordinary people to enter, access knowledge and data about processes of urban change, and creatively share their own knowledge and expertise concerning local dynamics and impacts of urban change, and their own personal and collective experience and memories of these processes. It is a place for exhibitions, activities and dialogues, and a 'safe space' where multiple and different voices can be heard, especially those that are often disregarded, drowned out or suppressed by more powerful interests.

Why at UCL East? Many in the surrounding local areas have protested at the impact of accelerated urban change driven by the London 2012 Olympic Games. They fear that the rewriting of the area's urban heritage and identity, the erasure of its industrial past and the effects of gentrification will define its future identity and lead to their own exclusion as long-standing urban communities embedded in the historic places around the Lea Valley and London Docklands. The UCL East vision, however, cited a 'commitment to creating a vibrant, diverse and accessible campus in, of and for East London . . . [which is] open and highly collaborative with external organisations'. It promised to deliver a physical development that will connect UCL East to its surroundings and 'invite people in', with a 'vibrant



Urban Room 'Seeded' Exhibition, 2023. Artwork by Noemi Gunea.

public space' at its heart. Many of UCL's academics developed relationships with local groups through community-based research activities, which strongly shaped the planning of UCL East. Urban Lab grasped the opportunity to create a dedicated space to host this kind of work, hand-in-hand with urban research and teaching, delivered through partnerships and cross-disciplinary collaborations across the academic communities of the Bartlett Faculty and School for Creative and Cultural Industries.

The opening exhibition 'SE1 Stories' provided insights into the work of housing activists in the 1970s, creating a space for dialogue with today's community campaigners for affordable housing in East London. Other issues foregrounded since then include the lack of access to healthcare by London's boater community, challenges faced by undocumented migrants in the European borderlands, and the place of memory in navigating urban change, resonating with the experiences of local urban communities in London and globally.

This is what we call 'making place' – for people. It's not just about delivering a replicable formula of urban and economic development that risks displacing existing communities for new ones, in beautified urban localities, but about using the university's resources to work with and contribute to the lives of existing communities, in imperfect places, to the best of our ability. By helping to build future narratives of urban heritage and identity on the foundations that exist already, it represents a real celebration of the positive role that UCL can play in the lives of Londoners who have settled here from all over the world for well over 200 years.

This piece is dedicated to the memory of Phil Cohen (1943–2024), an esteemed collaborator, who made such an important contribution to documenting the lives and heritage of East Londoners.

Clare Melhuish is Professorial Research Fellow in Anthropology of Built Environments at UCL Urban Laboratory.

The Global Informality Project

Alena Ledeneva

The Global Informality Project is a pioneering initiative that uncovers the hidden practices, unwritten rules and open secrets that characterise informal problem-solving across the globe. In its unique dataset of local knowledge, the project assembles the invisible forms of human interaction, defined as the ways of getting things done in more than 100 countries and regions (www.in-formality.com). Examples include local knowhow practices associated with communities (such as *Janteloven* in Denmark); with the use of connections (*pulling strings* in the UK); and with informal gifts and payments (*red envelopes* in China), each practice reflecting specific contexts, daily needs and problems, resolved by such informal means.

The key finding of the project is that informality is integral to all societies. The role of a given political regime or development is also significant in determining the visibility and scale of the practice. The database can be searched by location, theme or cluster. Let us look at Poland. Both native and international scholars present a range of practices characteristic of Poland's migration in different historical periods (*saksy, słoiki, ściągac*); shortcuts of the communist period (*kombinacja, załatwianie, stacze kolejkowi*); and ongoing practices with reference to mutually supportive networks used as ways of cutting across the red tape and pursuing informal agendas (*sitwa; zachachmęcenie*) or forms of favouritism (*kumoterstwo* and *kolesiostwo*). The spread of euphemisms indicates the scale of informal practices in different periods and contexts.

In socialist-era Poland, for example, *stacze kolejkowi* were individuals who, amid the severe shortages of consumer goods that plagued the country in the 1980s, stood in the queue for someone else as a means of generating income on the side. Even though the term literally translates as 'queue standers', the fact that *stacze kolejkowi* queued for monetary profit largely differentiated them from other 'queuers' (*kolejkowicze* or *ogonkowicze*), who queued to buy a product for either personal use or bartering.

The practice is one of many informal structures and arrangements that facilitated the provision of consumer goods in the 'grey zone' between state socialism and the market economy. While the collapse of the socialist regime and the transition to market economy resulted in the term falling out of use, the mid-2000s saw its revival, as some individuals began to earn a living by queuing for a fee at box offices, hospitals, state agencies and banks.

Alternatively, one could cluster practices from different locations but reflecting similar patterns of human cooperation – say, economies of favours. Such patterns are often universal yet made specific by the context in which they transpire. The project allows researchers and policymakers to compare the incomparable without losing their contextual meaning. Located in grey areas, taken for granted yet questionable, acceptable for 'us' but reprehensible for 'them', these patterns are deeply woven into the fabric of society. Informal practices, networks and institutions are difficult to measure, monitor and integrate into policy, so the ambition of the project is to integrate context-bound problem-solving into strategic thinking and to use the potential of informality in transformative mode.

The Global Informality Project offers a radical shift in how we perceive informality. Breaking with the tradition of viewing informality through the lens of state, legal constraints and formal institutions, this project emphasises informality's central role in social interactions and human cooperation for problem-solving. It discovers that informal practices are often essential for problem-solving, particularly in contexts where formal solutions may be ineffective or inaccessible.

In an increasingly complex world marked by digitalisation, polarisation, hybrid conflicts and increasing divisiveness, the Global Informality Project establishes the critical role of ambivalence in informal practices. Informal practices are a problem, but they also are a solution, often reflecting the



In Slovenian cities, *vrtičkarstvo* is the practice of establishing and maintaining household garden plots, detached from the main place of residence. *Vrtički*, meaning small gardens, are tended by residents of housing estates who either formally rent or informally take over a plot of land.

creativity, mastery of context-sensitive solutions and resourcefulness of individuals in navigating uncertainty. Often, informality is assumed to be synonymous with poverty or underdevelopment. Instead, the Global Informality Project reveals how informal practices can also be associated with wealth and power, underscoring the need for a more nuanced view of informality in various socio-economic contexts.

Launched in 2014, the Global Informality Project is an extensive online resource that supports the *Online Encyclopaedia of Informality*, a comprehensive database of informal practices for everyone to use, with all entries available in open access. The project's centrepieces are the three volumes of the *Global Encyclopaedia of Informality*, published by UCL Press in 2018 and 2024, reaching 211 countries and territories.

At the heart of the Global Informality Project is a remarkable collaboration of more than 600 scholars from five continents. This diverse group of researchers and activists brings together a range of perspectives on informal problem-solving, thus making the project a rich tapestry of insights across disciplines and area studies.

Involving students in research is a key aspect of the project. Through a research-led course on informal practices, taught at the School of Slavonic and East European Studies, students engage in native ethnography in the countries they know best, contributing to the project's findings and gaining invaluable experience in academic research. This bottom-up approach reflects UCL's commitment to fostering an inclusive research environment.

By shedding light on the role of informal practices, this project not only enhances our understanding of human behaviour but also paves the way for the 'nudge' generation of policies to address complexity, to include expertise on ambivalence to tackle uncertainty, and to integrate the full potential of informal problem-solving. The collaboration of scholars, students and practitioners in this endeavour highlights UCL's role as a leader in transformative research, making a lasting impact on society and culture for years to come.

Alena Ledeneva is Professor of Politics and Society at the School of Slavonic and East European Studies.

Complicity and perpetration, during and after the Holocaust

Mary Fulbrook, Stephanie Bird, Stefanie Rauch and Zoltán Kékesi



In seeking to understand complicity and perpetration across Europe and beyond, both during and after the Holocaust, our recent project focused on the notion of 'compromised identities?' – with a question mark, challenging us to think about contentious questions relating to empathy and complicity. We readily think of 'perpetrators' as those directly involved in physical violence: giving the orders, pulling the trigger, killing innocent victims. But right across Europe under

German Jews are arrested during Kristallnacht and forced to march through the streets under SS guard to watch the desecration of a synagogue, then to be incarcerated, 1938.

Nazi domination, millions more became involved in processes of discrimination and persecution, as conformity slid almost imperceptibly into active compliance with inhumane rule. Our interdisciplinary project 'Compromised Identities? Reflections



on Perpetration and Complicity under Nazism' explored how so many could become complicit in systemic violence, or more actively involved in acts of perpetration – and how they managed to justify their behaviours and continue to think of themselves as 'good people', at the time or later. We developed a new approach to analysis of narratives in sources such as diaries and letters, memoirs and oral history testimonies, and in fictional accounts. Collaborative analysis of the roles, relationships and self-representations of those closely involved in mass violence, and the ways in which others portrayed them, extended to collective violence across a range of contexts – not only Nazi Germany and Europe during and after the Holocaust, but also in places as far afield as Chile, Argentina and Israel.

By analysing the compromises that individuals, institutions, societies and states enter into, both during and after such violence, we expose how people's stories evolve, using varying strategies of justification, denial and rationalisation. Through shifting social relations and everyday interactions, people's sense of identity similarly changes over time, both affecting contemporary behaviours and shaping later reconfigurations. This research has proved invaluable for those who seek to understand and critically reflect on involvement in collective violence and its far-reaching aftermath.

We have published a series of scholarly books and articles and a co-edited collection arising from this research, alongside giving numerous public lectures and participating in documentary films, TV and radio broadcasts. With further generous support from the Pears Foundation, we jointly curated a research-led online exhibition, *'Compromised Identities?'*, which explores aspects of perpetration, complicity and their conceptualisation and representation at the time and later. Using texts, visual imagery and filmed interviews and discussions, alongside an interactive map, the exhibition offers an accessible yet critical way into the controversial and challenging questions

**Under Nazi domination
... conformity slid almost
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addressed by our research. Since its launch in 2020, the website has been used by the UCL Centre for Holocaust Education (see p. 200) and promoted for use in A Level history coursework and continuing professional development for teachers in the UK. Users around the world have engaged with the questions raised and acknowledged its usefulness as a resource for research and education. Additionally, members of the team are cooperating with museum and public-history professionals internationally, from Europe to South America, to explore the ways in which materials addressed in this research can be further developed and utilised in differing contexts.

The project continues the 200-year-old traditions of UCL in not only developing knowledge and the critical capacity for informed debate, but also challenging discrimination and engaging with strategies for reshaping perceptions and practices in the future.

Mary Fulbrook is Professor of German History. Stephanie Bird is Professor of German Studies. Stefanie Rauch is an Honorary Research Fellow at the Institute for Advanced Studies. Zoltán Kékesi is a Research Fellow at the Institute for Advanced Studies.

Everyday Islam: Life in a North African 'golden age'

Corisande Fenwick

The Muslim conquests of North Africa in the seventh century transformed the everyday lives of communities: between 800 and 1000, the region experienced an economic 'golden age', visible in the growth of cities, the introduction of new agricultural technologies and intensified exchange within a vast trading system stretching from the Atlantic to the Indus. New social and religious norms underpinned the development of a distinctly Islamic cultural package, marked by the spread of new aesthetics, public and private architecture, and Muslim dietary practices.

Despite significant recent advances, much of our knowledge continues to reflect the experience of rulers and elites, rather than the bulk of the population. Our understanding of everyday life is hampered by a reliance on later literary sources, monumental architecture and the high arts, the absence of high-resolution archaeological data, and an incomplete understanding of what these changes meant for the people living on the ground.

The Everyday Islam project which I lead explores the underlying reasons for the spread of the Islamic way of life in North Africa between c.600 and 1000 through new excavations, scientific analysis, legacy datasets and written sources. In so doing, this project aims to make a paradigmatic shift in our understanding of the impact of Muslim rule by focusing on local communities, their houses and their everyday practices. It takes a comparative approach and studies long-term changes in housing, agriculture, diet and technology in three key regions: the central Medjerda valley in Tunisia, the famed granary of Roman and Islamic Africa; the fertile Sebou Basin in Morocco, at the centre of the Idrisid state; and the Saharan oasis belt of the Wadi Draa in Morocco, on the margins of settled life.

Our ambitious objective is to rewrite the history of Muslim rule and the Islamisation of life from the perspective of the communities living through this pivotal period.

In 2024, we completed excavations at the UNESCO site of Volubilis – medieval Walila – where we have been collaborating with Moroccan colleagues to understand everyday life in the capital of one of the earliest Islamic states in North Africa. Our international team of specialists and students from UCL and INSAP (Morocco's National Institute of Archaeology and Heritage) have uncovered houses, shops, pottery, glass and metalworking workshops, and even a mint producing silver and copper coins inscribed in Arabic – all dating to the eighth century, a period which has traditionally been thought to be a dark age. We are midway through the laboratory work here at UCL – chemical and isotopic analyses reveal that the people of this city imported precious glass and jars of wine from the Levant and Egypt and gold from West Africa, but exploited the local landscape for most of their daily needs. They no longer ate pork and buried their dead in accordance with Muslim practices. The project is ongoing; the Moroccan–British team will continue to uncover this exciting site and learn more as we dig deeper in the coming years.

Corisande Fenwick is Professor of Late Antique and Islamic Archaeology.



Above: silver dirham found during the excavations. Opposite top: view of the INSAP-UCL excavations outside the Roman city walls. Opposite bottom: UAV shot of one of the trenches containing medieval housing, pottery kilns and a sunken workshop.



Ramsay Archive

Katy Makin

Sir William Ramsay (1852–1916) held the Chair of Chemistry at UCL from 1887 to 1913. His original research notes, including the data from his experiments and drawings of his handmade equipment, are held as part of his archive at UCL Special Collections, part of Libraries, Collections, Culture and Open Science (LCCOS).

At the back of one of Ramsay's notebooks dating from 1894 to 1896 is a hand-drawn periodic table, labelled 'Atomic Weights', showing the extent of the known elements at the time. It lacks the final column, which would later be known as the noble gases. During his time at UCL, Ramsay carried out pioneering research that led him to the discovery of most of these gases, namely argon, krypton, neon and xenon, as well as helium. Ramsay was awarded a Nobel Prize for this important contribution to science in 1904. He discovered argon first and gave it a name meaning 'idle' because it was unreactive. Building on this work, he isolated another gas which his notes reveal he initially called krypton, 'the hidden one'. But further tests showed that the gas he had found was helium. The existence of helium in the Sun's atmosphere had been observed, but it had never previously been isolated on Earth.

Ramsay's archive of correspondence and the lab notebooks themselves reveal the collaborative nature of his work. His notebooks take the form of journals, and show him visiting and being visited by the chemists John William Strutt, 3rd Baron Rayleigh, and Sir William Crookes, inventor of the Crookes tube for experimenting with gases. In March 1895, Ramsay gave a vial of a new gas obtained from the mineral cleveite to Crookes for testing. This was the gas he had called 'krypton'. But the entry for 23 March records an unexpected telegraph received from Crookes: 'Crypton is Helium, 58749, come and see it.'

The contributions of Ramsay's lab assistants are also recorded in the notebooks, principally those of Maurice W. Travers, who reviewed the archive after Ramsay's death and added clarification and



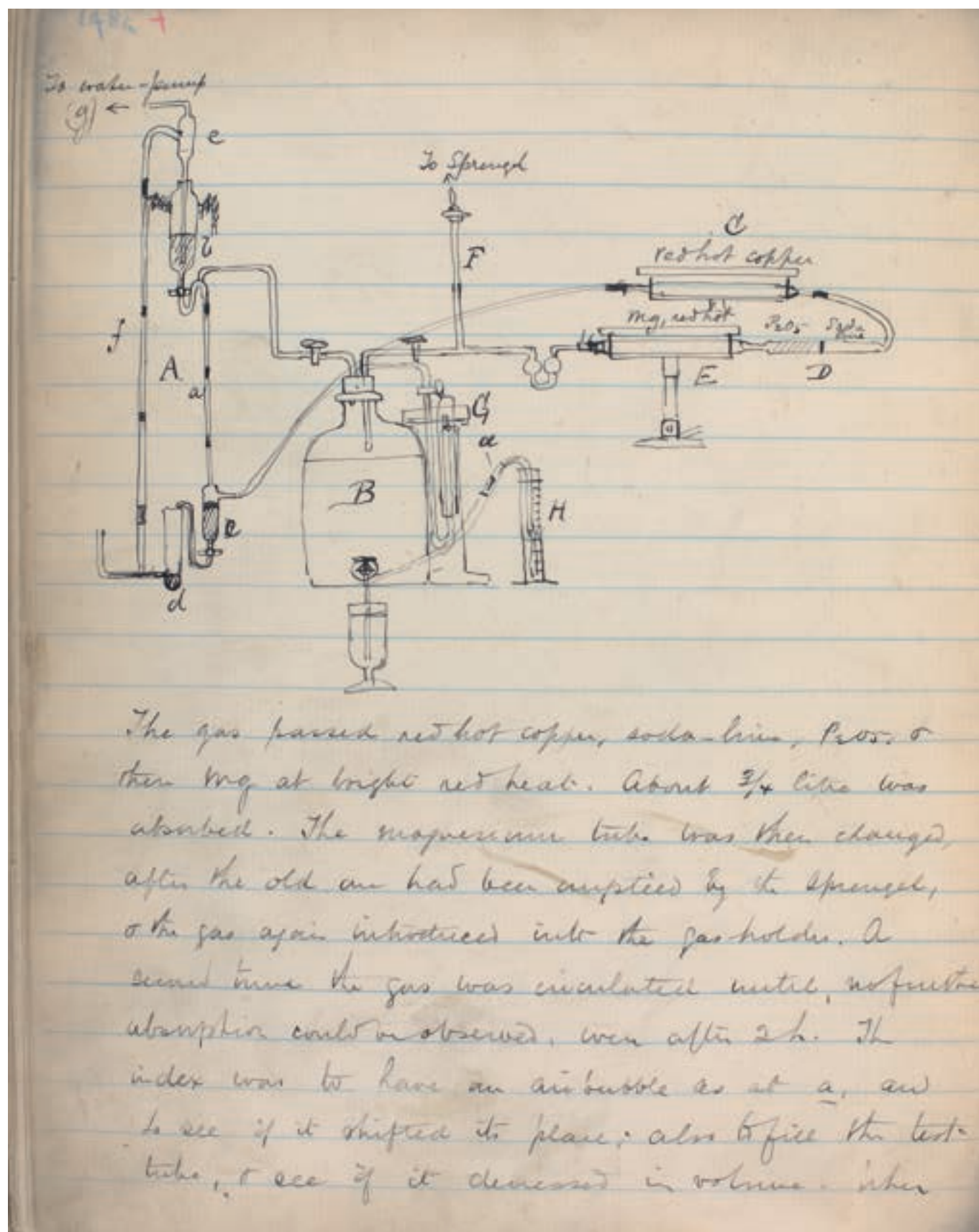
Sir William Ramsay.

commentary throughout. Some of the original notes are in his hand, picking up where Ramsay left off if he was called away. The same notes record work carried out under Ramsay's direction by J. Norman Collie, who would become Professor of Organic Chemistry at UCL, Donald Matthews, who became an oceanographer, and Alexander Kellas, now best known as a mountaineer.

Ramsay was clearly taken with the name 'krypton', and gave it to another previously unknown gas that he and Travers isolated from liquid air in 1898. This discovery was closely followed by neon, meaning 'new', and xenon, 'stranger'.

In the first years of the twentieth century, Ramsay carried out work with Kenneth Soddy on another of the noble gases, radon. There are photographs of Ramsay working in the lab at UCL with his notes open on the bench next to his equipment. The notebooks he used during his experiments with radon are now part of the archive, but they are contaminated with radium (Ra-226) and their use is limited to 30 minutes at a time. Other than this restriction, the archive is open to everyone.

Katy Makin is an Archivist at UCL Special Collections, LCCOS.



The gas passed red hot copper, soda-lime, P_2O_5 & then Mg at bright red heat. About $\frac{3}{4}$ litre was absorbed. The magnesium tube was then changed, after the old one had been emptied by the Sprengel, & the gas again introduced into the gas-holder. A second time the gas was circulated until, no further absorption could be observed, even after 2 h. The index was to have an air-bubble as at a, and to see if it shifted its place; also to fill the test-tube, & see if it decreased in volume. When

Thomas Coram Research Unit: an innovative centre for research on children, families and households

Ann Phoenix, Julia Brannen, Peter Moss and Charlie Owen

The Thomas Coram Research Unit (TCRU) reached its half-century in 2023. This was a time not only for celebration, but also to reflect on changes that have taken place, especially in the academic, social, cultural and political contexts surrounding TCRU. It also encouraged us to recognise institutional strengths and continuities that have enabled the Unit to survive and thrive over this period.

Among these strengths and continuities, three stand out. First, a desire and ability to do innovative research on the health, welfare and education of children, young people and their families, and the services and institutions provided for them; within that broad framework, the Unit's areas of work have evolved over time, while its funding sources (government programmes and grants from the Economic and Social Research Council and foundations) have been diverse. Second, TCRU's multidisciplinary character: psychologists work alongside sociologists, anthropologists, social workers, epidemiologists, social policy scholars, teachers, sociolegal scholars, statisticians and, at times, paediatricians and economists. And third, TCRU's strong sense of collegial identity and commitment makes it a supportive and critically engaged place to work, a stimulating environment that both underpins its innovative research and means it continuously attracts new generations of researchers.

Innovation, it could be said, is in TCRU's DNA. The Unit's founder, Jack Tizard, wanted to adopt a 'strategic' approach to social research, able to look ahead to upcoming issues not yet necessarily on the government's radar; to research new ways to tackle social policy; and to develop commensurate methodologies. In short, he wanted the Unit to take the long view and be willing to experiment.

Over its lifetime, TCRU has a strong record of doing this. Starting with piloting and researching

Children's Centres, an innovative response to wholly inadequate early childhood services, TCRU has undertaken cutting-edge research on many subjects, including (to name but a few) children's and young people's lived experience and family lives, motherhood and fatherhood, parental leave, parenting support, the workforce in children's services, social identities, migration, and services for looked-after children. This has been matched by innovative methodologies, developing qualitative methods, mixed- and multi-methods, ethnography, secondary analysis of large datasets, comparative international studies, the MOSAIC approach for listening to young children, and narrative approaches for studying everyday family practices. The Unit has contributed to theoretical understandings in all these fields.

Exemplars of its work include the study of work and care across four living generations conducted in the early 2000s, which drew upon biographical-narrative research to examine change and continuity. It found that fathers born around the Second World War experienced compressed life-course transitions into employment, marriage and fatherhood, while their sons had more staggered life-course transitions before embarking on fatherhood. Structural circumstances were important factors in the different generations' transition to fatherhood; but changing expectations and behaviour were equally important.

This nuanced understanding of how fathering practices evolve over time is echoed in Katherine Twamley's work two decades later. This research shows how parental leave policies, workplace cultures and societal expectations influence fathers' and mothers' involvement in childcare and their ability to balance work and family life. While the times, norms and contexts have changed somewhat, doing research in different periods shows how family

life has to be negotiated through the interplay of structure and agency across generations.

Over its five decades, TCRU has had to adapt. One way in which it innovated was by initiating an undergraduate degree programme. This multi-disciplinary programme introduces new generations of students to rigorous methodologies in 'research-led' and policy-oriented teaching that draws on TCRU's ethos and strengths. This also enables revitalisation and renewal through the recruitment of outstanding staff and cutting-edge research-teaching synergy.

Today, the Unit's research focuses on three main areas: children and children's wellbeing, services and practices; gender, families and work; and migration, mobility, diversity and family processes. These reflect long-established interests while addressing contemporary topics through innovative theoretical and methodological approaches. Recent projects include research on parenting cultures and families with young children in the Covid pandemic; the experiences of young donor-conceiving adults; minority stress in same-sex-parent families; identities and health among lesbians, gay men and bisexuals; racialised and gendered intersectional identities; negotiations of migrants' deservingness in welfare micropublics; the effects of migration on local populations; identity and migration experiences of families and young people; and diaspora and transnationalism.

These diverse projects give evidence of the Unit's capacity to evolve, innovate in response to changing times and continue to

generate income, while retaining a focus on children, young people and families and a deep commitment to team-based research and national and international collaborative engagement with policy and practice, knowledge exchange and outreach.

A fuller picture of TCRU's history and of the range of its work, past and present, can be found in a book published by UCL Press in 2023 to mark the Unit's fiftieth anniversary, *Social Research for Our Times: Thomas Coram Research Unit past, present and future*.

Ann Phoenix is Professor of Psychosocial Studies. Julia Brannen is Emerita Professor of the Sociology of the Family. Peter Moss is Emeritus Professor of Early Childhood Provision. Charlie Owen is Honorary Research Fellow.



Fifty years of TCRU publishing.

Geography and migration

John Salt

Since its creation in 1988, the UCL Geography Migration Research Unit (MRU) has addressed a wide range of issues related to national and international labour migration and the quality of the statistical base, as well as specific policy issues, including forced migration, school pupil mobility and the influence of religion on migration. Over the long term, MRU research has demonstrated the UK's dependence on labour immigration since the Second World War. Whatever the political targets for foreign labour over the last 70 years, results show that economic requirements usually dominate, and during this time the UK economy has absorbed foreign workers at all skill levels.

A key feature of the Unit's work has been engagement with official organisations, notably the EU, Eurostat, the Council of Europe, the OECD, the

UNHCR and various government departments. In 1995, the MRU was asked by the EU Commission to lead a major study, with the universities of Paris and Amsterdam, into the feasibility of establishing an EU migration observatory. Following its recommendation, the result was the establishment of the EU European Migration Network in 2008, bringing together migration and asylum experts from across Europe to provide objective, comparable policy-relevant information and knowledge on emerging issues relating to asylum and migration in Europe. Unfortunately, the UK withdrew following Brexit. In a separate exercise, the MRU Director drafted the Council of Europe's Migration Strategy in 1997.

From the mid-1980s to the present, the MRU has been part of a growing network of migration



Whitechapel market, a hub for the Bangladeshi community in East London.

experts at the OECD, producing the annual UK national report on international migration trends. Cooperation and exchanges of information within the network have often proved invaluable. For example, Bulgaria and Romania joined the EU in 2007 and faced a transition period of seven years before being allowed free labour movement. In 2014, parts of the UK media promoted the expectation that on the day the transition period ended there would be a 'flood' of their citizens coming to the UK. Information from colleagues in the two countries on flight bookings by their national airlines indicated that numbers were actually lower than the year before. This was conveyed in an MRU interview with the BBC that morning, changing the media narrative by lunchtime.

Underlying much of the research has been engagement with national and international

migration statistics. Projects with Eurostat, involving liaison with the EU Commission and governments, helped compile its main migration statistics database. This includes data from all member states and continues to be used in policy development. At home, the MRU was instrumental in setting up the Migration Statistics User Forum in 2012, bringing together researchers and officials in the field and organising an annual conference.

In 1997, the MRU produced the first model to explain human smuggling and trafficking, which continues to be relevant today. The main stages of the migration process were distinguished: the mobilisation and recruitment of migrants, including helping them raise money for the trip; their movement en route; and their insertion and integration into destination host societies. The



Since 2004 the *polski sklep* has become a feature of Britain's urban landscape.

analysis of the smuggling/trafficking 'business' showed how migrants were increasingly being channelled into common routes, city nodes and contact networks, such as through the Balkans, the now open borders of the former Soviet Union, across parts of the Mediterranean (now also the English Channel) and by some airlines. This was followed up as part of a subsequent major research programme with the University of Bristol.

In the early 2000s there was growing concern, fostered in some of the media, about the size of the population living illegally in the UK. A review by the MRU of some 30 methods used by researchers to estimate the size of populations living irregularly in different countries resulted in the Home Office accepting the Unit's recommended 'residual method' and then going on to produce in 2005 what is still the only official estimate, although later research studies have updated it.

The international migration of skilled workers has been a major focus of study, combining statistical analysis with interviews of employers. In 1970, the first major funded study in human geography in UCL showed how housing availability influenced regional labour migration in England and Wales. A major finding was the importance of staff relocation by large employers, providing a 'magic carpet' in the form of financial and other assistance for the move. These intra-company transfers (ICTs) were the subject of a series of successor studies over several decades to the present, funded by research bodies and governments, using qualitative surveys of employers and statistical data. From the 1980s until Covid and Brexit, ICTs accounted consistently for 40–50 per cent of managed labour immigration to the UK, suggesting a symbiotic relationship between government and employers to the mutual benefit of both. Related studies on the internationalisation of education have focused on the recruitment of international students, including survey findings showing that large employers deliberately target

them for employment upon graduation, partly because of their language, culture and willingness to travel.

Most governments today seek to attract skilled workers. Unlike supposedly low-skilled migrant labour, which requires a physical presence to perform tasks, the main contribution of the highly skilled is knowledge. Our research, with others, shows that this takes various forms and can be transferred geographically in various ways without necessarily requiring physical presence. The development of forms of artificial intelligence is also impinging on the migration of people. If robots become capable not only of storing, analysing and exchanging information but also of proposing and responding, we must now ask how far this will impact on the future need for human spatial movement and interaction.

John Salt is Emeritus Professor of Geography and Co-Director of the Migration Research Unit.

The development of forms of artificial intelligence is also impinging on the migration of people.

Women's experiences in the miners' strike of 1984–5

Florence Sutcliffe–Braithwaite

The UK miners' strike of 1984–5 was a showdown between the National Union of Mineworkers (NUM), a uniquely male-dominated trade union, and the Conservative prime minister, Margaret Thatcher. But women from the coalfields also played a crucial part in the strike. Miners' wives, mothers and daughters banded together with other women from mining communities to form support groups, running soup kitchens, giving out food parcels, raising money, going on marches and standing on picket lines. This novel activism was much discussed at the time, usually in a 'heroic' mode, as in activist Maureen Douglass's article for the feminist magazine *Spare Rib* in October 1984, where she wrote: 'This movement of women against pit closures has released women from their isolated role from the home into organising. This is something they have

never done before, bringing them into contact with aspects of politics they've not really known about previously.'

Between 2014 and 2024 I undertook a project with Natalie Thomlinson examining women's experiences in the strike, consulting archives and conducting oral history interviews with more than 100 women from coalfield communities across England, Wales and Scotland. We constructed the first national picture of women's activism in the strike – activism that reached astonishing proportions, and which was vital to maintaining the dispute for a full year. But we also aimed to historicise the 'heroic' narrative about working-class women's politicisation during the strike, and to explore other experiences in the dispute.

The 'heroic' narrative was a deeply political one. It was constructed during the dispute in order to



Anne (third left) and Arthur (right) Scargill protesting against pit closures in Barnsley, 1984.



Project interviewees Anne Scargill (left) and Betty Cook (right) looking at photos taken during the miners' strike, at the temporary exhibition at the National Coal Mining Museum for England, 2019.

appeal to feminist supporters outside the coalfields who might have been less than keen to give financial and practical support to the male-dominated NUM, and bolstered further in the strike's aftermath, in the plethora of pamphlets and books written collectively by women's support groups to commemorate what they had achieved – and to try to rescue something positive from the ashes of defeat. It obscured or distorted some facts about women's activism: not least the fact that many of the most active women, such as Sian James in South Wales, were deeply political – involved in trade unionism, Labour and other left-wing politics – long before the strike. Nevertheless, this narrative has loomed large in collective memory, and shaped how many of our interviewees recounted their experiences.

Other elements of women's experience in the strike have been marginalised by the dominance of this 'heroic' narrative. Women whose family members returned to work early have been largely silent: one of our interviewees, whose father returned to work before the strike ended, said speaking about it was like an 'exorcism'. Women's wages, and their emotional labour within the family, were also

crucial to sustaining the strike, but have often been overlooked.

We wrote a book, *Women and the Miners' Strike, 1984–1985* (2023), made a short film with five of our interviewees, held a series of public events around the country and curated a temporary exhibition at the National Coal Mining Museum for England (NCMM) in order to share our findings. Participating in the project made some of our interviewees re-evaluate their own experiences. One, who kept her family going through the strike through her own paid labour, said she had felt previously that she 'didn't really do anything', but now saw the significance of her actions differently. Another wrote, after attending our exhibition launch, that 'talking to other attendees, I thought most people were involved in women's activism, but many like me were working to support families'. The collection of interviews we created is now held in the NCMM's archive as a resource for future historians interested in women's and working-class history.

Florence Sutcliffe-Braithwaite is Associate Professor in Twentieth-Century British History.

Finding common ground: medical anthropology

A. David Napier

'Give me another life and I won't take it.' These words by the Dutch novelist and poet Cees Nooteboom well summarise a life fully realised. A confident if not big claim, it characterises precisely how I feel about my quarter-century at UCL.

Some 40 years ago, as an American postgraduate at Oxford, I quickly learned you could redefine yourself and your discipline in the UK, so long as whatever you did, you did it well. But two decades later, when I returned to teach and conduct research at UCL, I learned something else: if you're looking for new ways of defining your field, there is no better place in the world to do that than in London and at UCL, especially if you are what I am professionally – a medical anthropologist.

Medical anthropology is the study of how illness, health and wellbeing emerge and are understood socio-culturally. It examines how these are influenced by our shared conventional understandings (culture); how those understandings over time impact our actions and values (history); and how those values emerge individually and in group contexts (social psychology, politics and so on). Though in the past medical anthropologists mostly focused on the lived experiences of illness and wellbeing in different cultural contexts, increasingly we study how to bring that lived experience to the level of evidence, even working within large-scale interdisciplinary projects.

In my two decades here, UCL medical anthropology has either participated in or led several sustained interdisciplinary initiatives, including research that characterises the complex social drivers of non-communicable diseases through Cities Changing Diabetes, a global, public-private programme gathering and comparing data in more than 40 cities. We have characterised the experiences of the Covid-19 lockdown for the European Union in nine countries, worked with the Economist Impact Unit on its Health Inclusivity Index, which measures the social drivers of inclusion and exclusion at national scales, and pioneered field

research on hypertension in another global project called 'AI4Healthy Cities'. Here, we characterise and sufficiently scale the health experiences of otherwise invisible populations so that AI modelling can be used to develop and streamline health-policy decision-making.

While all of this may sound new to those who think of anthropologists as lone explorers who live among indigenous, and once isolated populations, UCL medical anthropology has a long history of collaboration. In fact, such cross-disciplinary collaboration in anthropology was founded here and at Cambridge by one person. In 1898, a St Bartholomew's Hospital medical doctor named W.H.R. Rivers was asked to head an anthropological expedition to the Torres Straits, the Melanesian sea between New Guinea and Australia. It was the first time that British anthropology had stood up from the armchair and gone into the field to collect data. And it revolutionised our mission.

If anything, Rivers was a disruptive thinker, making important contributions not only to anthropology, but also to ethnology, neurology and psychiatry. Rivers, for instance, was director of the first two experimental psychology laboratories in Britain (in London and Cambridge), having begun his lecturing career in experimental psychology at UCL in 1893. Indeed, Rivers was not only the first British anthropologist to engage in sustained fieldwork, he was also first to conduct pioneering psychological experiments using a double-blind procedure. He was, that is, as good at medicine and psychology as he was at anthropology. In fact, Rivers was so central to mental health that in 1904 he founded the *British Journal of Psychology*, and by the end of the First World War had become internationally recognised for his work on shell shock and its relationship to both instinct and the unconscious. W.H.R. Rivers, that is, never stopped crossing disciplinary boundaries. He was the first to bring a systematic and methodological approach to the study of



Recording and playing local songs: anthropological fieldwork in the Torres Strait expedition, 1898 (here Hula, Papua New Guinea).

other cultural ways of thinking. He, indeed, made anthropology a science.

Today UCL stands at the global centre of acting on the socio-cultural drivers of health (e.g. through its Institute of Health Equity) and the psychological drivers of social behaviour (e.g. through its Centre for Behaviour Change). UCL has also become a world leader in the study of health inclusion.

The reason medical anthropology plays a central role today is simple: as most of us know through personal experience, health is largely made or lost

outside the health sector. Of the 8,760 hours in each year, fewer than six (at least for most in the global north) occur inside something called a healthcare facility. This means not only that most spend relatively little time in formal care, but also that people increasingly live by what they can or cannot afford across the counter. Queues in pharmacies during the height of the Covid-19 pandemic are a stark reminder of how citizens meet their health needs when clinical care is unavailable, or when it cannot be made available in a timely manner.

At the same time, healthcare systems must adapt as people live much longer and less healthily than they did, leaving most of us as we age to struggle with compounding comorbidities that are significantly impacted by often heterogeneous risk factors that are often socially mediated. For example, type 2 diabetes and its comorbidities now consume as much as 20 per cent of the entire NHS budget for direct care, while treatment adherence rates rarely exceed 30 per cent on a given day.

In fact, socially mediated illnesses also blur the distinction between communicable and non-communicable diseases. Some half of all A&E deaths from Covid involved obesity, while about one-third of all Covid-related hospital deaths involved diabetes. Think how that pandemic might have played out differently had we better addressed health agency, and the challenges we all face in trying to care for ourselves, and so often on our own.

But the need to adapt disruptively is not just an acute healthcare challenge. In spite of many countries adopting increasingly exclusionary migration policies, as many as 20 per cent of A&E treatments in our UCL healthcare system are still for people whose social exclusion means they cannot identify a primary care provider. These are people about whom we therefore have little or no health data, making the human and financial costs of their exclusion a serious problem. This being the case, how will we face such challenges if our ways of gathering information on hidden populations and their health struggles have not changed substantially?

Developing new strategies for understanding how complex biosocial risk factors fuel one another on a daily basis to limit or enhance our health agency is one key task. Another is understanding how health exclusion leaves us with little or no longitudinal data to work with – not only locally, but globally. Indeed, if 70 per cent of all new AI is generated in Silicon Valley, and the other 30 per cent elsewhere in the global north or in Asia, how will our hospital systems – not to mention much of the global south – limit the growing AI health divide when the data AI needs simply does not exist for the health excluded?

Such realities, in short, ask for new kinds of evidence, especially as people so often today

live alone under conditions of calamity coping, leaving them either unwilling or wholly incapable of responding to traditional forms of data gathering such as surveys and focus groups. Yet while populations become increasingly health-invisible, we still focus on the idea that technology will solve these social challenges for us, often without acknowledging that a steep decline in social trust leaves so many of us feeling excluded. And that's where Rivers's focus on fieldwork comes in.

Given the research I have had the privilege of participating in while at UCL, I can assure you that AI will be of little use in meeting the healthcare needs of that 20 per cent of people our care system serves in some hospital trusts who have no primary care provider. Moreover, if one-third of the people that same system serves were not born in the UK, imagine what the world will look like in 30 years, when global migration is on track to increase ten-fold due to unanticipated social, economic and environmental events.

These problems, clearly, will not be solved by doing business as usual. Indeed, if what will happen globally is already happening to us right now, why not embrace this reality and think constructively about how those who migrate can help us address existing human resource needs? Why not also ask at the same time how those we assist in achieving more fulfilled lives might help work towards stabilising from the UK the very unsettled places that caused so many of us to migrate in the first place? As myself a migrant, I believe these are key questions.

Yes, give me another life and I won't take it. We have so much opportunity here at UCL. This is our privilege, our opportunity, but also our responsibility for the future.

A. David Napier is Professor of Medical Anthropology.

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**Fairer
futures**

Legacies of British slavery

Matthew J. Smith

For more than a decade, the work of UCL's Centre for the Study of the Legacies of British Slavery (CSLBS) has been vital to our understanding of the relationship between enslavement and the historical extraction of financial wealth to Britain from the Caribbean. Its role in providing descendants of enslaved and enslavers with accurate, detailed, historical evidence to underpin reparative debates and discoveries of previously unknown connections continues to grow.

The nucleus of the CSLBS is the Legacies of British Slavery database, the UK's foremost public history resource for research on the history of slavery and its afterlives. This freely accessible resource has been the foundation for advancing public discourse and debate across the Caribbean, the United Kingdom and the world. Since its launch in 2013, the database has seen more than three million unique visitors. The database uses the compensation records of the National Archives to identify British slave owners who received payment for the loss of their property in enslaved persons at the time of emancipation in the 1830s when the British government committed £20 million in compensation to enslavers. An incredibly rich resource, these records provide personal details and compensation sums for more than 40,000 British enslavers. Further research since has allowed us to expand this number to 67,000. This material has enabled us to track social and financial connections between slavery and the development of modern Britain. Through the application of modern database technology, users are able to conduct focused searches that reveal details of the impact of slavery in Victorian Britain that otherwise would have been quite difficult to discover. Our findings and data have been incorporated into research projects and publications, art exhibitions, television series and a range of public engagement activities. The work of the Centre's staff and team members has been reported consistently in the media in the UK, North America and the Caribbean.

The work of the CSLBS began with the pioneering project of its founders, Catherine Hall, Nick Draper and Keith McClelland, who investigated the financial connections between British slavery and nineteenth-century Britain. They developed new methods to assess Trinidadian historian Eric Williams's classic argument in *Capitalism and Slavery* (1944), which first drew attention to the way profits from the slave trade and slavery contributed to British development during the first industrial revolution.

The project was equally concerned with using this compensation data to make a profound argument about the role of slavery in race-making in Britain. Multiple research publications from project members have collectively reinscribed the importance of slavery to the history of modern Britain. The model developed by the project has been adapted by researchers in Australia, France and the UK and incorporated in university teaching across the world. As the esteemed historian Christopher L. Brown noted, 'No work in the field matters more than the Legacies of British Slavery project.'

The Centre's tremendous relevance to contemporary matters around race, memory, slavery and colonialism was made clear with the 2020 Black Lives Matter movement in the UK and the US. A new community of researchers and creatives came to the database and used its findings in their own critical interventions on the racial legacies of slavery.

As one of the flagship projects at UCL, the globally renowned CSLBS has powerfully shifted the national conversation on slavery, colonialism and race.



Aquatint showing enslaved people harvesting sugar cane, from W.A.V. Clark, *Ten Views in the Island of Antigua*, 1823.

I am a Jamaican historian of the Caribbean, and was appointed director of the CSLBS in 2020. Since then, the Centre has embarked on a new core research project, 'Valuable Lives: Unfreedom and Collapse of Slavery in British Jamaica', which will extend the work done in the first decade of the CSLBS with a new database that identifies the names of the last generation of enslaved people in Jamaica, bringing into global, public focus the lives, experiences and stories of thousands of unfree people in the critical decades leading to Emancipation. It will allow us to platform the histories of communities across the Caribbean and their links to the UK and around the world in unprecedented detail.

In addition to its core research activities, the CSLBS has made a significant mark with its numerous related projects, collaborations and public engagements. These include digital histories, a major collaborative project titled 'Global Threads' with the Science and Industry Museum

in Manchester, and educational and heritage projects such as 'Black Industrial Revolution' and our collaboration with 'The World Reimagined'. Members of the team serve as consultants, researchers, assessors and board members of museums and national institutions connected with the investigation of slavery and its longer impacts on British and Caribbean history.

As one of the flagship projects at UCL, the globally renowned CSLBS has powerfully shifted the national conversation on slavery, colonialism and race. The Centre's mission for reparative justice and decolonial narratives of difficult histories is motivated by the sustained response to our work. With its new phase of work, it will build on this legacy by maintaining its reputation for rigorous standards of research and to collect and tell lasting stories of the past, drawing on the tremendous potential of digital technologies.

Matthew J. Smith is Professor of History and Director of the Centre for the Study of the Legacies of British Slavery.

Sociology of education at the IOE

Jessica Ringrose

Sociology of education has a rich history at the Institute of Education (IOE), dating back to the 1940s. A newspaper clipping from 1945 announces the appointment of Karl Mannheim to the IOE, arguing his hiring was both 'daringly original and a sign of the times'. A Hungarian sociologist who had been in post at the London School of Economics, Mannheim was best known for his study *Man and Society in an Age of Reconstruction*.

From the 1950s IOE established and was at the leading edge of the sociology of education in the UK and internationally. Among the most influential figures in this field were Basil Bernstein, who worked on issues of social class and language codes, and Jean Floud, who studied the sociology of education and the economy. It was not until 1964, however, that the IOE offered a joint MA degree in the sociology and philosophy of education. Among the first group of graduates were Brian Davies and Pat White. In 1967, Brian Davies and Michael Young joined the IOE staff, and a distinct MA degree in the sociology of education was launched in 1969. Tony Green led the sociology of education degree from the 1970s for nearly 30 years. Notable staff working in the sociology of education included Chris Mullard, who researched race, Diana Leonard, who worked on the sociology of women, sex and feminism, and later Dave Gillborn and Deborah Youdell, who pioneered critical race theory at the IOE. A Karl Mannheim Chair was inaugurated – its notable holders have included Basil Bernstein; Geoff Whitty (Director of the IOE from 2000 to 2010); Stephen Ball, who pioneered educational policy studies from a sociological lens, and is one of the most widely cited sociologists in the world; and the present occupant of the Karl Mannheim Chair, Louise Archer, who was recently awarded an OBE for services to education in England.

The sociology of education looks at the relationship between education (writ large) and society. Strong strands of work in gender, race and class equity continue to thrive at the IOE through



Karl Mannheim (1893–1947).

the Centre for Sociology of Education and Equity co-directed by Louise Archer, Caroline Oliver and me. Our work is concerned with equity and diversity, both developing a critical analysis into structures of power in education and wider society and understanding modes of response.

Some examples of current and recent contributions include the work of Carol Vincent, who has looked at class, parenting and policy implications for three decades. Caroline Oliver uses Pierre Bourdieu's concepts to look at issues of migration and resettlement, and (with Vincent) the experiences of autistic young people and their families. Alice Bradbury applies Foucauldian approaches to understanding assessment practices and inequalities in the early years and in primary education. Bronwen Jones and Patrick Bailey's collaborations explore neoliberal policy formation and its application in schools. Rhiannon Firth studies the pedagogical practices of social movements including disaster

relief and food security movements and their utopian potential, drawing on Mannheim. Brett Lashua's research explores popular pedagogies through youth media-making in informal learning contexts and arts-based social justice initiatives. Tiffany Page analyses the enactment of institutional and epistemological forms of violence within the context of higher education. Victoria Showunmi has developed Black feminist approaches to educational leadership and schooling. Sara Bragg and I collaborate to explore issues of gender inequity and trans-inclusive and intersectional feminist frameworks for studying youth voice and gender-inclusive educational policies and interventions. Louise Archer and her team have worked extensively with teachers, informal educators, young people and

What we all have in common is, like Mannheim, breadth and depth that expands beyond a narrow understanding of the sociology of education as a sub-disciplinary field of sociology.

**University of London, Institute of Education :
Prof. Karl Mannheim**

DR. KARL MANNHEIM has been appointed to the chair of education in the University of London, in succession to Sir Fred Clarke, who retired at the end of the last academic year. The appointment dates from October 1, 1945, and is tenable at the University Institute of Education. Mannheim's appointment may be regarded as both daringly original and a sign of the times. A Hungarian by birth, he gained his doctorate in philosophy at the University of Budapest, and was becoming known as a sociologist of repute while teaching in Germany before 1933. The events of that year brought him to Britain, and to a lectureship in sociology in the London School of Economics. In 1940 his impressive study of "Man and Society in an Age of Reconstruction" established him in the front rank of sociologists, and the collection of essays he published in 1943 under the title of "Diagnosis of our Time" enhanced an already considerable reputation.

Mannheim has always shown himself peculiarly sensitive in his sociological studies to the importance of education, and since 1941 has been attached to the staff of the London University Institute of Education, but can scarcely be regarded as possessing the normal professional qualifications for a professorship in the subject. Paradoxical as it may seem, this is probably why he has been appointed. The Institute, under the leadership of Sir Fred Clarke, has in recent years been laying increasing emphasis on the social aspect of public education, and insisting that the philosophy of education must be worked out on a sociological basis. No one is better fitted to undertake this task than Mannheim.

policy organisations to uncover the factors shaping unequal participation in STEM and to co-design new tools and approaches to support equitable and inclusive practice in the UK and internationally.

The sociology of education MA programme is still going strong alongside sociology-based master's degrees in social justice and education, and policy studies in education. We also work at the undergraduate level, contributing a strong sociological strand on the BA Education, Culture and Society degree and the BSc in Sociology. What we all have in common is, like Mannheim, breadth and depth that expands beyond a narrow understanding of the sociology of education as a sub-disciplinary field of sociology. Our team is passionate about researching how educational processes are integral levers through which social transformation manifests for good or for bad, and our work seeks to shine a light on how more equitable educational pathways are always possible.

Jessica Ringrose is Professor of Sociology of Gender and Education.

Refugees hosting refugees

Elena Fiddian-Qasmiyeh



Everyday life in Baddawi refugee camp, Lebanon, home to Palestinian refugees since 1950 and to refugees from Syria since 2011.

It is typically the members of local communities who provide support and assistance when refugees arrive in their towns, cities and refugee camps. UCL's 'Refugee Hosts' research project has examined how refugees displaced from Syria since 2011 have experienced living alongside different 'hosting' communities in nine neighbourhoods across Lebanon, Jordan and Türkiye.

In many cases, the people who are first responders and are hosting refugees have themselves had personal or familial experiences of displacement, through processes of 'refugees hosting refugees'. Refugee-led initiatives developed in response to displacement directly challenge widely held (although equally widely contested) assumptions that refugees are passive victims in need of care from outsiders. In one of the neighbourhoods at the heart of the Refugee Hosts project, our team examined encounters between established Palestinian refugees who have lived in a refugee camp on the outskirts of the Lebanese city of Tripoli since the 1950s (Baddawi camp) and increasing numbers of new refugees arriving from Syria since 2011. These include not only Syrians but also Palestinians and Iraqis who had been living in Syria at the outbreak of the conflict and who became refugees once more. In Baddawi camp, Palestinians have been active providers of support to others, rather than merely aid recipients themselves, reflecting the extent to which urban refugee camps become shared spaces.

This is not the first time that Baddawi camp and its inhabitants have welcomed 'new' refugees. The camp's residents also hosted over 15,000 'new' Palestinian refugees who were internally displaced from nearby Nahr el-Bared refugee camp when that camp was destroyed during fighting in 2007. With an estimated 10,000 refugees from Nahr el-Bared still residing in Baddawi camp, these 'internally displaced refugees hosted by refugees' have in turn become part of the established community in Baddawi, hosting 'newly' displaced refugees from Syria.

While destabilising the assumption that refugees are always hosted by citizens, and highlighting the importance of relationships between different groups of refugees, the Refugee Hosts project shows that encounters characterising refugee-refugee hosting

are not to be idealised, since they are also often framed by power imbalances and processes of exclusion and overt hostility by the members of the original refugee community towards new arrivals.

Rather than viewing these tensions as inevitable, our research shows clearly that certain policies and programmes designed and implemented by states and humanitarian organisations alike can activate resentment and insecurity among hosts. There is therefore an increasing commitment to implementing development-oriented programmes that aim to support both refugees and host communities. In the context of overlapping displacement and refugees hosting refugees, these tensions may be the result of the uneven development of programmes for different 'generations' of refugees and for refugees according to their country of origin. This is visible in Baddawi camp, whose established inhabitants have received limited assistance from UNRWA (the United Nations Relief and Works Agency for Palestine Refugees in the Near East) since the 1950s, while newer arrivals from Syria received support from an expanding range of international and national organisations.

The challenge that remains is for researchers, policymakers and practitioners to actively explore the potential to support the development, and maintenance, of welcoming communities, whether these communities are composed of citizens, new refugees or established refugees. Acknowledging the widespread reality of overlapping displacement is an important entry point to recognising and engaging with the agency of refugees and their diverse hosts: refugees, hosts and refugee hosts all provide support and welcome as active partners in processes of integration, while also recognising the challenges that characterise such encounters. At a minimum, research shows how new programmes and policies must avoid re-marginalising established refugee communities which are hosting newly displaced people; at best, they can be sensitive to supporting the needs and rights of all refugees, whether they are hosting or being hosted.

Elena Fiddian-Qasbiyeh is Professor of Migration and Refugee Studies.

Addressing grand challenges with missions

Mariana Mazzucato

In 2018, I became founding Director of the UCL Institute for Innovation and Public Purpose (IIPP). IIPP was founded to rethink the state across several key pillars: new economic theory, global policy impact, training for new leaders and civic engagement. IIPP's research addresses how public value is imagined, practised and evaluated, and investigates the role of policy beyond simply fixing market failures towards a more ambitious agenda of actively co-creating and shaping markets to achieve inclusive and sustainable growth. Our work encompasses themes like rethinking value, shaping innovation, transforming institutions, directing finance and – more recently – creating an economy centred on the common good. The IIPP Master of Public Administration (MPA) curriculum is based on the premise that civil servants are not just market fixers, but co-creators and shapers of value. The programme explores new approaches to public value and market shaping, public policy and innovation, design, creative bureaucracies and digital government, in a combination of topics that is unique to our MPA. Concurrently, the IIPP PhD encourages researchers to push new economic thinking forward. Both our programmes attract a diverse group of students from around the world who bring their distinct experiences, knowledge and interests to the table.

Beyond our academic offerings, IIPP's policy work is based on the concept of practice-based theorising, where new economic theories are tested in real-world contexts and then fed back into the theory, providing a link between policy, research and training. As part of this work, we have advised governments locally and around the globe on their mission-oriented strategies, which can be used to generate momentum around solving challenges such as climate change and inequality. Through well-defined goals, or 'missions', policymakers can determine the direction of growth, coordinate action across different ministries and sectors, and shape

new markets, industrial landscapes and national innovation systems. Orienting policies around outcomes, rather than specific sectors, catalyses intersectional collaboration, as all sectors can work and collaborate towards solving the challenge, resulting in sustainable and inclusive growth – not just growth for growth's sake.

Our work has had a big impact on the adoption of missions in regions such as the EU, the UK, Barbados and Brazil. Additionally, on the global level, I shaped the G20 agenda as co-chair of the Group of Experts to Brazil's G20 Taskforce for the Global Mobilization against Climate Change alongside Dr Vera Songwe. The Group of Experts had a unique opportunity to provide bold advice that brings global climate action together with global financial reform, with a direct mandate from President Lula of Brazil. Our final report – *A Green and Just Planet: The 1.5°C agenda for governing global industrial and financial policies in the G20* – sets out a global agenda to decarbonise G20 economies based on ambitious, all-of-government green industrial strategies and green financial policies.

In the EU, I worked with the former European Commissioner for Research and Development to advise the Horizon Europe innovation programme on implementing five key missions around adaptation to climate change, cancer, healthy oceans, climate-neutral cities and soil health. In the UK, we helped the government shift from a sector-focused industrial strategy to a challenge-oriented strategy, going from a list of sectors (aerospace, automotive, life sciences, finance and the creative industries) to four challenges (focused on outcomes including sustainable mobility, healthy ageing and clean growth) through my work as co-chair of the UCL Commission on Mission-Oriented Innovation and Industrial Strategy in 2018. More recently, we advised the Starmer government on how to shape Labour's mission-oriented strategy and think more concretely about its implementation, for

example in relation to procurement and the national wealth fund.

We have also worked with countries in Latin America and the Caribbean for over a decade to help shape economies that are resilient, inclusive and sustainable. In 2022, I co-authored an influential report with the UN Economic Commission for Latin America and the Caribbean titled *Transformational Change in Latin America and the Caribbean: A mission-oriented approach*, which kicked off IIPP's work with several governments in the region. In Barbados, I have advised Prime Minister Mia Mottley on the development of a mission-oriented policy strategy launched by the government in 2023, leading to the adoption of six missions focused on turning the country's challenges into opportunities for growth and development. Meanwhile, in Brazil we have worked with the Ministry of Management and Innovation of Public Services and the National School of Public Administration to advise on the design and implementation of a new mission-oriented industrial policy around public procurement, state-owned enterprises, digital public infrastructure and the government's relationship with the private sector in Brazil, aligning the state's tools and institutions with critical climate and inclusion goals.

The next phase of our research here at IIPP will be focused on developing a deeper theoretical understanding of the common good, which builds on but goes beyond mission-oriented statecraft. This new framework can be applied to many areas, such as water. The final report of the Global Commission on the Economics of Water, which I co-chaired, calls for valuing the whole hydrological cycle as a global common good, understanding that the complexity of the water crisis crosses regional and political boundaries, and thus requires new governance structures and new economic thinking. More broadly, the economics of the common good focuses on common objectives, where the *how* matters as much as the *what* – a fundamental transformation of the



The hydrological cycle in action: evaporation in the Amazon rainforest.

way we approach our shared global challenges. In November 2024, I convened a dialogue with Pope Francis and Prime Minister Mia Mottley at the Vatican to discuss this very topic, a historic convening of moral, political and economic leadership.

While the societal and economic challenges we face are daunting, mission-oriented policies and a common good framework can bring hope by offering a way of breaking the solutions down into concrete steps that can be implemented across various policy contexts, transforming challenges into opportunities.

Mariana Mazzucato is Professor in the Economics of Innovation and Public Value and founding Director of the UCL Institute for Innovation and Public Purpose (IIPP).

London Day Training College: forerunner of the Institute of Education

Tom Woodin

At the turn of the twentieth century, a sense of change was palpable. Although London sat at the heart of the largest empire in history, it was ravaged by inequality and poverty, which imperial adventures such as the Boer Wars had illuminated. A year after the death of Queen Victoria, the 1902 Education Act seemed to promise an 'educational ladder' based upon scholarships for secondary education, but these were only for the lucky few.

The London Day Training College (LDTC) – now the IOE – began in 1902, as a partnership between London County Council and the University of London. In contrast with most teacher training colleges, the LDTC accepted women and men on a non-residential basis, many from modest homes, who followed courses of between one and four years, usually comprising general education and professional training, which required a strong physical and mental constitution. From the outset, the LDTC operated in an international arena where it gained an impressive reputation, attracting students from what were then Britain's colonies and dominions and beyond, especially from India.

Shifting ideas about teaching were in circulation at the time. Technical aspects of training teachers were complemented with expansive conceptions of teaching and learning. John Adams, the first principal, laid out his ideas for a cultured and professional body of teachers which was ambitious and expensive, but without it a generation of children would be sacrificed to poverty and ignorance. The cost of teacher training could be borne by the public in one of two ways, he averred: 'it can pay in money or it can pay in children'. Adams was supported by a formidable body of staff who made a major contribution to the 'new education' that dispensed with traditional pedagogies such as rote learning. A key role was played by the deputy principal and mistress of method, Margaret Punnett, who was celebrated in a student song: 'If owt's been dunn 'ere, Miss Punnett's dunnit.' Clotilde von Wyss



A lecture by Percy Nunn at the London Day Training College.



infused teachers of biology, hygiene and nature study with an irrepressible sense of wonder and enthusiasm. A future director, G.B. Jeffery, in contemplating the mix of craft and scholarship at the LDTC, recalled his influential predecessor, Percy Nunn, who 'never talked down to you . . . you were learning together'. From the 1920s, 'colonial' courses were introduced and would gradually transform into the field of international development familiar today. Staff in art, history, English and modern languages made strong intellectual and practical contributions that bequeathed a rich legacy to the Institute of Education, established out of the LDTC in 1932. As a full part of the University, the IOE could enhance its research and attract academic kudos through new appointments such as Susan Isaacs, who developed original work on child development (see p. 208). Paradoxically, progressive education in this period could be closely allied to restrictive definitions of intelligence and selection, asserted by Cyril Burt and others, connections that would subsequently be severed as it was realised that educability was potentially universal.

As teacher educators continued to innovate, they would benefit from diverse disciplinary approaches, notably psychology, philosophy, history and sociology but also geography, art, science, economics and others. The early focus on psychology would be complemented with the wider social perspective of people like Fred Clarke (see p. 214), the director from 1936, who made appointments in history and comparative education as well as the prominent sociologist Karl Mannheim (see p. 164). The IOE was to remain at the forefront of the coming waves of reform while enriching our understanding of education. Crucially, the founding principle of blending teacher education and critical scholarship persisted as a defining feature of the LDTC, the IOE and, from 2014, UCL.

Tom Woodin is Professor of the Social History of Education.

Inclusive crisis recovery

Lauren Andres and Lucy Natarajan

Researchers from the Bartlett School of Planning (BSP) have been learning from the Covid-19 pandemic and associated crises, looking at their impact on cities, policies and more importantly people. Coping, resilience, recovery and future crisis preparedness have been at the core of their work. This has included leading major initiatives from large-scale global studies on young people's vulnerabilities and cities' adaptations to up-close action-research on food security in London and Birmingham. All these projects have critically reflected upon the failure of state responses and involved an examination of communities' adaptations to address basic needs and rights.

The impact of crises is enormously unequal and shaped by intersectional vulnerabilities and burdens, with women and racial minorities typically suffering the most. Among those at risk are children and young people, whose voices and needs are not sufficiently accounted for. During the pandemic, this age group was dramatically impacted by the combination of school closures, restricted access to nutritious food, and limited opportunities to play and socialise. Overall, limited lessons have been drawn from the pandemic, while other crises (such as the cost of living, increased school dropouts, mental health and the international funding aid landscape) are spreading further. Multi-scalar work is being conducted at BSP in partnership with local, national and international organisations (among them the Institute of Development Studies and UNICEF) to co-design recommendations that inform both policy and practices. Key here is to ensure that the most vulnerable can be better supported in the context of ongoing disruptions and major future crises.

Our commitment to leading transformative societal change translates into our research-led teaching, which informs how we are approaching planning, urban design and real estate pedagogy and helps prepare BSP students to engage with crisis and practise urban making. Their designs show

how to embrace the principle of recovery in city re-imagining. For example, inspired by beehive structures, an undergraduate employed the natural modular design principles to plan a biophilic liveable outdoor co-working space. This formed part of the post-pandemic recovery-themed BSP Expo in 2024, which allowed students to exhibit their work and specifically their innovative ideas around how urban environments can recover and thrive.

BSP is co-producing strategies to allow communities, cities and organisations, in various urban settings, to be better prepared for the next crisis. This includes working with UNESCO to promote learning and community hubs for the evolving right to education in times of crisis, preparing a call for action on strengthening urban resilience and sustainable neighbourhoods for children with UNICEF, and shaping the underpinnings behind the development of devolved community hubs as radical catalysts to deliver health and food justice. Our team also works with the UN's network of professional bodies, the Habitat Professionals Forum, to roll out their initiatives for inclusive practice post-crisis, including the 'Roadmap to Recovery', and to implement the International Participatory Charter. The combination of those initiatives positions BSP at the forefront of shaping the future research, policy and pedagogical directions for promoting inclusive crisis preparedness and recovery, with the primary focus of not leaving anyone behind.

Lauren Andres is Professor of Planning and Urban Transformations and Director of Research at the Bartlett School of Planning. Lucy Natarajan is an Associate Professor at the Bartlett School of Planning.

Children adopting the streets as playgrounds in Paraisópolis, one of the largest favelas in São Paulo (Brazil), lacking green and outdoor spaces and where young people live in extreme poverty while receiving little support from the state (captured during PANEX-YOUTH research exploring the impact of Covid-19 on young people's access to food, education and play/leisure).



Residencial S...
Paratibapi...

Residencial S...
Paratibapi...

Forensic science

Ruth Morgan

We all love a great mystery: piecing together the clues, working out the what, where, who, when and why, and having the pieces fall into place. Thanks to the many portrayals of forensic science in literature, television drama and film, the idea that science is a powerful tool that unravels the clues and solves the puzzle is compelling and has put forensic science in the spotlight.

In 2009 the National Academy of Sciences (NAS) released a report that highlighted serious concerns about the scientific basis for many fields of forensic science. It created shockwaves throughout the science and justice communities. The root of the problem? It was not the accuracy of the analytical techniques classifying traces to work out what they are. It boiled down to the issue that evidence can tell you everything you need to know, but only if you know what it means.

There was a lot of science underpinning the capability to work out 'what is this trace' and even 'who does it belong to'. The road less travelled was finding the key to evaluating that evidence and understanding what the evidence means. If your DNA is found on a weapon, is that because you used that weapon to commit a crime, or did it get there through secondary transfer, weeks before the crime took place?

The UCL Centre for the Forensic Sciences (CFS) was founded in 2010 on the basis that the question 'what does it mean' could only be answered by bringing multiple disciplines together to tackle the deep roots of this challenge. The CFS was the first research unit in the world to pioneer an approach that was steeped in casework-informed co-designed research questions and empirical methods to answer this critical question. The vision of the CFS is to ensure that our understanding of traces (how they transfer, how they interact in different environments), and our understanding of how scientists and investigators interact with evidence to evaluate and infer what it means, were underpinned



Diatoms – microscopic algae – are highly environmentally specific and are environmental traces that can assist in crime reconstructions.

by empirical casework-informed data.

The CFS has become the most prolific producer of award-winning research that addresses this challenge in the world. Research has addressed trace DNA, explosives, soils and sediments, diatoms and pollen, human remains, fragrances and digital traces. There has also been ground-breaking research seeking to understand how the scientists who collect, identify, analyse, interpret and evaluate those traces, and present the findings to investigators and the courts, make inferences and reach conclusions about what the evidence means.

In 2016 it became clear that despite the new insights and data that had been produced, the same challenge that the NAS had identified in 2009 was still very much the reality in practice. Excellent science was step one. Step two, getting that science into the hands of those that could use it within the justice system in an engaging and accessible way that had real impact, needed attention. The CFS developed research to connect the science with policymakers and the public (who sit on juries). A key question was, 'how big an issue is the misinterpretation of evidence really?' The CFS

carried out a study that identified that 22 per cent of cases upheld at the Court of Appeal in England and Wales in 2010–16 had misinterpreted evidence in the original trial. To raise the visibility of this challenge, the CFS collaborated on a widely aired and award-winning film about the challenge of misinterpreted evidence. I worked as a specialist adviser to the House of Lords Science and Technology Committee, and CFS academics advised on science evidence in casework and acted as expert witnesses.

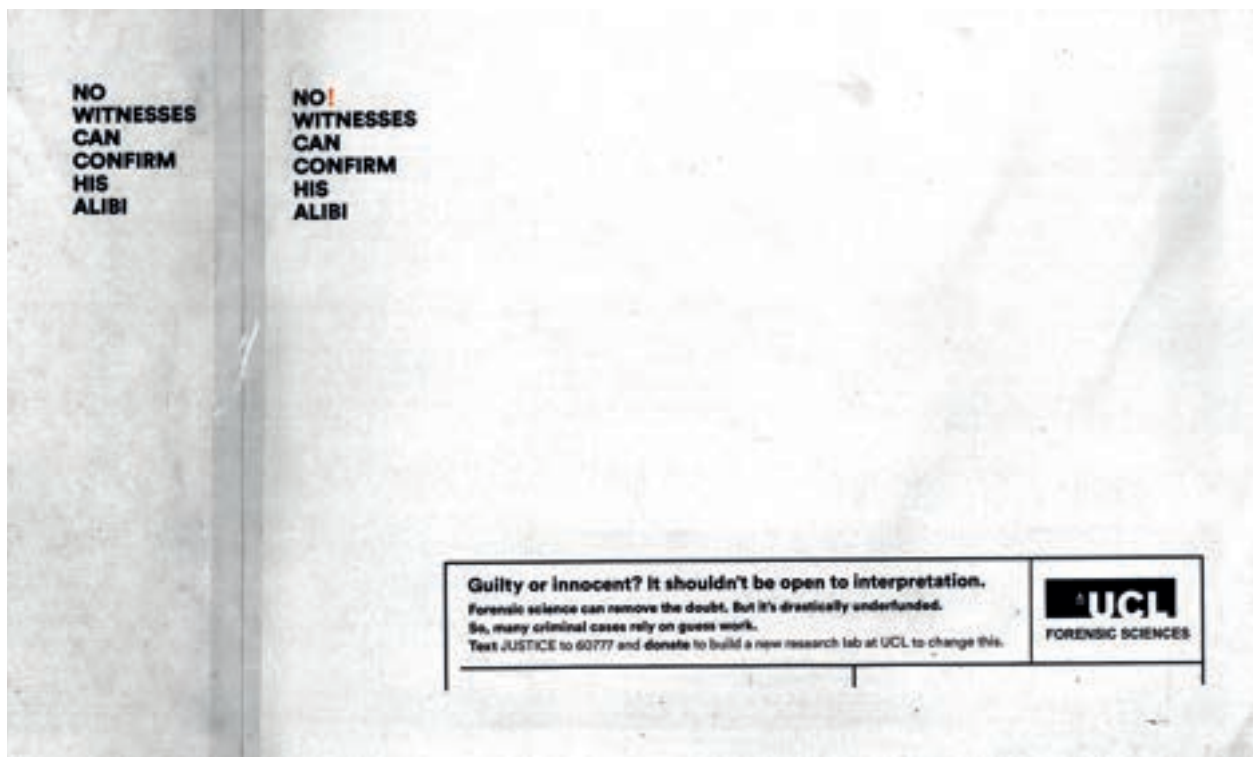
Looking forward, the CFS continues to have a highly distinctive remit in the discipline of forensic science focusing on the interpretation of evidence. New challenges are emerging as the capabilities of technologies grow and evolve, meaning that new forms of evidence need to be understood.

To that end, the CFS is pioneering creative and innovative approaches, championing the importance of connecting the arts and sciences to specific

If your DNA is found on a weapon, is that because you used that weapon to commit a crime, or did it get there through secondary transfer, weeks before the crime took place?

issues in forensic science, advocating for the necessity for creativity and imagination, enabling conversations across traditional boundaries, raising the importance of storytelling for science to contribute and aid the justice system, and above all remaining agile and staying curious.

Ruth Morgan is Professor of Crime and Forensic Sciences.



Evidence can tell you everything you need to know, but only if you know what it means. This campaign shared the story of UCL's work addressing the robust interpretation of evidence in the justice system.

Microeconomic policy analysis

Richard Blundell

Forty years ago saw an exciting turning point in the history of economics at UCL. One of the oldest economics departments in England took a step change in its research and policy profile to become a world leader in the new field of empirical microeconomic policy analysis. Combining innovative research on economic models and econometric methods with new sources of microeconomic data, this analysis successfully addressed some of the key policy challenges in economics and in society. It sought to answer questions such as: how do individuals, families and firms respond to tax and welfare reform? What is the impact of such reforms on inequality? Why do different families have such different levels of retirement savings? What are the drivers of investment and innovation by firms? This cutting-edge microeconomic research was able to draw credible inferences about the impact of policy reforms at a level of detail and rigour that was previously unattainable, generating a new breed of exceptionally talented young social scientists and a lasting impact on empirical policy research across the world. PhD students who worked on that research are now full professors at Stanford, Yale, Oxford, LSE, Manchester and many other leading universities. Other researchers took a less academic, but equally successful route, to become influential policymakers and government ministers, leaders in the business community and high-profile economic journalists, including at the BBC, the *Financial Times* and the *Economist*.

I was lucky enough to be there at the outset. I was appointed to the Ricardo Chair in Political Economy at UCL in 1984 (arguably the oldest-established chair of economics in England) and built a close collaboration with a then-fledgling policy research institute, the Institute for Fiscal Studies (IFS), where I was appointed Research Director in 1986. Together with a remarkable group of young colleagues and students at UCL and IFS, this venture has produced some of the most-cited academic

papers in economics and some of the most influential microeconomic policy analyses with a material impact on people's lives. For example, microeconomic work on tax policy research in the late 1980s and 1990s, co-authored with my then young UCL colleague Costas Meghir, now a professor at Yale, uncovered the precise impact of tax and welfare reform on individuals and families, showing that many were largely unresponsive to tax reform but, for some specific groups, the impact could be large, with lasting impacts on employment and on inequality. The work highlighted the trade-offs for families with children in the labour market and set the scene for the radical change in work incentives that underpinned the Tax Credit reforms of the late 1990s and early 2000s. Among other academic accolades, this work was awarded the prestigious Frisch Prize, given by the Econometric Society for the best empirical research published over a five-year period.

There was also a very positive reception from policymakers, including HM Treasury, whose permanent secretary at the time noted, 'This microeconomic research on the tax and benefit system has directly influenced UK economic analysis and policy making with respect to the design of tax, tax-credit and benefit integration reforms.' This work not only provided a prediction of the likely revenue and employment effects of tax and welfare reforms, it also provided a detailed impact on poverty and inequality, thus allowing the combination of both 'macro' and 'micro' assessments of policy, now an essential requirement of modern public policy analysis.

Until the 1980s most empirical analysis in economic policy and research was carried out at the aggregate level, only very loosely connected to the behaviour of individuals, families and firms. Consequently, the importance of differences across people was downplayed, and the impact of policy on inequality was almost non-existent. By developing new methods and models, better suited to the study of newly available panel and longitudinal data, work at



Cash continues to play a role in the economic behaviour of individuals in Europe – including approximately 1.5 million adults in the UK in 2023 who are *primarily* cash users, a slight rise on the previous year.

UCL revolutionised the understanding of economic behaviour, and the research group gathered an international reputation for its work on the differential impact of policy reforms across different kinds of people. This work became the underpinning of the highly influential policy research collaboration between UCL Economics and the IFS.

To study questions about the drivers of inequality and many other important issues required extensive collaboration with non-economists. For example, to get to grips with policies around health and retirement, the English Longitudinal Study of Ageing was initiated through a collaboration with the UCL epidemiologist Michael Marmot (see p. 204).

The breadth of microeconomic policy research emanating from this new agenda has been drawn together in two large-scale reviews: the 2010 IFS Mirrlees Review of Tax Reform, and the 2025 IFS Deaton Review of Inequality. The tax review proposed a comprehensive blueprint for radical, but implementable, reforms to the taxation of companies, of property and of labour earnings. Published

to universal acclaim, this work had a substantial influence, inspiring similar reviews around the world. It remains a highly cited guide to tax reform the world over. The inequality review is concluding as I write, and by uncovering the nexus of interactions between educational inequalities, labour market inequality, health inequalities, firm productivity and political inequality, it has already had a major impact on policy discussion over how best to address the adverse effects of inequality.

This thriving collaboration between UCL and IFS continues today, with Imran Rasul from UCL Economics at the helm as IFS Research Director. I am enormously proud to have been there at the inception of this remarkable collaboration. It continues to generate highly innovative research, to inspire new generations of talented young empirical researchers, and to provide a lasting impact on the understanding of economic behaviour and of policy impact around the world.

Richard Blundell is Ricardo Professor of Political Economy.

Legal reform

David Ormerod

Law is a dynamic evolving phenomenon, and this energises legal education and offers exciting opportunities for scholars to impact on legislative, policy and practice reforms. From its inception, members of the UCL Faculty of Laws held leadership roles in major reform agendas. Andrew Amos and John Austin (founding professors) served the Royal Commission on the Criminal Law (1833–45). Inspired by Jeremy Bentham, the Commission was tasked with 'digest[ing] into one statute the statutes touching crimes, and the trial and punishment thereof' and of examining the merits of codification generally. Work on codification continues: Ian Dennis worked on the Draft Criminal Code team in 1989, producing a Bill containing the main criminal offences; and I led the work on the Sentencing Act 2020, distilling more than 50 statutes into an accessible Code designed to remain the single source of sentencing procedure law. By the use of innovative drafting the new Code is able to apply to any case, irrespective of when the crime was committed. Throughout the twentieth century, Faculty members galvanised legislative changes in their fields. Notable examples include Val Korah's role (see p. 194) advising Parliamentary Counsel on the creation of the Commission of Industry and Manpower Bill, which established a new body to develop the work of the Monopolies Commission. Similarly, Sir Robin Jacob has been a dominant voice in intellectual property reform for several decades, in the UK and the EU, through his roles in the European Patent Office and European Commission Expert Group.

Faculty members' reform efforts have consistently focused on society's pressing issues. In the nineteenth century the targets included, for example, the work of Henry Roby (Professor of Jurisprudence) on reforming and extending accessibility to the education system. A century later, Lord (Dennis) Lloyd's expertise influenced the creation and enactment of the Rent Act 1965, which introduced regulated tenancies with long-term

security of tenure and independently assessed fair rents – to end 'Rachmanism' (the exploitation and intimidation of tenants by unscrupulous landlords). In the present day, staff continue to promote fundamental values in their reform work. Examples are legion. Dame Hazel Genn's pioneering 1999 Paths to Justice national survey demonstrated the peripheral role of formal justice institutions in delivering everyday justice. It led to the Ministry of Justice commissioning what became the English and Welsh Civil and Social Justice surveys, which accompanied a major shift from demand-led to need-based funding and delivery of legal aid in England and Wales. Led by Pascoe Pleasence, these surveys were used to measure progress against policy targets, and the resulting evidence base has detailed how everyday legal problems are unevenly distributed across populations, how problems cluster and how they have huge social, health and economic impact. The Paths to Justice methodology has been replicated in numerous countries worldwide. The influence of this research can now be seen in the activity of multinational organisations, such as the United Nations and OECD: 2020 saw the introduction of a third Sustainable Development Goal (SDG) indicator, with an exclusive focus on civil justice (to complement the two existing criminal-focused indicators). This was an unlikely prospect two decades earlier.

The Paths to Justice methodology has been replicated in numerous countries worldwide. The influence of this research can now be seen in the activity of multinational organisations.



Tenants in the kitchen at 11 St Stephens Gardens, Paddington – a typical, poorly maintained ‘Rachman property’ before the Rent Act 1965.

UCL Laws has had impacts on numerous other fields. Virginia Mantouvalou’s human rights scholarship on labour law continues to expose the failings in legal protections for victims of severe labour exploitation, sometimes also described as modern slavery. Michael Veale’s work on promoting data rights issues has a global impact on policymakers, industry and legislators and demonstrates the Faculty’s continued commitment to leading reform agendas on emerging social challenges. Further examples where UCL Laws has had impacts on reform across numerous jurisdictions include Andrew Amos’s service on the Governor-General’s Council in India. Amos worked on revisions to Macaulay’s draft Code of Criminal Law, which subsequently became the official criminal code in India between 1860 and 2023.

These and countless other Faculty members’ endeavours reflect the strong reform ethos

integral to legal scholarship and education at UCL. Unsurprisingly, there is also a catalogue of alumni who have contributed to fundamental legal developments across the globe. In England and Wales a notable example is Lord Woolf, former Lord Chief Justice and author of the report which revolutionised civil justice procedure leading to the introduction of the Civil Procedure Rules.

UCL Laws is proud to celebrate almost two centuries of exceptional impact on reforms to promote justice and improve the way people experience the law.

David Ormerod is Chair in Criminal Law.

Collaborative research for community-based solutions in Lebanon

Nikolay Mintchev and Henrietta Moore

Since 2017 the Institute for Global Prosperity (IGP) has led the Prosperity Co-laboratory for Lebanon (or PROCOL Lebanon) – a transdisciplinary network of academic, business, civil society and community partnerships committed to creating new methods, concepts, datasets, capacity-building programmes, policy proposals and streams of funding to support recovery, improve quality of life and build pathways to better futures in Lebanon. PROCOL Lebanon is one of three IGP PROCOLs working on the pressing problems of the twenty-first century in the UK, Lebanon and Africa.

The IGP PROCOLs emerged in response to the need to rethink how prosperity should be conceptualised for the twenty-first century (not as GDP but as quality of life for people and planet) and to revise the role of universities in driving the

translation of new ideas into practical solutions that make a difference. PROCOL Lebanon's initial focus was on prosperity in the age of mass displacement. Since 2019, however, multiple new crises in Lebanon – including severe economic decline, the Beirut port explosion and the outbreak of war in 2023 – have changed the scope of the work into a wider effort to help communities respond to the rapidly emerging, and often devastating consequences of these crises for livelihoods, public services and community wellbeing.

A central part of PROCOL Lebanon's ethos is a commitment to transdisciplinary collaborations between academics, NGOs, policymakers, entrepreneurs and members of the public in the communities where the work takes place. This ethos includes practising a citizen social science methodology in which community



PROCOL Lebanon Researcher and Citizen Science Coordinator Mayssa Jallad leading a discussion with citizen scientists on the impact of their work in their communities.

residents are recruited and trained as members of the PROCOL research team, and subsequently invited to collaborate in research, production and dissemination of outputs, and creation of solutions in their communities and beyond.

PROCOL Lebanon has teams of citizen scientists in a number of areas across the country, including El Mina (Tripoli), Bar Elias and several neighbourhoods across Beirut. These teams have worked collectively to develop context-specific and multi-dimensional prosperity models with metrics and indicators that reflect local experiences and concerns – from access to public services and livelihoods, to quality of urban infrastructures and trust in governance stakeholders. The resulting prosperity models and metrics have subsequently acted as the basis for quantitative and qualitative data collection programmes that measure how well communities are doing on various indicators of quality of life and what areas should be prioritised for interventions. They have also acted as a tool for informing and catalysing the collaborative design and implementation of solutions by citizen scientists, entrepreneurs, NGOs and other members of the PROCOL Lebanon network. The result has been a sustained and ongoing generation of community-based interventions – regeneration of public spaces, an educational programme for young people, social activities to support elderly people and, more recently, projects for offering psychosocial support, essential necessities such as food and sanitation, and food waste collection during the 2024 crisis of war and internal displacement. The lessons learned from these interventions, and the collaborative and participatory methodologies that made them possible, are the subject of ongoing policy dialogues that aim to reshape the narratives of what it means to support communities with their

needs and how positive change can take place in Lebanon and elsewhere.

Nikolay Mintchev is Principal Research Fellow at the Institute for Global Prosperity. Henrietta Moore is Professor of Culture, Philosophy and Design and Director of the Institute for Global Prosperity.

The result has been a sustained and ongoing generation of community-based interventions – regeneration of public spaces, an educational programme for young people, social activities to support elderly people ...

Working together to tackle the biggest issues facing society: UCL Grand Challenges

Sam Balch and Geraint Rees

In its early years UCL introduced several important areas of research to England that are now regarded as core academic activities, such as architecture, medicine and civil engineering. The university went on to pioneer research in disciplines as varied as law, economics, geography, philosophy, Dutch studies, statistics and medical physics in response to the contemporary needs of society.

By the twenty-first century, the world's most pressing concerns had become unprecedentedly complex, systemic and interconnected, evading the grasp of any single area of expertise. In response, UCL led the way in seeking synergies *between* disciplines, and in 2008 David Price (Vice-Provost, Research) established UCL Grand Challenges to provide space for researchers in different subject areas to bring their collective expertise to bear on key societal issues.

By the early 2020s six Grand Challenge themes – Global Health, Sustainable Cities, Cultural Understanding, Human Wellbeing, Justice & Equality and Transformative Technology – had generated nearly 450 innovative projects thanks to internal small grants funding. This involved more than 850 researchers from across UCL's departments, centres and institutes. The outcomes of these projects have been profound, in line with the latest evidence showing that collaborative, interdisciplinary approaches to global problems lead to more significant research and policy impacts compared to conventional approaches. Examples of impact range broadly from improving sustainability and access to urban transport in cities across the global south to reducing infant mortality in low-income countries.

Working effectively in an interdisciplinary way is not easy. It requires researchers to find common ground around a shared interest or problem, to value and respect each other's disciplines and approaches, and to confront the limits of their own knowledge. The role of research-adjacent staff in these projects

is often critical but unseen, from finding connections and organising networks to providing practical support and advice to enable groups of diverse researchers to explore their shared interests. Researchers have also embraced collaborative working with communities, building relationships and shaping research informed by real-life conditions.

UCL's 2022–7 Strategic Plan reimagined the Grand Challenges as a key academic initiative, with five new themes, new strategic academic leadership, a twenty-fold increase in investment, and a diverse network of partnerships with different organisations and groups across London, the rest of the country and globally. We find many willing partners, as other universities and organisations have recognised the effectiveness of this approach and adopted it to accelerate progress on humanity's major problems. We look forward to the launch of two further Grand Challenges in 2025/6 and 2026/7 – Inequalities and Intercultural Communications.

Looking ahead, the Grand Challenges will embrace a unified and collaborative approach, integrating academic and professional expertise across the institution. We will lead with vision, spark innovation, mobilise efforts and strategically fund transformative projects. By forging new strategic partnerships and expanding networks, we aim to drive profound change both within the institution and beyond, contributing to bold and holistic societal impacts.

Sam Balch is Director of UCL Grand Challenges.

Geraint Rees is Vice-Provost (Research, Innovation and Global Engagement).

The university's current Grand Challenges include:

Mental health and wellbeing **Essi Viding and Argyris Stringaris**

UCL is leading the way in finding new solutions for mental health and wellbeing. We are breaking down

disciplinary silos and bringing discovery to practice. Our computational neuroscience research has led to major advances in our understanding of brain function. Scientists are now using biomarkers based on this understanding to help us identify which antidepressant drugs work best for whom, and how exercise can have an antidepressant effect. Our ambitions go beyond treating severe mental illness. We know that prevention and early intervention of mental health problems is of key importance and work together with schools and communities to achieve that. Our researchers have partnered with young people to develop a school-based

intervention for adolescents at risk. This combines computerised emotion training and group-based social skills practice that provide adolescents with a 'resilience toolkit'.

Essi Viding and Argyris Stringaris are Pro-Vice-Provosts for the Mental Health and Wellbeing Grand Challenge.

Climate crisis

Lisa Vanhala and Mark Maslin

UCL is the global university for climate leadership, with a critical mass of expertise and convening power to develop solutions and provide advice on climate



Luke Jerram's *Gaia* (2023), installed at UCL East.

issues. In 2024 UCL launched the new Climate Crisis Grand Challenge, aiming to significantly advance cross-disciplinary climate change research within UCL and to foster engagement with top-tier partners, including business, government and civil society. At UCL we are training the next generation of scientists, researchers, policymakers, politicians and business leaders who will play an essential part in developing the tools needed for the global net zero transition and to build climate-resilient societies. Through the Grand Challenge's 'living lab' model, we are creating an environment on campus through which students and staff can research, teach and experiment on practical solutions to sustainability challenges, on issues such as plastic waste, water consumption and supply chains. We are also partnering with London local authorities, including Camden and Islington, to support them in taking climate action in a research-led way. UCL is committed to working with partners across the world to make our future more sustainable, healthier and safer for everyone.

Lisa Vanhala and Mark Maslin are Pro-Vice-Provosts for the Climate Crisis Grand Challenge.

Data-empowered societies

Allison Littlejohn and James Hetherington

Data is changing almost every aspect of our lives. It's transforming medicine and healthcare, improving climate resilience, and altering how we live and learn through new ways of measuring, sharing, analysing and making decisions. But in an era of 'data-driven' innovation, technical advances sometimes outpace our understanding of how elements of society can be harmed, or left behind through exclusion, machine bias or reductionist approaches to analysis. To truly empower society with data, we need to ensure that data serves human needs. Our vision is to deliver positive innovation through data, realising benefits and minimising harms that digital technology is contributing to in society. We are doing this by bringing transformative technologies into harmony with the values, vulnerabilities and needs of people and society. The challenge-led problems we are

Our vision is to deliver positive innovation through data, realising benefits and minimising harms that digital technology is contributing to in society.

tackling include 'knowing and deciding with data', questioning how data can be used to address global issues such as healthcare, sustainability and climate change, and the strategies needed to prioritise human needs and build resilience. 'Data and social change' examines how data can be harnessed for meaningful social change while also addressing equity, privacy and inclusion. 'Working and learning with data' explores how work and learning are being transformed through data use, foregrounding societal impacts and human vulnerabilities. We are also examining 'data-empowered organisations', using UCL as a 'living lab' to research how data-informed approaches can transform operations and offerings. We aim to shift the primary focus from data and technology towards humans and societal needs, freedom, bias and vulnerability as a starting point for the technical design and development of advanced digital systems.

Allison Littlejohn and James Hetherington are Pro-Vice-Provosts for the Data Empowered Societies Grand Challenge.

Jurisprudence

George Letsas, Philip Schofield and Kevin Toh

Jeremy Bentham was the intellectual inspiration for the founders of the London University in 1826, which became UCL in 1836. Bentham's mortal remains in the form of his 'auto-icon' sit prominently nowadays in UCL's Student Centre, and the Faculty of Laws resides in Bentham House. Bentham's follower John Austin (1790–1859) became the first occupant of the Chair in Jurisprudence and the Law of Nations at London University in 1826. The lectures that Austin prepared, published in two bundles – as *The Province of Jurisprudence Determined* (1832), and the rest edited by Austin's widow and published posthumously as the *Lectures on Jurisprudence* (1863) – became the most important work on jurisprudence to appear in England until the publication of H.L.A. Hart's *The Concept of Law* in 1961. They have had enormous influence on subsequent thinking about law and its relation to morality, politics, religion and much else. Summing

up Benthamite thinking about the nature of law in a portmanteau form, Austin defined laws as general commands of a sovereign. In ways that were considered bracingly radical and demystifying at the time, laws were thus portrayed as man-made artefacts, rather than as constraints imposed by God or some other necessary features of the world, and hence things that could be made and remade in the interests of human welfare.

This legal positivism (the idea that law is 'posited' or laid down), and the particular imperativist form of it that Austin took from Bentham, proved to be enormously consequential, not just in the academic world, but also in the self-understanding of many lawyers and politicians internationally. In the academic world in particular, even those who subsequently disagreed with Austin about the nature of law – including Hart, who embraced legal positivism but rejected the imperativist versions



'Lady Justice' on the Old Bailey, London. Gilt bronze statue by F.W. Pomeroy, 1905–6.

associated with Bentham and Austin, and Ronald Dworkin (1931–2013), another seminal UCL figure, who disagreed more fundamentally by characterising moral considerations as partial determinants of the law – have sought to emulate the rigour, clarity and economy of Austin's thinking and expressions. No less a figure than John Stuart Mill, in his reviews of the published lectures, highlighted these aspects as even more important than the contents of Austin's views.

It was Austin's teacher Bentham who was the outstanding legal and moral philosopher of his age. For a long time, however, Bentham's influence was significantly limited by the lack of a modern, scholarly edition of his works. UCL's Provost and Council decided to put this right by establishing a Bentham Committee in 1959 to oversee the preparation of a new authoritative edition of Bentham's writings. UCL has a particular responsibility in that it holds Bentham's voluminous unpublished manuscripts, amounting to around 85,000 pages. The first volumes in the new *Collected Works of Jeremy Bentham* were published in 1968, and the thirty-sixth appeared in 2024. The edition is now being published in open-access format by UCL Press. It is estimated that the edition, when completed, will run to around 85 volumes.

There is no editorial programme comparable in size and importance, from both the historical and the philosophical points of view, to the Bentham *Collected Works* in the Western world, except perhaps that of Marx and Engels. Bentham saw himself first and foremost as a legal philosopher, writing on crime and punishment, the law of evidence and codification, as well as general jurisprudence; but he also made outstanding contributions in economics, politics and ethics. In ethics in particular, as the founder of classical utilitarianism, he has had arguably the deepest and most lasting impact. As the Bentham Project makes more and more of Bentham's writings available, the profundity and importance of his thought will become ever more difficult to ignore.

Dworkin was another guiding light in UCL's jurisprudence firmament. Once a student of Hart's at Oxford, Dworkin rose to prominence through his influential criticisms of Hart's legal positivism, and his devising of a potent alternative – a moralised conception of law based on the primacy of rights and

the ideal of equality. In 1969, he succeeded Hart in the Chair of Jurisprudence at Oxford, which position he left in 1998 to join UCL as the Quain Professor of Jurisprudence. Dworkin left an indelible mark on the academic world of normative theorising not only by his published writings, but also through a colloquium series in legal and social philosophy that he convened at UCL until 2007. Dworkin's colloquium was a cutting-edge intellectual workshop, packed by academics, graduate students and members of the public from London and beyond.

The colloquium had what was then a unique format. Each invited speaker, a leading figure in his or her field, sent a paper in advance and met with Dworkin for lunch, ahead of the seminar, where Dworkin broached three questions about the paper. At the start of the seminar, Dworkin himself would present the speaker's paper before orienting the discussion around the three questions. Dworkin's reconstruction of the speaker's argument would strike the audience as clearer and more nuanced than that in the paper itself. During the ensuing three hours, what initially appeared an innocuous concession by the speaker would gradually emerge as a compelling criticism of the paper. Invariably, arguments were sharpened and papers improved thanks to Dworkin's penetrating intellect. And the discussion would continue, no less structured, during the subsequent dinner. It was in effect a 10-hour intellectual marathon, but only fair, as Dworkin saw it, since it was little compared to the time the speaker spent in writing the paper.

Like Bentham, Dworkin insisted on the importance of a close link between the philosophical study of law and its practical applications. It is entirely fitting that Dworkin retired from UCL as the Bentham Professor of Jurisprudence, bringing our distinguished history in the field to full circle. His colloquium still runs today, now officially under the name 'the Dworkin Colloquium', under the auspices of our interdisciplinary Institute for Law, Politics and Philosophy, to explore the most pressing social and political issues of the day.

George Letsas is Professor of Philosophy of Law. Philip Schofield is Professor of the History of Legal and Political Thought. Kevin Toh is Professor of the Philosophy of Law.



Engraving by James Thomson of a portrait of Bentham, 1823.

6

**The power
of education**

Jeremy Bentham's auto-icon

Tim Causer

Jeremy Bentham (1748–1832), the philosopher, reformer and intellectual inspiration to the founders of the London University (renamed UCL in 1836), died at his home in Westminster on 6 June 1832. His last will and testament contains two particularly striking wishes. The first was that his body be publicly dissected to advance medical knowledge, which was done on 11 June 1832 at the Webb Street School of Anatomy. Bentham's second request was that his remains be reassembled into an auto-icon ('self-image'), which was duly created by his friend, the physician Thomas Southwood Smith. The auto-icon consists of Bentham's articulated skeleton, padded out (not stuffed) and dressed in a suit of his clothes, surmounted by a wax head of such remarkable likeness that 'it seems as if alive', according to the politician Henry Brougham, a friend of Bentham and one of the founders of UCL. Bentham had desired that his own head should be part of the auto-icon,

but the result of the experimental preservation process was rather gruesome, so the sculptor Jacques Talrich was commissioned to create a wax replacement.

The auto-icon remained as an attraction at Southwood Smith's consulting rooms until March 1850, when he offered it to UCL. But for some time UCL seemed unsure about what to do with the auto-icon. In 1857 Southwood Smith was disappointed that though visitors could see it in 'some back room' the 'authorities seem to be afraid or ashamed to own their possession'. John Bowring, Bentham's literary executor, was likewise dismayed when in 1866 he found the auto-icon 'neglected, & I fear moths had attacked the garments'. This neglect is in marked contrast to the present, when both Bentham and the auto-icon are celebrated by UCL.

A number of stories have arisen around the auto-icon and UCL. One is that King's College London



The auto-icon is present, but not voting, at UCL Council on 9 July 2013.



Jeremy Bentham's auto-icon.

students absconded with Bentham's preserved head and played football with it in the Quad. While a group of students did carry off the head in October 1975 (they returned it after UCL paid £10 to the housing charity Shelter), it should go without saying that nobody has used the head as a football. In the late 1980s or early 1990s another group of King's students stole the wax head.

Another tale is that the auto-icon regularly attends UCL Council and is recorded in the minutes as being 'present, but not voting'. This story seems to have already been in circulation when the auto-icon was brought to the University College Committee meeting on 10 February 1976, which marked the College's sesquicentenary, making myth reality. The only other such occasion was when the auto-icon attended UCL Council on 9 July 2013, Sir Malcolm Grant's last as Provost.

The most enduring story is that Bentham founded UCL. In fact, his only active involvement in the foundation was to purchase share no. 633 in the university for £100. Nevertheless, William Twining, formerly Quain Professor of Jurisprudence in the Faculty of Laws, argues that it is right to regard UCL as 'Bentham's College', since 'the central planks of UCL's ethos are clearly Benthamite', namely 'religious tolerance, educational opportunity, freedom of speech and enquiry, useful knowledge and innovation'. The auto-icon, a monument to Bentham's radical philosophy, could have no more appropriate home.

Tim Causer is Principal Research Fellow at the Bentham Project, Faculty of Laws.

Myths have arisen around the auto-icon and Bentham. One is that King's College London students stole Bentham's preserved head and played football with it in the Quad.

Working towards gender equality in and through education

Jenny Parkes and Elaine Unterhalter

In 1878, UCL became the first UK university to admit women to study at degree level. As other universities followed suit, the promise of higher education was one reason, in subsequent decades, for rising numbers of young women completing secondary school in the UK. However, this trend began much later in many other parts of the world, and by 2000, in most countries, it was only girls from higher socio-economic classes who had education opportunities. From the 1950s researchers started to document aspects of gender inequalities within schools and universities, generating questions about how to build gender equality through education.

Women's studies, with a focus on the UK, was pioneered at the Institute of Education (IOE) by Diana Leonard from 1984. In 1997 a module was launched on 'Gender, Education and Development', which looked at some of the international dimensions. A new master's programme on education, gender and international development enrolled its first students in 1999. Every year, over 25 years, a highly dynamic cohort of education practitioners and activists from around the world committed to transforming gender inequalities in and through education has come together, and the degree has launched the careers of a number of leading figures in this field.

Linked to the degree, we developed a range of research studies and published dialogues with policymakers and practitioners looking at the question of gender equality and inequality in and through education from many angles. An early example of our approach was the title of one of the first books from our team, which expressed a concern for work in education to go 'beyond access'. Thus we wanted to push discussions in policy and research on from a narrow aspiration of parity in ratios of girls to boys entering school, to a wider notion of gender equality that entails removing

deeply embedded structures of power and exclusion, and striving for gender equality that entails freedoms for all individuals, irrespective of gender or other markers of discrimination, to choose actions and aspirations that they have reason to value. This book, co-edited with a colleague who was working at Oxfam, included a number of chapters by students based on MA dissertations. We were thus starting to use our teaching to help build the scholarly field.

Over 25 years the research of those teaching on the MA has taken various routes towards our broad goal, with a range of research designs, including qualitative, longitudinal and mixed-methods studies with young people in diverse contexts, critical policy studies, and participatory action research with policymakers, teachers and activists. At the heart of this work have been collaborative partnerships, with national and international NGOs, women's rights activists and governments. For seven years, before the internet became a major source of information, we published the newsletter *Equals*. Here we reported on meetings, key issues and debates, and some personal experiences. Over some years we published the month-by-month experiences with gender issues of a teacher in a small town in India.

One strand of our work has focused on school-related gender-based violence, exploring how young people engage with and navigate multiple forms of interpersonal and structural violence, and contributed to policy and practice on how to prevent and respond to violence through whole-school approaches, and beyond the school grounds. For example, in Uganda we have partnered in studies with Raising Voices, a Ugandan non-profit organisation aiming to prevent violence against women and children, whose whole-school approach is being rolled out in schools countrywide. A new strand of this collaboration, working also



Participants in the Contexts of Violence in Adolescence study.

with Ugandan disability rights organisations, youth activists and researchers, is exploring the intersection of violence, gender and disability, and the role of education.

Another collaborative research project is Accountability for Gender Equality in Education (AGEE), which uses an innovative framework for evaluating gender equality in education. A UCL team has led on its development. Working across a number of locations, including in Malawi, South Africa, Kenya, Indonesia, Sierra Leone and UNESCO offices, AGEE is enhancing the ways in which gender equality in education is understood and evaluated, by supporting the identification of indicators, and using novel forms of data visualisation to build insight into how gender equality in and through education is linked with other areas of social policy. In helping policymakers and activists see beyond parity as the only viable indicator for documenting

gender issues in education, the project is supporting discussions of what gender-transformative education might look like and what actions are needed to bring this about.

The first women students at UCL knew from personal experience a world marked by extreme gender inequalities. While some of these are now a matter of history, violence against women, gender and intersecting inequalities, and the threat of climate change continue to be etched into the education systems we have. There is much to continue to study on these themes at UCL in the hope of understanding better how to support change.

Jenny Parkes is Professor of Education, Gender and International Development. Elaine Unterhalter is Professor of Education and International Development.

Women in legal education and the legal profession

Alison Diduck

UCL Laws is proud of its pioneering role in supporting women's access to legal education. From its inception in 1827, the faculty was the first law school in England to admit students regardless of their religion, the first to admit women alongside men and the first to award a law degree to a woman. It appointed one of the first three female law professors in the UK. These 'firsts' are important. They helped to change attitudes about the role of women in law and society.

Eliza Orme, for example, was the first woman to receive a law degree in England and Wales. She was one of only nine women who sat the first General Examination for Women at UCL in 1869. After UCL allowed both men and women to attend lectures, she became a student in 1872. She persisted with her studies during this time when universities did not yet permit women to receive degrees and nor were women permitted to qualify as a barrister or solicitor. When the University of London reversed its policy in 1878 and permitted women to receive degrees, Orme continued with her studies and received her LLB degree in 1888. She began her legal work in 1875, establishing an office with other UCL Laws graduates, first Mary Richardson and later Reina Lawrence. Because they could not be admitted to the Law Society or the Inns of Court, they offered other legal services including drafting pleadings and documents and providing legal opinions.

These women, like Dorothy Bonarjee, who in 1917 was the first woman to achieve an internal law degree from UCL, and Valentine Korah, who in 1982 became one of the first three law professors in the UK and the first at UCL, followed their dreams not only to study and work in the law, but also to pursue their commitment to justice. Orme was active in Liberal Party politics, the National Society for Women's Suffrage and the Society for the Promotion of the Employment of Women. She became Assistant Commissioner to the Royal Commission on Labour, investigating the working conditions of barmaids and women in the metal industries, and was invited to

join a Departmental Committee on Prison Conditions. Lawrence was the first female councillor elected in London. Bonarjee was a renowned poet and supporter of women's suffrage. Korah's commitment to legal education extended to her teaching around the world, including in Khartoum, and a number of universities in Australia, Europe and the United States.

UCL Laws is proud of these 'firsts'. But our story does not stop there. It is important to see what comes next. In commemorating the achievements of UCL Laws and these exceptional women, and the many more who cannot be listed here, we take inspiration for our continued efforts to support current and future generations of women in the law, as judges, business leaders, politicians, barristers, solicitors and educators. UCL Laws is not content to rest on its history of pioneering women. The faculty's historic commitment to social justice remains steadfast and we are excited about the contributions UCL Laws women will make over the next 200 years.

Alison Diduck is Professor of Law.



Portrait of Eliza Orme, 1900.

Treating the economy as a calculus of pleasure and pain: the Jevons revolution

Ian Preston

'In matters of philosophy and science, authority has ever been the great opponent of truth. A despotic calm is usually the triumph of error.'

From its inception, UCL admitted political economy into its innovative curriculum, the science whose object, in the words of its own statement justifying its inclusion, 'is to ascertain the laws which regulate the production, distribution and consumption of wealth, or the outward things obtained by labour, and needed or desired by man'. The principles taught were rooted in the classical form of economics based in the work of the London-born economic thinkers David Ricardo and John

'In matters of philosophy and science, authority has ever been the great opponent of truth. A despotic calm is usually the triumph of error.'



Jevons in Sydney, aged 22.

Stuart Mill that came to constitute the orthodoxy of its day. In the latter part of the century, these ideas became subject to a challenge now known as the marginal revolution from several writers in different traditions and different countries, among whom the principal British contributor was W. Stanley Jevons (1835–1882).

Jevons was both a student and professor at UCL. A lifelong Unitarian, he enrolled at UCL and studied mainly chemistry and mathematics before family pressure forced him to leave for work in Australia. There he began to develop radical ideas about reformulating economics before returning to study the subject at UCL from 1859 to 1862. Having first presented his new vision, to little notice, in 1862, he developed and eventually won recognition for his ideas while at Owens College in Manchester before returning as professor at UCL from 1876 to 1881. He died in a tragic swimming incident, aged only 46.

Complaining of the 'noxious influence of authority', Jevons rejected the then-dominant framework of ideas which tied the value of goods to the work put into their production. His alternative proposal was to 'treat Economy as a Calculus of Pleasure and Pain', to study how to 'satisfy our wants to the utmost

with the least effort'. Clearly deeply influenced by utilitarian thought, he took seriously Jeremy Bentham's 'felicific calculus', discussing how pleasure derives from consumption of commodities. From there he developed a theory of trade in which goods exchange at prices linked to how they contribute to pleasure 'at the margin', which is to say as associated with the last unit consumed. This perspective on the role of preferences in price determination, refined and extended, is the starting point of modern economic approaches.

If Jevons was not alone in such thoughts, he put together and expressed them with singular clarity – as John Maynard Keynes put it, we find his thoughts 'chiselled in stone' where any other writer 'knits in wool'. Part of what gives his work clarity is his innovativeness not only in the content of his economic thought but also in the mathematical manner in which he thought it should be studied. 'Our science must be mathematical, simply because it deals with quantities,' and the 'appropriate branch' of that mathematics was the differential calculus, the appearance of which in the expression of his theories gives them a particular semblance of modernity.

And as economics was quantitative, so also it should be statistical. Besides his contribution to deductive theorising, Jevons made significant advances in bringing data to bear on economic questions. He made his name, for example, inquiring into the possible exhaustion of coal supplies, writing one of the earliest serious pieces of work on environmental and resource economics, and he was assiduous in collecting data on movements in economic variables as he tried to understand swings in economic activity.

The project that preoccupied him of developing a theoretically coherent quantitative economics, founded on and responsive to evidence, still motivates modern economics.

Ian Preston is Professor of Economics.

Part of what gives his work clarity is his innovativeness not only in the content of his economic thought but also in the mathematical manner in which he thought it should be studied.

Learning with objects: a 200-year history

Thomas Kador and Helen Chatterjee

In an era before photography and cheap ways of reproduction – as in the 1820s – physical objects and specimens represented an essential basis to support learning, and teaching collections were often a mainstay of higher education. When Robert Edmond Grant (1793–1874) was first appointed Professor of Zoology and Comparative Anatomy at UCL in 1827, he was the first person to teach this subject in England and consequently had no pre-existing teaching materials to draw on. He therefore sought a grant of £500 from UCL to build a collection of zoological specimens that he could use for teaching. Most of the specimens he acquired in the late 1820s and throughout the 1830s are still part of the collection of what is now called the Grant Museum of Zoology and Comparative Anatomy (see p. 241). Equally, there was a need for art students at the Slade School of Art to encounter 'great' works of art for inspiration

and acquire essential skills. A number of bequests and donations from the 1840s onwards (including those of John Flaxman's casts and sculptures and Charles Grote's collection) provided the foundation for what is now the UCL Art Museum.

In short, the practice of object-based learning (OBL) at UCL is as old as UCL itself, although the phrase has only been coined over the past decade or so. By way of definition, we would describe OBL as a facilitated interaction with material culture – including museum objects, artworks, documents and even everyday items – to support learning and student engagement. Given UCL's rich variety of collections – including four public museums and some 15 other collections – containing a huge number of objects, artworks and specimens, it is uniquely placed to lead the way not only in the practice of OBL but also in the underlying research



A still-life class using object-based learning at the Slade School of Art in 1881.



Detail from Flaxman's statue of St Michael in the UCL Flaxman Gallery.

on the benefits of working with material culture to support learning and, more recently, wellbeing. One of the key benefits of working with physical collections is that they allow learners to engage using all their senses, rather than just sight and hearing, which tend to dominate mainstream education. Therefore, OBL has the possibility of making learning more accessible for learners who prefer more embodied and multisensorial to visual and aural engagements.

Perhaps the best way to illustrate the power of OBL and collection-based working is through some examples from UCL's collections. A prime example of the potential of reinterpreting historical materials is UCL's Eugenics Collection, which was formed during the first half of the twentieth century to preserve the work of Francis Galton (1822–1911) and Karl Pearson (1857–1936). Both of them were considered esteemed scientists at the time, and while their contributions to science in some fields have been valid, their work on anthropometrics, heredity,

disability and ethnicity has since been debunked as directly racist, ableist and misogynist, with no basis in scientific evidence. Having the facility of working with the objects and materials they put together for the study of eugenics can now provide invaluable insights into dealing with the difficult legacy of colonial and scientifically racist practices. The material also provides a powerful case study regarding questions of ethics, research integrity and what can pass as scientific evidence (see p. 108).

In the early 1900s, at a time when Galton and Pearson were busy conducting experiments that actively sought to denigrate the role of anyone who was not able-bodied, white and male, the Slade School of Fine Art was dominated by female students. For example, in the class of 1918 (the year of universal suffrage), every one of the School's prestigious painting and drawing prizes was won by a female artist. While the UCL Art Museum started with gifts and bequests of 'old masters' and other famous – largely male – artists, there has been a tradition

of accessioning the annual prize winners to the collection since the late 1890s. Consequently, some 45 per cent of the Art Museum's holdings are works by female artists, which compares to less than 2 per cent for many traditional art collections, such as that of London's National Gallery. As many galleries and art museums work on rebalancing their biased collections and exhibitions, the UCL Art Museum provides an essential reference collection especially concerning the works of many emerging, including female, visual artists, who went on to make a name for themselves; they include Paula Rego and Winifred Knights (see p. 66). This collection is also a goldmine for students and academic researchers wanting to gain a more equitable insight into the twentieth-century art world than most modern art museums would allow.

Another collection of international significance is that of the Petrie Museum of Egyptian and Sudanese Archaeology. With some 80,000 objects from Egypt and Sudan, spanning every chronological period from the Lower Palaeolithic (Old Stone Age) to the twentieth century, it is the second largest collection of Egyptian and Sudanese material outside Egypt (after the British Museum). The so-called Tarkhan Dress (see p. 247) is a case study in the important

role that collected items may hold in an as yet unknown future. For over six decades, the Petrie Museum held a rough bundle of linen rags excavated at an early dynastic cemetery in Tarkhan, Egypt in 1913. Just over a century after this shapeless bundle of linen was added to the collection, it was identified as the oldest known woven garment in the world, clearly highlighting that working with objects from heritage collections is as much about the future – i.e. thinking about the learning possibilities the collections may hold for future generations – as it is about the past.

While it is true that object-based learning can be carried out with virtually any physical objects, these examples from UCL show that the university's heritage collections provide a unique opportunity for learners and researchers to engage with the histories of knowledge as preserved in these materials. These histories are multilayered, complex, frequently difficult and always interdisciplinary, thus granting learners rare opportunities to approach the world beyond the binaries of true and false.

Thomas Kador is Associate Professor in Creative Health. Helen Chatterjee is Professor of Human and Ecological Health.



Object handling, slow looking and drawing session with a range of UCL Collections items, including a puma skull from the Grant Museum of Zoology.

Research-informed teacher education, supporting learning about the Holocaust

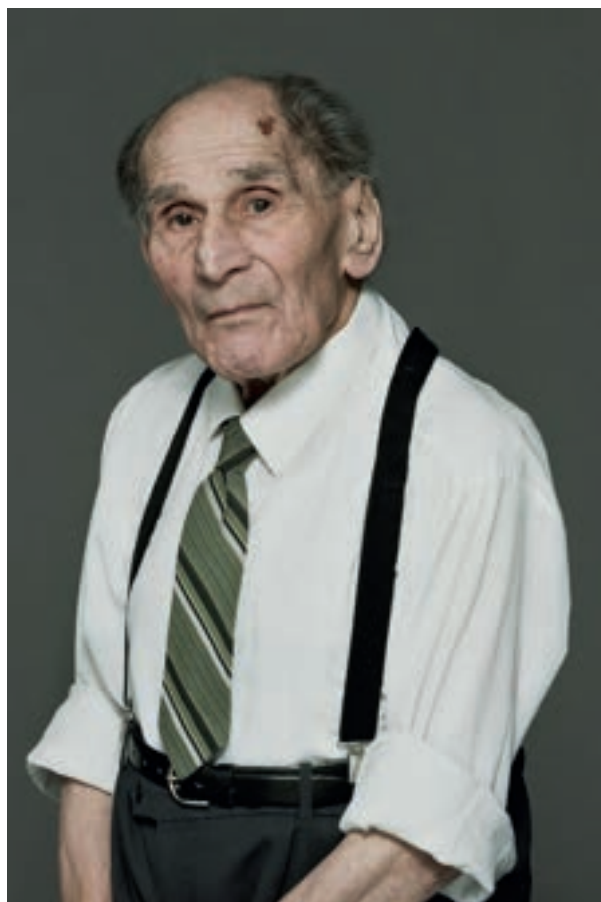
Stuart Foster

Established in 2008 with support from the Pears Foundation and the Department for Education, the UCL Centre for Holocaust Education offers an internationally acclaimed programme of research and teacher professional development from which approximately 40,000 secondary school teachers have directly benefited. The Centre's Beacon School Programme, a nationally recognised and government-supported initiative in which individual schools develop their practice and curriculum in collaboration with a UCL mentor, has also been especially significant in transforming teaching and learning about the Holocaust. Since 2012, more than 250 schools have become UCL Beacon Schools, working with an extensive network of approximately 2,000 additional local schools. The programme has annually impacted the educational experience, understanding and attitudes of an estimated two million students.

For almost two decades the Centre has built on the founding principle that for its educational programme to be truly responsive to classroom needs, it must be grounded in world-leading research and ongoing evaluations of impact. This is a feature of the Centre which distinguishes it from other Holocaust education organisations nationally and internationally. Accordingly, researchers at the Centre have conducted empirical studies focused on teaching and learning about the Holocaust in England. For example, the landmark study *What do students know and understand about the Holocaust?* (2016), based on the responses of almost 10,000 students aged 11–18, revealed that although the Holocaust had been a mandated part of the National Curriculum since 1991, students often had limited knowledge and harboured troubling myths and misconceptions. The study found, for example, that two-thirds of students did not understand the term 'antisemitism' and commonly failed to understand why Jews were targeted. Many also were ill informed about the British government's

response to the Holocaust, underestimated how many were killed, offered simplistic Hitler-centric causal explanations, and did not recognise that it was a continent-wide genocide with devastating impact in Eastern Europe.

In response to these findings and the results of several other large-scale studies with teachers and students, the Centre has developed a national programme of professional development for teachers in service and in training. This comprises CPD, initial teacher education, an MA module and classroom resources. Situated within the IOE, this ambitious national programme deepens



Leon Greenman.



A teacher CPD session at the Centre for Holocaust Education.

teachers' knowledge and understanding, develops effective teaching practices, builds professional confidence and ultimately empowers young people to learn about this critical history and reflect on its contemporary relevance.

Making this complex and difficult history accessible to secondary school students is a significant challenge and one the Centre directly addresses. One of the most successful ways this has been achieved is through the development of the world's only research-informed textbook on the Holocaust, which has been distributed free of charge to more than 2,900 schools across England.

A central feature of the educational programme is to engage young people with compelling personal stories which raise thought-provoking questions related to human behaviour. The experiences of Holocaust survivor Leon Greenman serve as a powerful example. Born in London's East End in 1910, Leon and his family moved to Rotterdam, where he

grew up. Years later he frequently travelled between England and the Netherlands for work purposes. In June 1935 he married a Dutch Jewish woman, Else, and in March 1940 their only child, Barney, was born. Tragically, following the Nazi invasion of the Netherlands in May 1940, as a Jewish family they rapidly became swept up in the harrowing events of the Holocaust. Ultimately, Else and two-year-

A central feature of the educational programme is to engage young people with compelling personal stories which raise thought-provoking questions related to human behaviour.

Leon survived the Holocaust, but he was forever scarred by his traumatic past and lived to confront racist abuse and personal attack by right-wing extremists in England in subsequent decades.

old Barney were murdered by the Nazis in the gas chambers of Auschwitz-Birkenau. Leon survived the Holocaust, but he was forever scarred by his traumatic past and lived to confront racist abuse and personal attack by right-wing extremists in England in subsequent decades. In the 1990s and beyond, Leon was a regular visitor to the IOE, relating his experiences and insights to beginning and practising teachers. Since its inception the Centre has used Leon's story to provide teachers with a powerful vehicle to explore with their students vital issues such as: why were Leon and his family targeted? How did the Holocaust unfold across time? How did it impact countries across Europe? Who was responsible for the death of his family and millions of other victims? What does it mean to 'survive' the Holocaust? What relevance and significance does Leon's story have for us today?

In keeping with its mandate as part of a public university, the Centre's programmes and expertise are available to all national and international institutions. The Centre has actively collaborated with all the leading Holocaust education organisations in the UK and a vast range of international organisations, including the International Holocaust Remembrance Alliance, UNESCO, the United States Holocaust Memorial Museum and Yad Vashem.

Today the UCL Centre for Holocaust Education is recognised as the world leader for research-informed teacher and student education. The Centre's approach is driven by UCL's mission, which emphasises the importance of 'the integration of research and education . . . for the long-term benefit of humanity'. Its work is also underpinned by the belief that young people should know and understand how and why this genocide occurred and be able to thoughtfully consider why this history matters and recognise the dangers of twenty-first-century extremism and antisemitism.

Stuart Foster is Professor of History in Education and was Director of the Centre for Holocaust Education from 2008 to 2025.

Digital literacy: promoting safe and healthy online consumption for young people

Kaitlyn Regehr

Along with my colleague Caitlin Shaughnessy at UCL's Department of Information Studies I have evidenced how harmful content is gamified on social media, and its impact on young people's wellbeing. Our research has explored how new methodologies can be used to understand online landscapes, traced the impacts of harmful content on young people's behaviours, and developed education strategies to support young people online. The Safer Scrolling Project, conducted in collaboration with the Association of School and College Leaders (ASCL), employed online fieldwork and an algorithm study on TikTok, sampling more than 1,000 videos through four archetype accounts. After only five days of TikTok usage, the research showed a fourfold increase in the level of misogynistic content being presented on the 'For You' page of TikTok accounts. The findings revealed how the algorithm privileges more extreme material, and how, through increased usage, users are gradually exposed to more toxic misogynistic ideologies, which are presented and gamified through soft or humorous cultural forms. These findings were triangulated against interviews with young people and school leaders, to trace how these ideas become embedded within mainstream youth cultures, negatively impacting peer relationships and creating new challenges for schools and society.

The research drove widespread national media coverage and calls for policies to provide digital literacy strategies in schools to promote healthy digital habits that support young people's wellbeing. In 2024 the regulator Ofcom identified the issue of 'safer algorithms' in a new consultation regarding online harms and the education secretary pledged to implement the recommendations of the research across the National Curriculum. The research team has continued to integrate with educators to explore how to address the real-world impacts of online harm. Along with my interdisciplinary research



A digital diet pyramid which promotes critical thinking around how time is spent online.

team, including Caitlin Shaughnessy and Katharine Smales, I have worked with young people nationwide to co-create a healthy digital nutrition approach to digital literacy. The Digital Nutrition Report (2025), published in association with ASCL and distributed to schools nationwide, explored how to embed understanding of healthy digital consumption into the national curriculum by taking a peer-to-peer approach to digital literacy, empowering young people to share their own knowledge to protect and inform their younger classmates.

The research has further led to my book *Smartphone Nation: Why we're all addicted to screens and what you can do about it* (2025), which gives parents tools to upskill themselves to engage with safer digital usage. It provides critical, accessible knowledge regarding digital literacy that embeds UCL research at the heart of digital public health and education. I have provided consultation on this issue in the House of Lords, to Members of Parliament and to the Metropolitan Police. My work has subsequently fed into the Online Safety Act.

Kaitlyn Regehr is Associate Professor in Digital Humanities.

Health inequalities: from research to policy and practice

Michael Marmot

'We will make England a Marmot nation,' said Andrew Gwynne, Minister of Public Health, at a public panel at UCL in October 2024. Certainly, something was needed. The UK had just come through a 14-year period where life expectancy did not improve, health inequalities grew and life expectancy for the poorest people declined.

At the request of the British government, I had led the Marmot Review. Our 2010 report, *Fair Society Healthy Lives*, synthesised the evidence on the causes of health inequalities, and made six domains of recommendations. The UK governments from 2010 on, with austerity a priority, and seeking to roll back the state, had more or less gone in the opposite direction to each of our recommendations.

At the UCL Institute of Health Equity, faced with the national government not caring, or worse, we started to work with local areas. Coventry, Greater Manchester and 40 others in England and Wales invited us to advise them on becoming Marmot places, applying our recommendations at a local level. In 2024, we kicked off a two-year programme of work with Scotland, developing a national strategy to reduce health inequalities, and to work with three Marmot places in Scotland. It is this national movement that fuelled Gwynne's ambition.

In retrospect, it feels like a fairly direct line from my 1978 publication on the social gradient in health in the Whitehall Study, through decades of research on health inequalities, commissions for the World Health Organization and the British government, and rather complete rejection by the national government in Westminster for 14 years, to what now feels like a social movement.

It started with the Whitehall Study of British civil servants, a longitudinal study of individual risk factors for disease: smoking, plasma cholesterol levels, body mass index, blood pressure, blood glucose. In my 1978 and 1984 Whitehall publications I showed that mortality rates followed a social gradient: the lower the grade of employment, the

higher the mortality rate. The British civil service may seem an unpromising venue for studying health inequalities. It excludes the richest in society – no bankers or hedge-fund managers – and the poorest – everyone is in office-based employment. It is, though, a highly stratified organisation, and the social gradient in health ran from the very top, good health, to the lowest grades, poor health. Subsequent analyses showed that what is true for civil servants is true for the country: the greater the degree of deprivation, the fewer the years of education, the shorter the life expectancy.

Poverty and health can be readily explained. It is not difficult to see how doing without the essentials of life can be bad for health. But the gradient is something different. Why should people in the middle of the hierarchy, not poor in any sense of that word, have worse health and shorter life expectancy than those above them, but better than those lower in the hierarchy? It is this challenge that has fuelled our research and recommendations for policy and practice. Our approach is that both absolute and relative poverty are important. Amartya Sen proposed that relative poverty with respect to income leads to absolute inequalities in capabilities. It is not only what you have that is important, but what you can do with what you have.

Faced with inequalities in health, the two most common explanations posed are inequalities in access to healthcare, and differences in behaviours. The problems with the NHS have been well documented, but access to healthcare is more equitable in the British system than in that of other rich countries. The opening line of my book *The Health Gap* was: why treat people and send them back to the conditions that make them sick? It is those conditions to which we must give attention, the social determinants of health. They were the focus of the Whitehall II study of men and women in the civil service, and a vast and growing body of research globally.

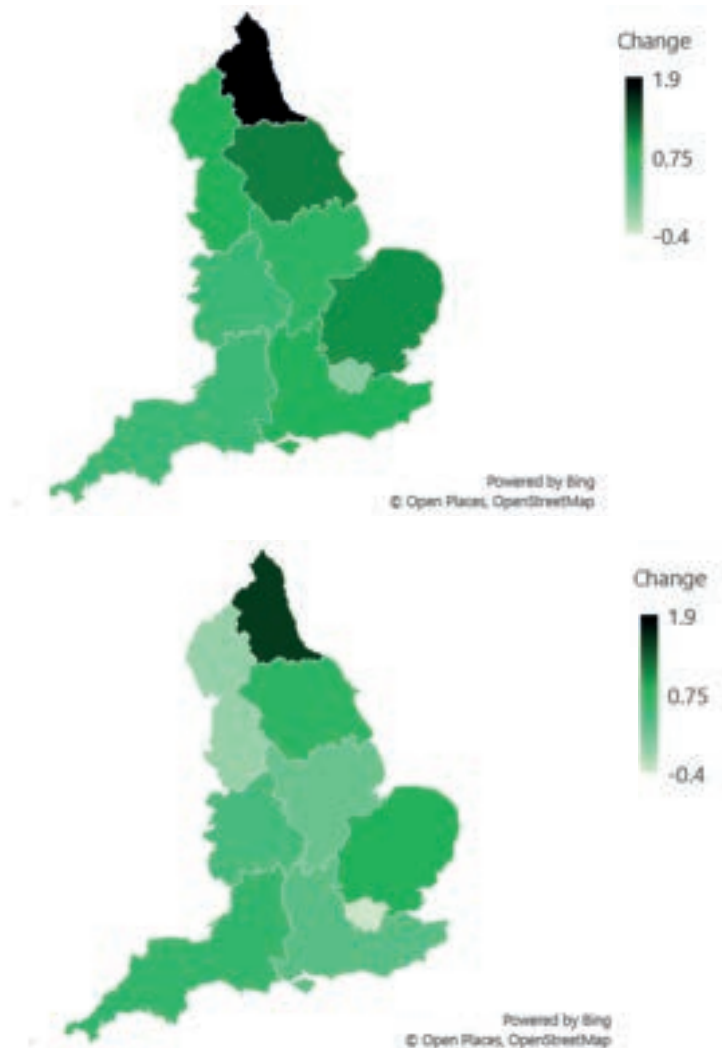
That relates to the second type of explanation for health inequalities, lifestyle choices. To put it bluntly, lifestyle choice is not an adequate description of the situation of a single mother, living in a cold dwelling – she can't afford to heat it – with mould on the walls, threatened with eviction because rent is unaffordable, having to resort to food banks, unable to work because she can't afford childcare. Nor does 'lifestyle choice' do much to illuminate the effect of adverse childhood experiences on the health and development of her children.

The social gradient should bring our attention not to individual behaviours but to the conditions in which people are born, grow, live, work and age; and to inequities in power, money and resources – the social determinants of health. Certainly, that was the conclusion of the World Health Organization's Commission on Social Determinants of Health that I chaired, and which reported in 2008. That report led to three regional WHO commissions, in Europe, the Americas and the so-called Eastern Mediterranean Region.

It also led to the Marmot Review in England. We had, initially, six domains of recommendations: give every child the best start in life; education and lifelong learning; employment and working conditions; having the minimum income for healthy living; healthy and sustainable environments in which to live and work, including housing; and a social determinants approach to prevention. We have now added two more: tackle racism, discrimination and their outcomes; pursue environmental sustainability and health equity together. It is these eight principles of action that form the basis of our work with Marmot places.

The mission of these Marmot places, and perhaps countries, is to achieve greater equity of health and wellbeing. In essence it means creating the conditions for everyone in society to be able to live flourishing lives.

Michael Marmot is Professor of Epidemiology and Public Health and Director of the UCL Institute of Health Equity.



Changes in inequality in life expectancy for females (top) and males (bottom) in the English regions, between 2010–12 and 2017–19.

Statistical research methods

Richard Chandler and Petros Dellaportas

Tall parents tend to have tall children. It's obvious. Or is it?

Nowadays, we know that our genes are responsible for passing characteristics – such as height – down through generations. Our understanding of heredity began in the mid-nineteenth century, with the work of Gregor Mendel in what is now the Czech Republic. Meanwhile, in 1859 in the UK, Charles Darwin's *On the Origin of Species* introduced 'evolution via natural selection' – for which the notion of heredity is essential. Darwin's work influenced his half-cousin Francis Galton, whose research into heredity led to the concept of 'linear regression,' developed from an experiment with sweet peas in 1875.

This is where the UCL connection starts, with Karl Pearson who was appointed Professor in the Mathematics Department in 1884. Introduced to Galton in the 1890s, he set about putting some of Galton's ideas on a firmer mathematical footing. Linear regression was one of these, as was the measure of association now known as the 'Pearson correlation coefficient', which should be familiar to anyone who has taken an introductory statistics course. A classic demonstration of this theory uses a dataset on the heights of fathers and their sons collected by Pearson and his co-worker Alice Lee between 1893 and 1898.

Over the next two decades, UCL became the birthplace of what has become the modern discipline of statistics: the work done by Pearson and his colleagues, both within and beyond UCL, still forms the core of statistical methods that are a fundamental part of all scientific training worldwide. Along with correlation and regression, this work includes the idea of hypothesis testing (including the chi-squared test), which is ubiquitous in almost all areas of quantitative investigation nowadays. On Galton's death in 1911, he left his estate to UCL to fund a permanent professorship. The position was filled by Pearson, who created the Department of

Applied Statistics: the first university department of statistics in the world, and the precursor to what is now the Department of Statistical Science.

There is, however, a darker side to the story (see p. 108). Galton's work on heredity was motivated by questions about 'all influences that improve the inborn qualities of a race [and] develop them to the utmost advantage'. This quotation is from his definition of eugenics. Pearson was an enthusiastic advocate: the title of his position in 1911 was the Galton Chair in National Eugenics, and in 1913 he renamed his department as the Department of Applied Statistics and Eugenics. In 2021, UCL formally apologised for its historical links with eugenics. The statistical methods developed, however, remain central to modern science.

Richard Chandler and Petros Dellaportas are Professors in the Department of Statistical Science.

Model of the dataset on heights of fathers and sons, collected by Karl Pearson and Alice Lee in the 1890s. The bar heights represent the number of father-son pairs with heights in the corresponding intervals. The regression line is indicated in red. This model, currently held within the Department of Statistical Science, is thought to have been constructed shortly after the dataset was collected.



Susan Isaacs and progressive education

Sandra Leaton Gray

Susan Isaacs (1885–1948) was one of Britain's foremost progressive educators and was also responsible for introducing child psychoanalysis to the UK. Her formative years were deeply influenced by the early death of her mother, and her father's subsequent marriage to her mother's nurse. She was then immersed by her parents in the evangelical Methodism common to the North of England at the time, experiencing a series of emotionally charged religious events (later described by her sister as 'revivalist orgies') that she would periodically re-enact as a child. These early encounters with complex, and sometimes disturbing, adult social behaviours became the foundation for her subsequent contributions to child psychology and education. Isaacs would go on to develop a pedagogical model that revolutionised how childhood and development were understood.

From 1924 to 1927, Isaacs applied these ideas practically at the Malting House School in Cambridge, a short-lived but influential experiment in child-led learning set up by an eccentric businessman at his family home in Cambridge. It marked a turning point in progressive education. At Malting House, children were encouraged to explore their environment freely and engage in imaginative play, while adults acted as facilitators rather than authority figures. This approach offered a radical alternative to the dominant, disciplinarian educational models common at the time. The school also functioned as a research site, where children, many of whom boarded full-time from an extremely young age, were observed systematically, generating extensive data for Isaacs' scientific enquiries (practices that would likely face ethical scrutiny today).



Malting House school: children experimenting with a Bunsen burner.



Children playing with a gramophone.

From 1929 to 1936, Isaacs was a parenting 'agony aunt' for the magazine *Nursery World*, where her writing was based on the psychoanalytical ideas of Melanie Klein. By 1933, Isaacs' influence had extended to the Institute of Education (IOE), where she became the first Director of the Department of Child Development, initially based in just two rooms. This department, the first of its kind in England, was a pioneering initiative. In addition to Klein, Isaacs drew on the philosophies of Jean-Jacques Rousseau and John Dewey, to construct an interdisciplinary framework that placed children's emotional and social lives at the forefront of educational practice. This was also a strategic move away from the religiously influenced philosophies dominant in teacher training at the time, replacing them with a scientific approach that laid the foundations for

modern psychology as a discipline. The IOE led the field in this regard, thanks to its Director, Sir Percy Nunn, an advocate of individualism in education, as well as the earlier work of Cyril Burt (inventor of the now largely discredited 11+ school selection test, which relied heavily on IQ measurement).

Isaacs' work continued during the Second World War, even as the Department of Child Development temporarily closed. During this period, she focused on the psychological impact of wartime evacuation on children. Isaacs' psychoanalytic expertise proved vital in addressing the trauma experienced by evacuees, and her contributions played a key role in shaping child welfare strategies and the development of child guidance clinics across Britain in the post-war years.



Susan Isaacs with children at Malting House school.

Despite her fundamental contributions to early education, Isaacs faced significant institutional and gender-based barriers. Although she led a pioneering department and influenced educational practices profoundly, gaining international recognition, she was never awarded a full professorship. Her career was tragically cut short when she died of breast cancer in 1948, at the age of 63. Yet her legacy endured through the efforts of her students and colleagues, such as Dorothy Gardner, who continued to expand upon Isaacs' visionary approach. Isaacs was not merely an educator; she was a transformative figure who redefined childhood and left an indelible mark on education both in Britain and beyond.

Despite her fundamental contributions to early education, Isaacs faced significant institutional and gender-based barriers.

Sandra Leaton Gray is Professor of Education Futures.

Alexander Williamson, organic chemistry and the 'Chōshū Five'

Andrea Sella

If a time traveller from UCL's early years dropped in to find out whether Jeremy Bentham's vision had panned out, they might be astonished by the many changes: the urban environment, the scale of the place, but above all the diversity of the staff and especially the student body. Not only are half of our students women, but we are not far from having a similar proportion of foreign students; we don't call ourselves London's global university for nothing. It is tempting to trace these extraordinary changes back to UCL's third Professor of Chemistry, Alexander Williamson (1824–1904), a chemist who is probably better known abroad than in the UK. Williamson was born in South London into a prosperous middle-class family, his father having worked for the East India Company. Blind in one eye and with a crippled left arm, Williamson



Portrait of Alexander Williamson by John Collier.

nevertheless became an organic chemist, first studying with Leopold Gmelin in Heidelberg and then moving to work with the brilliant and flamboyant Justus Liebig in Giessen, where he obtained his PhD in 1845. Liebig was one of the most influential organic chemists of his time, who worked to unravel the mystery of how a tiny clutch of elements – carbon, hydrogen, oxygen and nitrogen – could combine to make myriad compounds. With Liebig, Williamson learned technique as well as theory, and his time in Giessen left a lasting impression. Williamson then spent three years in Paris studying mathematics but becoming steeped in the new structural theories of chemistry. In Paris he met the UCL chemist Thomas Graham, who encouraged him to apply to be Professor of Analytical and Practical Chemistry, a post unexpectedly vacant after the death of George Fownes.

It was after his appointment that Williamson made his greatest contribution to chemistry: he found a method to make a class of organic compounds called ethers by combining haloalkanes with alkoxides. It is so simple that we still teach it to undergraduates today. More importantly, the method confirmed the cognate structures of water H-O-H, alcohols R-O-H (where R is some carbon-containing fragment) and ethers R-O-R (where the two fragments on either side of the oxygen can differ). This clarified the idea that oxygen had a valency (bond-forming capacity) of two and reinforced the structural theory of chemistry. But it also trashed a key contention of his mentor Liebig; Williamson was very much his own man. This 'synthesis' was key to Williamson being chosen to replace Graham as top dog in chemistry at UCL in 1855.

Williamson developed his own teaching programme along a broad liberal model to ensure his students gained a rounded education, and by the late 1860s had started delivering lectures in chemistry for women, a programme that probably prepared the



The 'Chōshū Five'.

ground for UCL's revolutionary decision to admit women and grant them degrees in 1878.

In 1863 five Japanese teenagers of the Chōshū clan were smuggled out of Japan to study abroad at a time when foreign travel carried the death penalty. This was a period of growing internal instability in Japan, as British and American traders began to visit the country in increasing numbers, resulting in deep xenophobia among the ruling classes. The Chōshū elders hoped that the trip might pay off by giving the clan technical and especially military advantage.

The clan enlisted the help of the British merchant shipping firm Jardine Matheson. After enduring the humiliation of having their topknots cut, and sliding into Western clothes for the first time, the five young men snuck away from Yokohama (at first concealed in the coal hold) to the vast trading hub of Shanghai. A fast tea clipper then took them to Liverpool, where they boarded a train to London.

It is hard to imagine the level of culture shock experienced by the five as they emerged from a feudal, agricultural Japan and ended up in the thronged and smoky, steam-powered racket that was London. They were stunned by the contrast. James Matheson, who had helped smuggle the five out, approached UCL about their education. Williamson was chosen as mentor because of his enthusiasm for teaching and his progressive ideas.

Williamson was 39 and with the increased salary that came with his promotion, he lived in a large house in Primrose Hill (in Provost Road – should we infer any future ambitions from the choice?), where his wife had just given birth to their first child. Williamson welcomed the five students not simply into his lab but also into his house, where he helped them learn English and answered their many questions, bridging the vast chasm between their upbringing and this new world. Williamson's guiding principle was 'unity through difference', taking the view that 'civilisation blossoms only through harmonisation of cultures of individuals and states'. After lectures he would take the Japanese students to visit industrial installations to see the scientific principles they learned at UCL put into practice.

The Chōshū Five would later return to Japan to begin its modernisation. They were followed to UCL by 19 students from the Satsuma clan, and then still more, across a wider range of subjects. These studentships were not always quite so well funded (in later years some students endured real hardship) or supported. But these events led to a number of young British lecturers moving to Japan to start chemistry, physics and engineering schools there. One of them, Robert William Atkinson, Williamson's assistant at UCL and co-writer of his textbook of chemistry, helped spread Williamson's idea that chemistry and physics were inseparable.

One of Atkinson's students, Joji Sakurai, would come to Britain to study with Williamson just before the professor's retirement. At the age of 24 Sakurai would be appointed the first Japanese Professor of Chemistry at the university of Tokyo. In 1937 Sakurai returned to London to receive an honorary doctorate from UCL. We have a recording of his address in which he pays tribute to his UCL mentor

and reminisces about Sakurai's astonishment at the achievement of the age – from Brunel's railway and Darwin's big idea about biology, to seeing Ellen Terry and Henry Irving on the stage. Williamson had done much more than teach chemistry – he had helped these students embrace a vision of an open, cultured world, where 'science was studied for its own sake', and then applied. These were students who really 'got' London and were transformed by it.

Many of them corresponded with Williamson in the decades after their visit. Shortly before

Williamson died, one of the original Chōshū students, Shinsuke (Hirobumi) Itō, presented Williamson with a silver incense burner in the shape of a lion. We have it on loan in the Department's collection, a symbol and reminder of an object lesson in deep mentoring by a rare academic whose impact truly changed the world.

Andrea Sella is Professor of Chemistry.



Silver incense burner in lion shape made by Joun Ōshima.

The Institute of Education and educational studies in the 1940s

Gary McCulloch

In the 1940s, the IOE established a national position in the institutionalisation of education as a subject in its own right in higher education. As the director of the IOE from 1936 until 1945, Fred Clarke (1880–1952) held and maintained a vision for educational studies that went beyond the preparation of teachers. He insisted that it should include the study of education in its broadest sense, drawing on established disciplines such as sociology, history and philosophy. In this spirit he published his own main public contribution, *Education and Social Change* (1940), and proposed the outlines of such a course in *The Study of Education in England* (1943). Clarke was able to preside over the appointment of professors in a wide range of disciplines, including the eminent sociologist Karl Mannheim (see pp. 164–5).

Clarke's contribution was national, not just institutional, in its scope. Before the Second World

War, he conducted the first national survey of research in education, under the auspices of the British Association for the Advancement of Science. This helped to make possible the launch in 1952 of the first national journal of educational studies in Britain, the *British Journal of Educational Studies*.

In retrospect, through its efforts in the 1940s the IOE helped to institutionalise not simply the study of education, but a particular formation of knowledge that became known as educational studies, understood to be discipline-based teaching and research committed to education in its wider context. Over the longer term, the IOE was instrumental in transforming the field of study and its position in higher education, with worldwide effects.

Gary McCulloch is Brian Simon Professor of the History of Education.



The IOE is based at 20 Bedford Way in a Grade II* listed modernist building designed by Sir Denys Lasdun.

Impington Village College, opened in 1939, is the only building in Britain designed by the Bauhaus founder Walter Gropius. The school's pioneering, progressive approach – with a vision of lifelong learning, both formal and informal – attracted attention in the 1940s, and photographs of the school appeared in Fred Clarke's 'School and Life' report to government, published in 1947.



7

Life on and beyond Earth

Understanding the biology of ageing

David Gems

Perhaps the greatest challenge for medical research today is to understand and find treatments for the diseases of later life: cardiovascular disease (including stroke and heart failure), cancer, chronic obstructive pulmonary disease (COPD), Alzheimer's disease, osteoarthritis and many, many more. All of these awful conditions are largely the product of the biological process of senescence (ageing), which is by now the main cause of serious illness and death worldwide. Yet our understanding of the underlying causes of this devastating process remains sketchy.

UCL has long been a world centre for biogerontology, the study of the biology of ageing. This includes the development of the evolutionary theory of ageing by J.B.S. Haldane and Sir Peter Medawar in the 1940s, and pioneering work in experimental gerontology by John Maynard Smith and Alex Comfort in the 1950s. Latterly, Comfort's research interests shifted to the study of human sexuality, leading to his remarkable bestselling book *The Joy of Sex* (1972); an interesting man.

Biogerontology at UCL was revived near the turn of this century with the arrival of Linda Partridge and me. Together we established the Institute of Healthy Ageing (IHA), a major centre for research investigating the fundamental mechanisms of ageing using short-lived animals (including nematode worms, fruit flies, killifish and mice). Work at the IHA has identified genes, pathways and mechanisms that control ageing as a whole, and has led to the development of new general theories of the causes of ageing and late-life disease.

But what do scientists exploring the biology of ageing actually hope to achieve? To cure senescence, and eliminate the ageing process altogether? Based on current knowledge, this outcome remains firmly in the realm of science fiction (which is in many respects fortunate). It is, though, possible to slow down some facets of senescence, at least in short-lived animals in the laboratory, suggesting that similar effects may be achievable in our own

species. Perhaps more exciting is the growing prospect of understanding the general principles of the biology of ageing in a way that can explain, at last, the underlying causes of late-life diseases. Key to developing treatments for a given disease is understanding its cause. To develop treatments that can really prevent development of Alzheimer's disease, for example, we need to understand the ageing process that causes it. The biology of ageing is truly a field that is full of future.

David Gems is Professor of Biogerontology and Research Director at the Institute of Healthy Ageing.

It is possible to slow down some facets of senescence, at least in short-lived animals in the laboratory, suggesting that similar effects may be achievable in our own species.

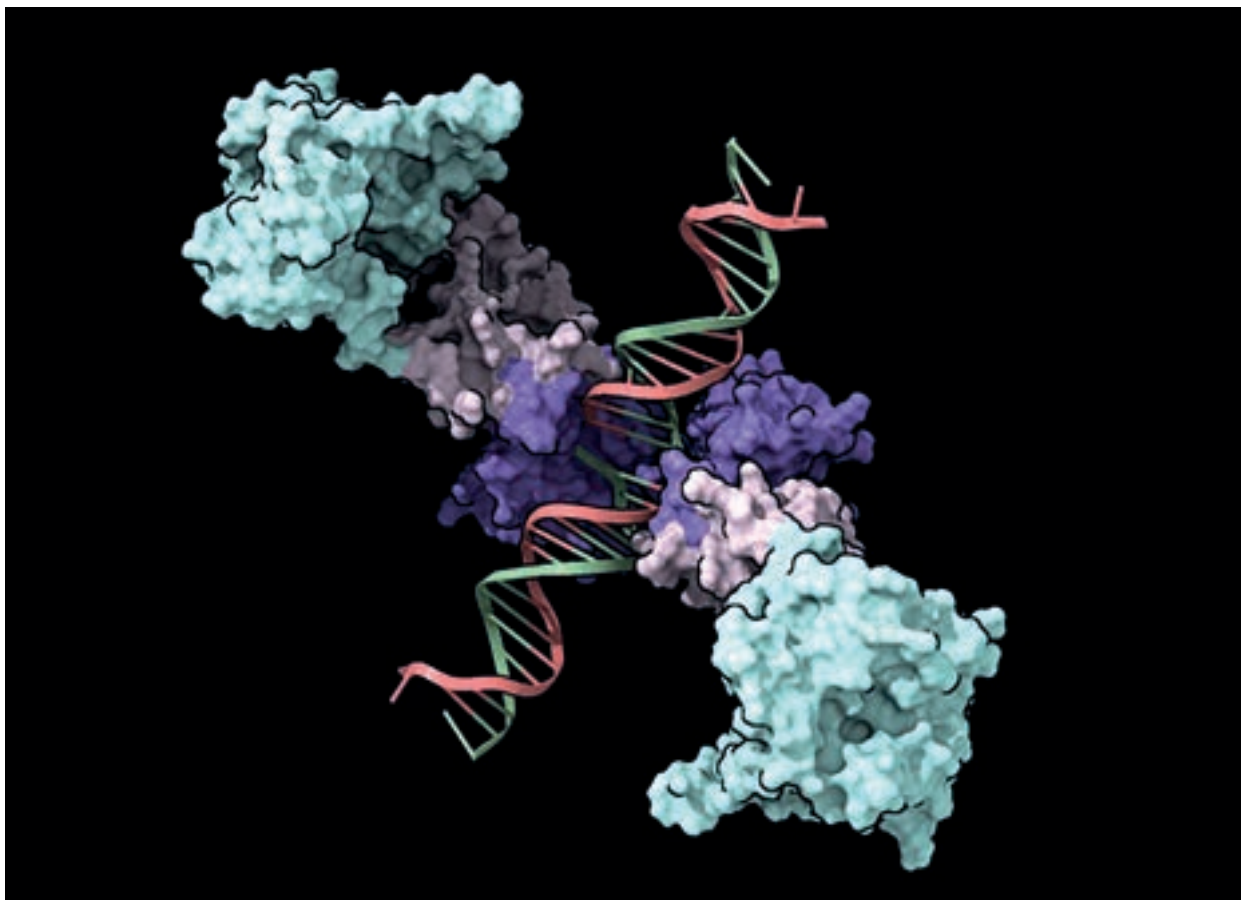
The humble fruit fly *Drosophila melanogaster*, from which many secrets of ageing biology have been learned.





Janet Thornton and structural bioinformatics

Snezana Djordjevic



An image of a human protein bound to a portion of DNA. The protein is shown using a molecular surface representation. Individual domains of the protein are coloured separately in light blue, lilac and purple.

In 2024, the Nobel Prize in Chemistry Committee recognised that the ability to accurately predict the structure of a protein based on its amino acid sequence alone was a transformative scientific milestone worthy of the award. However, what pre-dated this AI-empowered breakthrough, as frequently happens in science, was many years of a joint effort of the multidisciplinary, worldwide research community. UCL holds a special place in the history of these developments, with the work of Dame Janet Thornton, one of the world's pioneers in structural bioinformatics, who nurtured an exceptionally accomplished research group that

used computational methods to explore and analyse the relationships between the sequence of amino acids within a protein and its structure and function.

A protein comprises a long chain of amino acids. What amino acids and the order in which they link to one another is inscribed in a corresponding gene. While a gene codes for the specific amino acids forming the protein chain, the resulting protein's amino acid sequence encapsulates a key for how the protein chain will twist, turn, loop and organise into a specific fold. A protein's fold and its three-dimensional atomic structure are tightly linked to that protein's function, enabling interactions

with other molecules of life and underpinning its biological role. The interplay of protein structure and function further allows us to explain developmental processes, disease, infection, ageing and the function of micro-organisms and to leverage that knowledge in therapeutic or industrial applications. Therefore, being able to predict a protein's structure from its amino acid sequence has, for 50 years, been a holy grail of structural biologists and bioinformaticians.

Janet Thornton was appointed Professor and Director of the Biomolecular Structure and Modelling Unit in the Department of Biochemistry and Molecular Biology (now in Biosciences) in 1990. In this role, she helped to create a joint endeavour between UCL and Birkbeck College, exploring protein structures. Janet was fascinated with the intrinsic beauty of protein structures. She spent many years characterising, classifying and analysing the new protein structures as they were determined and stored in a public depository called the Protein Data Bank (PDB). Although at the start of Janet's career there were only 20 determined protein structures, she had a clear foresight that developments in structural biology and computational science were going to lead to a

Being able to predict protein structure from its amino acid sequence has, for 50 years, been a holy grail of structural biologists and bioinformaticians.

rapid increase in protein structural data and that bioinformaticians had a profound role in curating the quality of the structures, classifying and interrogating them. Together with her colleagues, Janet developed essential software, tools and databases that were used by the academic, medical and industrial scientists of the world and catalysed the exponential growth of the data and the expansion of the field that ultimately enabled AI methods to predict complex protein structures. As of 2025, the PDB holds more than 230,000 experimentally determined structures, and more than 200 million protein structures have been predicted.

In recognition of being a prominent voice in the scientific community and a strong advocate for open data, women in science and science infrastructure, Janet has received numerous awards and has undertaken leadership and governance roles in the Royal Society, the European Research Council and other institutions. In 2011, Janet was awarded the Suffrage Science Award and in the 2012 Birthday Honours, she received a damehood for services to bioinformatics. In 2001, Janet left UCL to lead the European Bioinformatics Institute and to establish the pan-European infrastructure for life science data ELIXIR, but she has maintained and enjoyed a close interaction with former members of her group, most notably Christine Orengo and David Jones, whose own research at UCL left a lasting legacy in the computational life sciences.

In more recent years Janet has pioneered foundational frameworks for understanding protein functional mechanisms. These will help transform protein and drug design. Janet is an inspirational figure and is generally acknowledged as the 'Godmother of Bioinformatics' by her community.

Snezana Djordjevic is Professor of Structural Biology of Signalling.

How cells survive and thrive: Sydney Ringer

Jonathan Ashmore

The face looks out at you with a steady gaze. Despite the studied pose, it is of a man comfortable with his position as Holme Professor of Medicine at University College Hospital (UCH). It is a portrait of Sydney Ringer who, in his late forties, made a discovery that is one of the pillars of modern cell biology. His discovery was the composition of the watery medium that enables tissues to survive. Ringer's Solution is the basis of all subsequent culture media that are now used in research laboratories and plasma replacement media in clinical care.

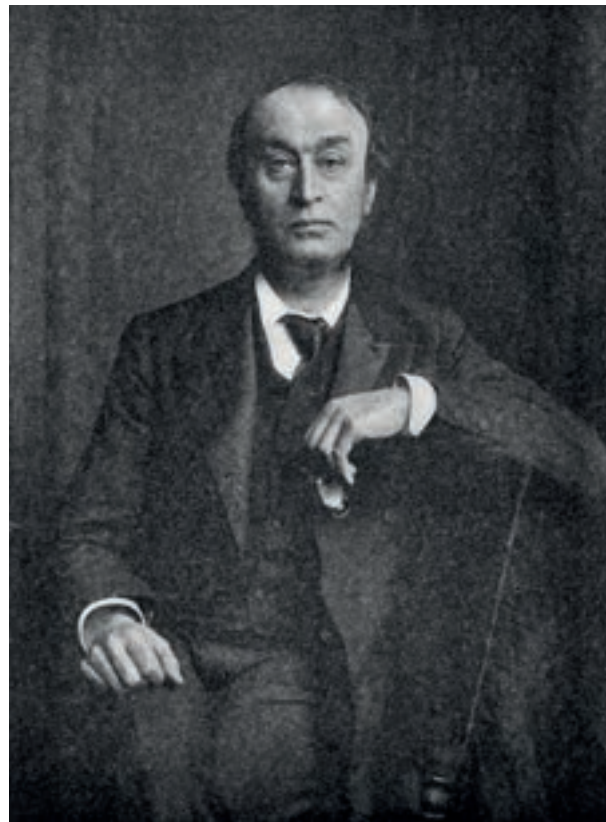
Ringer was a busy clinician but maintained an active interest in basic physiological research. He had a laboratory then housed in what is now the Slade School on the north side of the UCL Quad. A stone tablet there commemorates his presence. His experiment for this discovery was a type of bioassay – a frog's heart was mounted in an apparatus and the heartbeat monitored while various solutions were changed around it. The apocryphal story is that, after trying various saline solutions that failed to maintain the heartbeat, Ringer found one day that the heart continued to beat vigorously and reported his finding to a meeting of the Physiological Society in 1882. It subsequently turned out that on that occasion the distilled water still was broken, and Ringer's technician, Fielding, had used London tap water instead ('Mr Ringer will not know the difference'), then supplied from the New River Water Company's conduit that flows through North London. (Soft Yorkshire water was later found not to have the same effect.) Much to Ringer's credit, the serendipitous mistake was followed up and the river water difference was identified as the presence of calcium. London water is hard: it contains about 1 mM calcium, close to what is found in vertebrate plasma.

The result was published in one of the most-quoted (but probably little-read) papers of the Physiological Society in 1883. Ringer also explored whether other similar divalent ions might

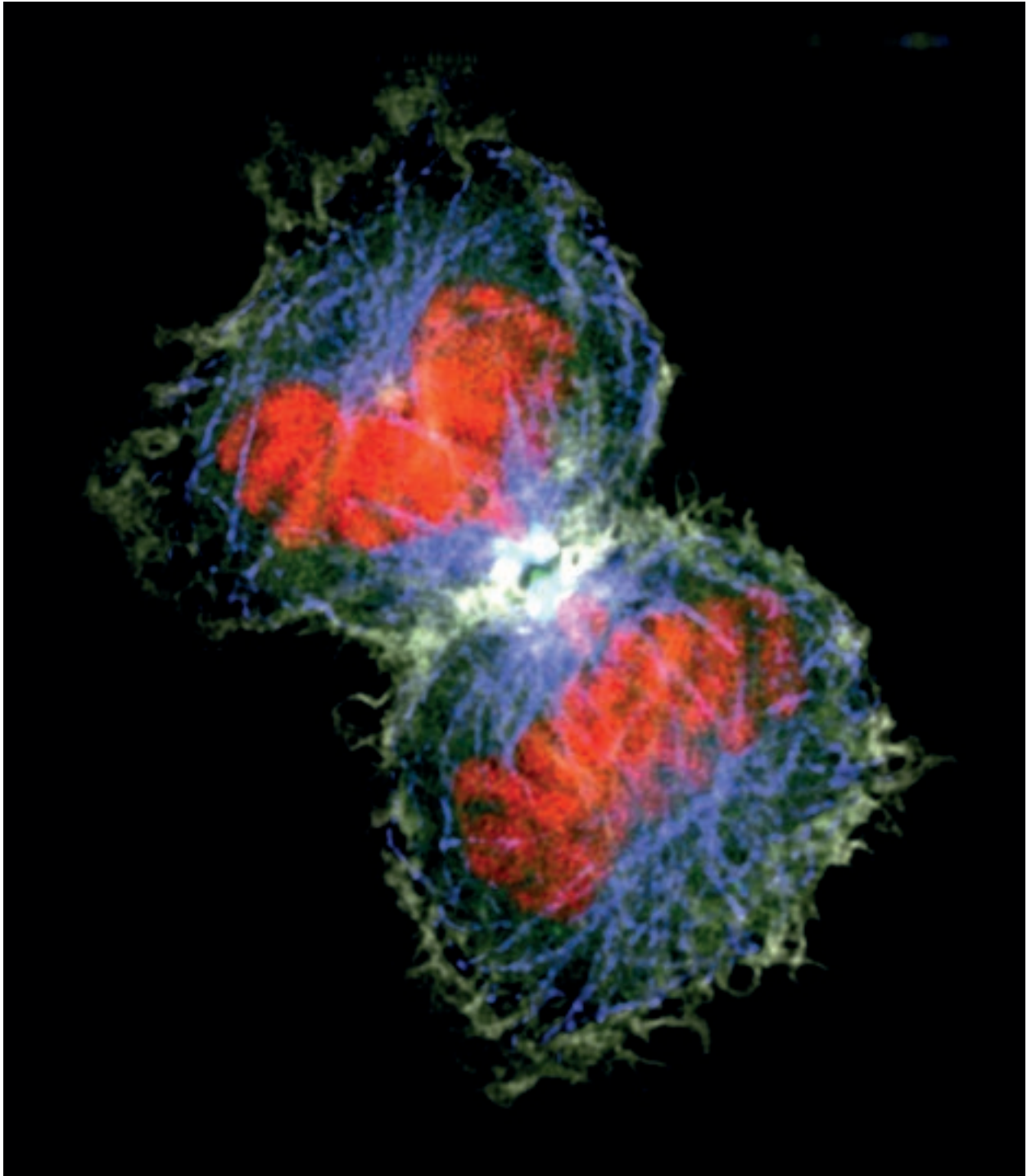
work instead, although at the time it was not understood how cells required calcium for proper function. The importance of calcium for the majority of cell processes is central to all modern biomedical science.

Sydney Ringer was born in 1835 and obtained his medical degree at UCH in 1860. Rising to a professorial chair in 1879, he was known as a slightly shy individual, but one meticulous about careful observation in research as well as in clinical teaching. A blue plaque to Ringer can be seen on the doorway entrance to the UCL Medical Sciences building, which is where the Department of Physiology moved in 1906.

Jonathan Ashmore is Bernard Katz Professor of Biophysics.



Portrait of Sydney Ringer.



Cytokinesis (part of the cell division process) of human cancer cells. Calcium plays a vital role in this process.

Nitric oxide, neuroscience and nearly Nobels: the story of the discovery of a signalling molecule

David Selwood

Nitric oxide* is one of the smallest scientific discoveries: a gas composed of just two atoms: nitrogen and oxygen (NO). It was an esoteric substance until its role in sending signals around the body was established, in the 1980s and 1990s. This was in large part by two UCL scientists, Salvador Moncada (in the cardiovascular system) and John Garthwaite (in the brain). Nitric oxide signals in many body systems: it is one of the controllers of blood pressure, and is the stimulus for the action of Viagra. Nitroglycerin, used as a drug against angina, generates nitric oxide to elicit its effects, though this wasn't worked out until over 100 years after its identification as an angina remedy in 1879. In the brain the gas can mediate short-range signalling between neurons, and in signalling in the optic nerve. From blood vessels to individual neurons, this reactive, diffusible gas is a unique chemical messenger.

Nitric oxide's effects on the body had been observed for many years, and it even had a name: endothelial-derived relaxing factor (EDRF), which is a kind of science speak for 'we haven't a clue what it is, but it does this'. The extraordinary idea was that EDRF could be a gas. Moncada did key experiments to demonstrate that all the properties of EDRF were consistent with it being nitric oxide. Garthwaite and Moncada established EDRF as being a key messenger in the brain in 1988. Despite this, the importance of nitric oxide in the brain remains somewhat neglected by the scientific community in my view.

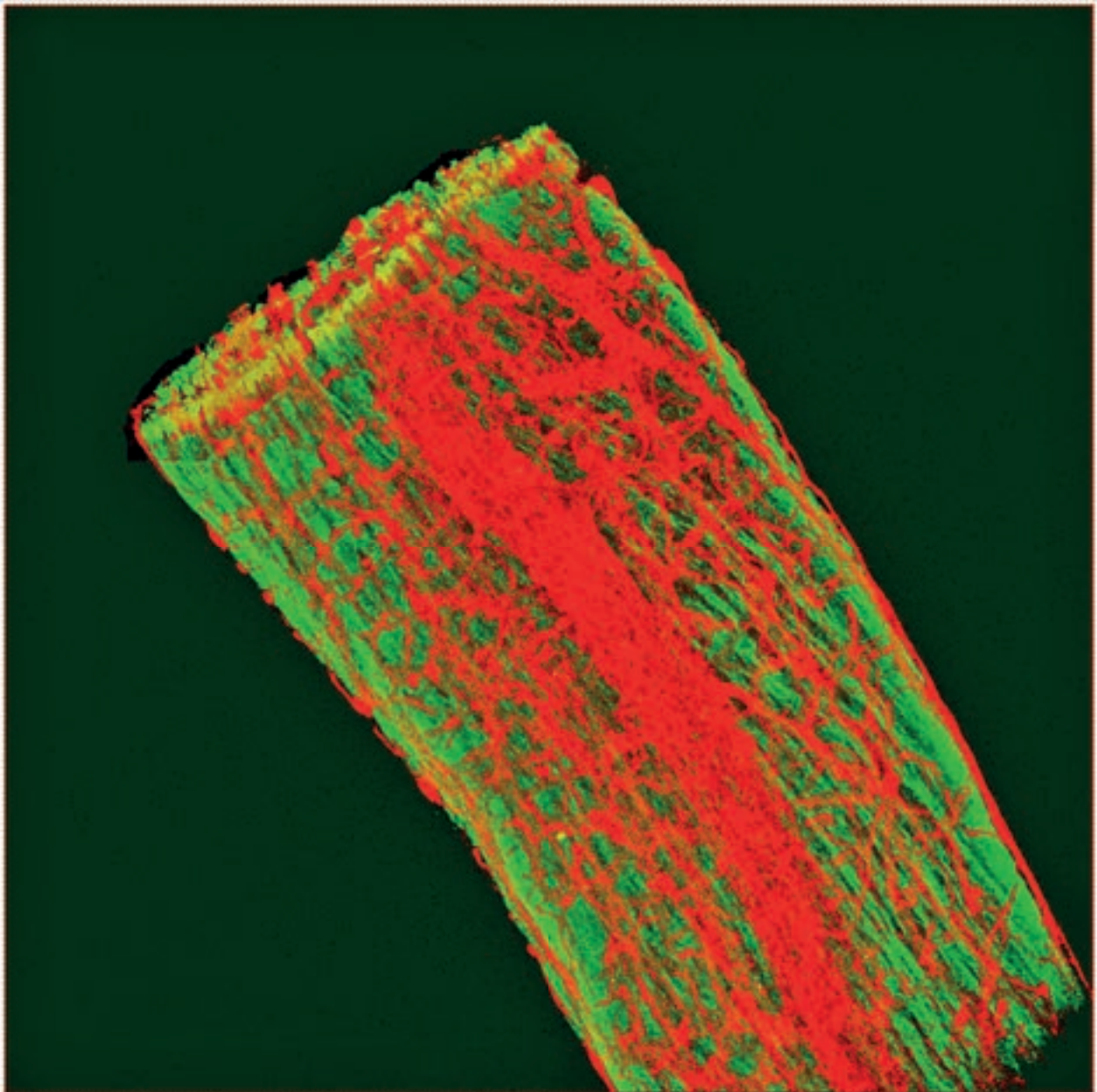
The story of nitric oxide is bigger than just UCL, of course, with many labs involved around the world, and there is a human side to the story as well; it's about nearly Nobels, desperate hope and friendship. Moncada and Garthwaite came to UCL in 1995 as part of a new Institute: the Cruciform Project, later the Wolfson Institute for Biomedical Research. Moncada was to be the fourth scientist in the group

and was therefore unrecognised for the Nobel Prize for medicine awarded for nitric oxide in 1998. The prize was awarded to three US scientists – a hugely controversial decision at the time. Few of us will even get close to a Nobel (though I still make sure I have my phone charged when the chemistry prize is being announced). Moncada got close to two, being in the frame also for the prostacyclin discovery. My recollection of the time (as a young scientist) was of dashed hope, followed by the sense of injustice, and disappointment felt by the whole Institute. Sometimes, even in the Darwinian hell of academic research, true friends show up, and a cathartic moment occurred when Garthwaite gave a seminar (with Moncada in the front row) where he explained the reward of science lies in the discovery and the recognition of your peers rather than in prizes (my words). This address drew gasps from the audience but seemed to be a pivotal moment in acceptance of the situation. But what happened after nitric oxide? John Garthwaite continued to work in the area and retired as a highly respected figure in 2017. Salvador Moncada worked on mitochondria and contributed to understanding the molecular basis of the Warburg effect. This is where cancer cells switch from aerobic respiration to glycolysis for their energy generation. It sounds like it might be important, if anyone on the Nobel committee is listening . . . oh yes, and he married a princess and is now ambassador for Honduras in Beijing (all true). I think my phone is flat but perhaps there is no rush to get it on charge after all.

David Selwood is Professor of Medicinal Chemistry.

* Not to be confused with nitrous oxide (N₂O), which is the party drug and spinal degenerative agent; it doesn't affect the body in the same way as nitric oxide.

The story of nitric oxide is bigger than just UCL, of course, with many labs involved around the world, and there is a human side to the story as well; it's about nearly Nobels, desperate hope and friendship.



NO signalling from capillaries to axons in optic nerve. Whole-mount preparation of rat optic nerve co-stained for eNOS (red), which labels blood vessels, and neurofilament (green) which labels axons.

Ariel 1

Lucie Green

When NASA was only six months old, in 1959, it was authorised to launch scientific instruments for other countries as part of the emerging civil space-exploration programme: an exciting opportunity, especially given that this was to be done free of charge. Scientists and engineers in the UK were keenly interested, and a team led by Harrie Massey, who was Quain Professor of Physics and Head of the Physics Department at UCL at the time, forged an agreement with NASA for the UK to provide instruments for what would become the first UK/US satellite. The aim was to use the satellite to learn more about a layer of the Earth's atmosphere called the ionosphere and the impact that the Sun's high-energy radiation has on this layer.

By this time, the UK's own space programme was well underway, with teams at a small number of UK universities having been involved in flying instrumentation on the *Skylark* sub-orbital rockets that reached an altitude of 100 km. These rockets became available because of the work and vision of Harrie Massey. The story goes that on the morning of 13 May 1953, Massey received a phone call just as he was preparing to leave his office for the Physics Department's annual cricket match. It was the Ministry of Supply asking whether he would like to use their rockets for scientific research. He immediately said yes, and from this grew the *Skylark* programme.

The mission launched successfully on 26 April 1962, from Cape Canaveral in Florida, and was named *Ariel 1* by the prime minister at the time, Harold Macmillan. *Ariel 1* carried seven experiments: four led by UCL, one joint UCL–University of Leicester and one each from Birmingham University and Imperial College London. It was a product of Massey's understanding that to be successful in space research required a range of skills and expertise.

Success was somewhat short-lived, because on 9 July 1962, the American Starfish Prime nuclear bomb was detonated high in the Earth's atmosphere

Studying the Sun and the ionosphere remains a key area of active research, having now flourished into the study of so-called space weather.

as part of a test programme. The explosion sent out radiation that damaged the *Ariel 1* solar cells, meaning that charging the satellite batteries became challenging. However, the satellite managed to take limited observations until 1964.

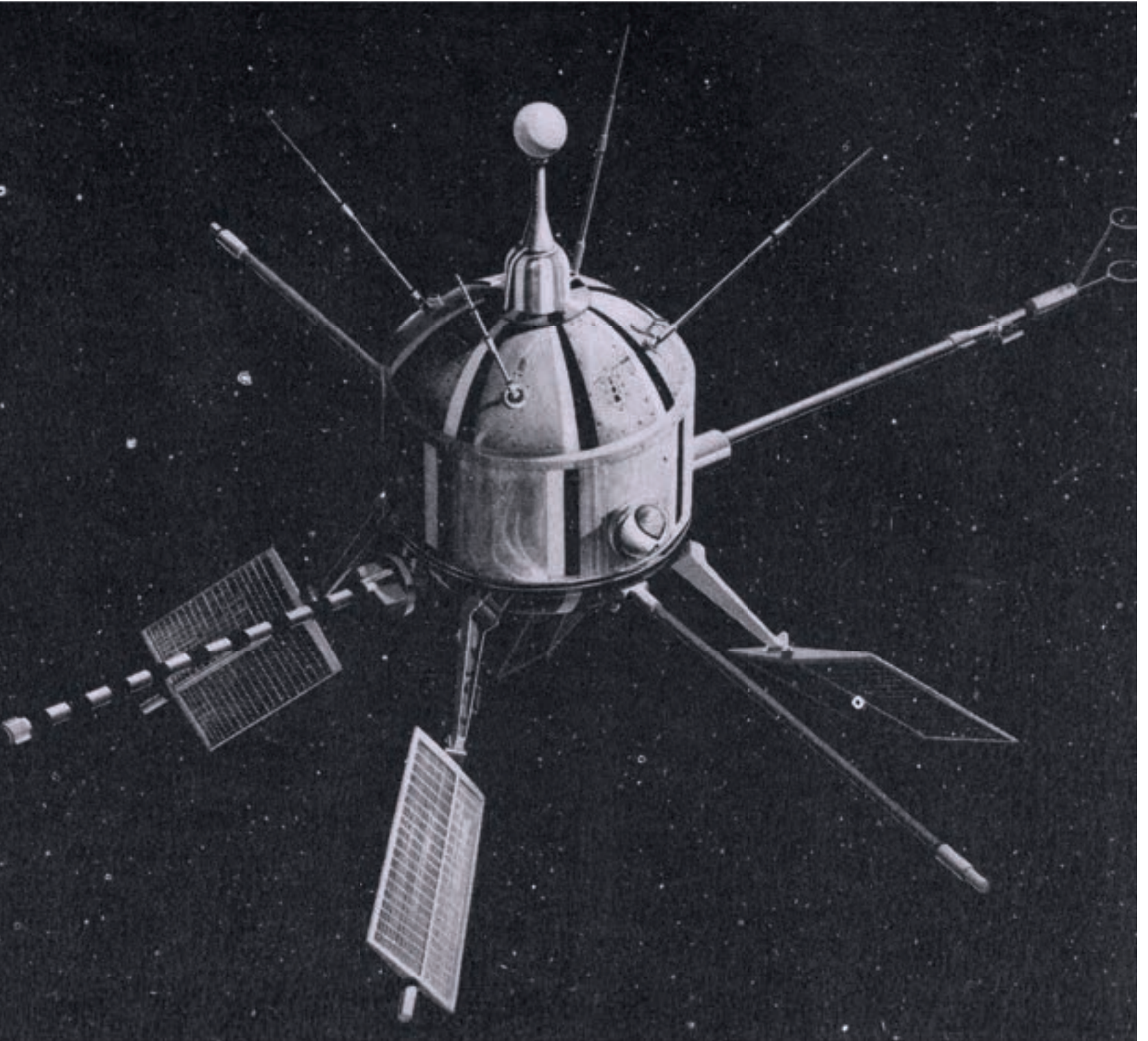
Studying the Sun and the ionosphere remains a key area of active research, having now flourished into the study of the so-called space weather. The Sun's varying impact on the ionosphere has significant implications for our modern forms of communication, which include bouncing radio signals off the ionosphere. And the destructive impact of the Starfish Prime radiation on the satellite's solar panels led to new designs and spacecraft that are more resilient to the harsh space environment.

Massey was knighted in 1960 for his services to the UK, and the experience gained from being a partner in *Ariel 1* enabled the country to become a world leader in space science and engineering, a position that it still holds today.

Lucie Green is Professor of Solar Physics.

***Ariel 1* (artist's impression of the satellite).**





William Farr and the birth of health data science

Paul Taylor

UCL's Institute of Health Informatics is a product of the digital age; the work we do is largely possible because the information doctors record while caring for patients is now created and stored on computers, and so can be shared for use in research. This kind of data science, however, belongs to a tradition that stretches back to the Victorians. We have spent much of the last several years exploring datasets compiled in response to the Covid-19 pandemic. The first attempt to identify a statistical pattern in the deaths linked to a disease outbreak was an 1840 paper by William Farr. Farr, who completed his medical training at UCL, took mortality data collected at the end of a smallpox epidemic

and described a mathematical series capturing the decline in the rate of deaths.

Farr was born into extreme poverty, the child of an agricultural labourer, and was something of an outsider in the medical profession, supporting himself partly through journalism. He was interested in mathematics and became known for articles informed by statistical analyses. This reputation led to an appointment in the General Register Office (GRO), a newly created body charged with replacing the patchwork of local parish records with a national system for recording births and deaths. He stayed at the GRO until his retirement in 1880, using the position, and the access to data it afforded, to



Hampstead smallpox hospital, 1871.



Rash of pustules on the hand of a patient probably suffering from smallpox, 1831.

Farr was born into extreme poverty, the child of an agricultural labourer, and was something of an outsider in the medical profession, supporting himself partly through journalism.

publish an extraordinary range of reports, which improved our understanding of the transmission of disease, death rates in the cities of the industrial revolution, the health of workers and even the pricing of life insurance.

Farr was a close friend and collaborator of Florence Nightingale, a passionate advocate for the theory that disease was spread through 'miasma' and best combated through improvements in hygiene and sanitation. Farr found support for the theory in an association between cholera and soil elevation, the disease being more prevalent in low-lying areas of London. However, as evidence accumulated that it was a water-borne disease, he pushed for studies comparing mortality rates among customers of different water companies and concluded that polluted water was the principal means of transmission.

In 1839 Farr was involved in a technical dispute with Edwin Chadwick, after whom UCL's Chadwick

Building is named, over the inclusion of 'starvation' in his classification of causes of death. Chadwick was trying to shore up support for the Poor Law, which in theory ensured everyone had access to the basic minimum required for life. Chadwick argued that 'starvation' was too broad a term, and that Farr was making a critique which went beyond his role as a medical statistician. Farr, in fact, through his work on the classification of diseases, contributed to a gradual shift by which medicine became increasingly organised around the study of diseases, a shift which has arguably led clinicians to be less concerned with the social determinants of health. But he was also acutely aware that, in the London of the 1830s, some people died because they did not have enough to eat.

Paul Taylor is Professor of Health Informatics.

Water vapour in the atmosphere of a transiting extrasolar planet

Giovanna Tinetti and Jonathan Tennyson

The authors describe the first ever detection of a molecule (water) in the atmosphere of an exoplanet, HD 189733b, the birth of a long-standing collaboration and how UCL is at the forefront of research into the nature of exoplanets.

Giovanna: Planets orbiting other stars (exoplanets) were only discovered in the 1990s, and by 2007 only about 200 were known. The sample of known exoplanets was very biased towards easily detected giant planets, similar in size and composition to our own Jupiter, but very hot as they orbit very close to their mother star. In 2007 I held a European Space Agency (ESA) Fellowship in Paris. I had just moved there the year before from Los Angeles, where I was working as a NASA Astrobiology Institute Fellow in Caltech, from where the NASA's Spitzer Space Telescope was operated.

Jonathan: In 2007 I was Head of Department for Physics and Astronomy. Giovanna came to UCL to give an informal seminar. She described how she was analysing observations taken at infrared wavelengths by Spitzer which showed that planet HD 189733b blocked different amounts of starlight at different wavelengths as it passed in front of (transited) its stars. These observations showed that the planet had an atmosphere which was absorbing lights of different colours in differing amounts.

Giovanna: I was convinced that to 'chase' molecules in exoplanet atmospheres, one had to use infrared light as diagnostics, as molecular signatures are unique and very prominent in those wavelengths. I had built a model of the atmosphere of HD 189733b to try to demonstrate this absorption in the infrared light which I thought was due to water vapour, but the models did not quite match Spitzer observations.

Jonathan: I had been working with my then PhD student Bob Barber making a reliable database of absorptions by hot water by performing detailed quantum mechanical calculations; we called this BT2, as it was our second attempt to get a good answer. This database comprised a list of more than 500 million colours (wavelengths) at which water might absorb light. After the seminar I asked Giovanna what data she was using to model the absorption of the very hot (about 1000°C) water in the atmosphere. When Giovanna told me what she was using, my immediate response was, 'That's rubbish, use our results.' A week later I got a very excited email from Giovanna saying that her new model using BT2 gave excellent results.

Giovanna: We submitted a paper entitled 'Tentative detection of water vapour in the atmosphere of a transiting extrasolar planet' to *Nature*. The journal in its wisdom accepted our paper but deleted the 'tentative' from the title. However, further observations have shown our result to be correct.

Jonathan: Reader, I hired her.

Giovanna: I am now Head of the Astrophysics Group at UCL and science lead of ESA's Ariel Space telescope (due for launch in 2029), the first mission dedicated to observing the chemical composition of hundreds of exoplanets. Guess what? Ariel is an infrared space telescope . . .

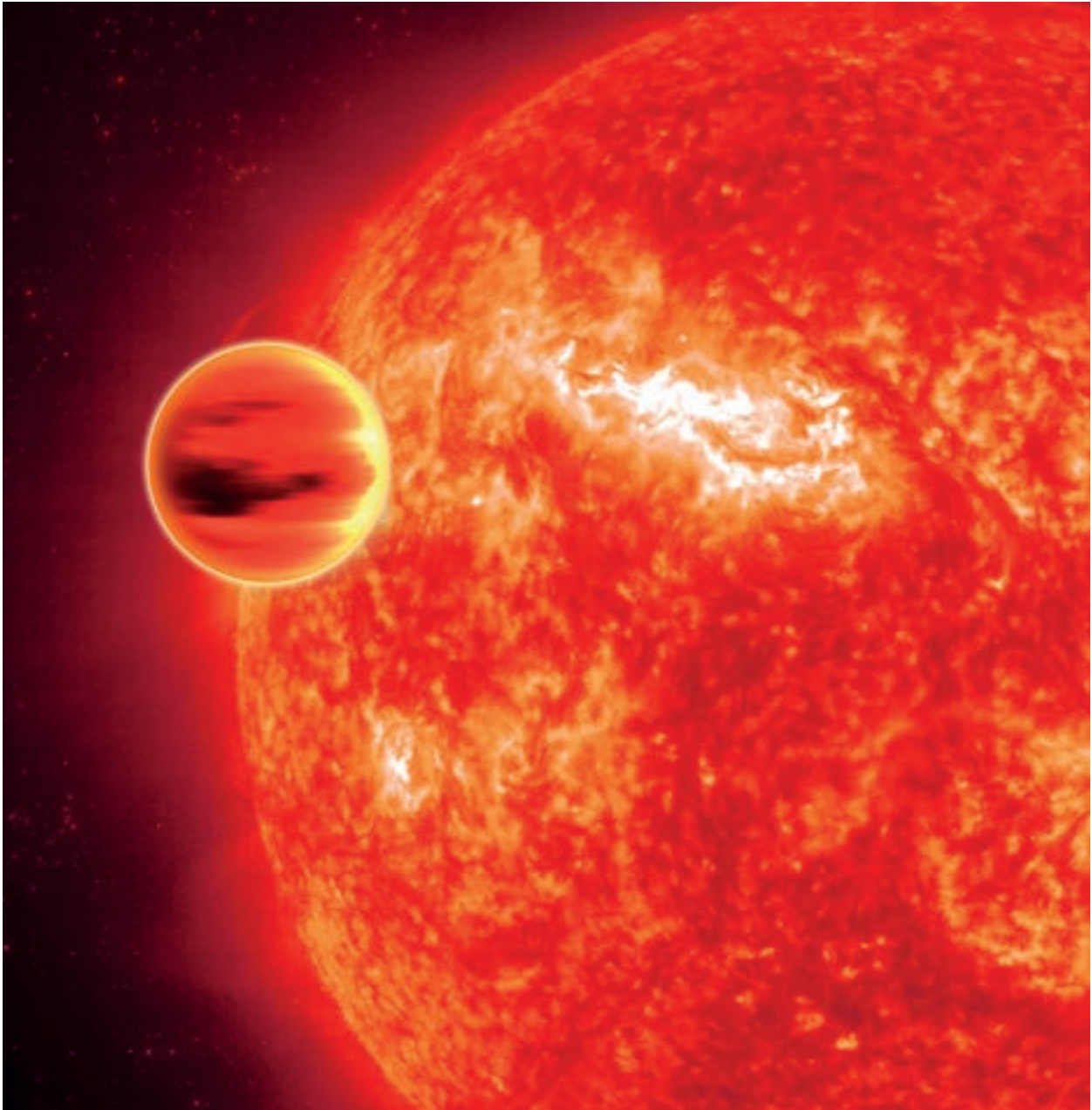
Jonathan: In 2011 I resigned as Head of Department to take up a five-year grant from the European Research Council (ERC) to start the ExoMol project to provide molecular data for studies of exoplanets and other hot astronomical objects. Unusually, the ERC renewed this grant for a further five years in 2020. In 2025 I was awarded the Gold Medal of the

Royal Astronomical Society, their highest award, for 'molecular physics (research) and pioneering leadership of the ExoMol project', an unexpected outcome for someone who has spent his research career solving Schrödinger's equation.

Both: In 2014, with Marcell Tessenyi, who had just completed his PhD at UCL with Giovanna, we founded Blue Skies Space Ltd, a start-up company that develops and launches satellites to provide

high-quality data to the global scientific community. Many things have changed since 2007, such as the number of exoplanets discovered, now approaching 6,000. However, one hasn't: we still need good observations and ExoMol molecular data to understand what exoplanets are made of!

Giovanna Tinetti is Professor of Astrophysics. Jonathan Tennyson is Massey Professor of Physics.



An artist's impression of the transiting exoplanet named 'HD 189733b'. The image is 'reddened' to provide an idea of the view in the infrared.

Michael Abercrombie and contact inhibition of locomotion

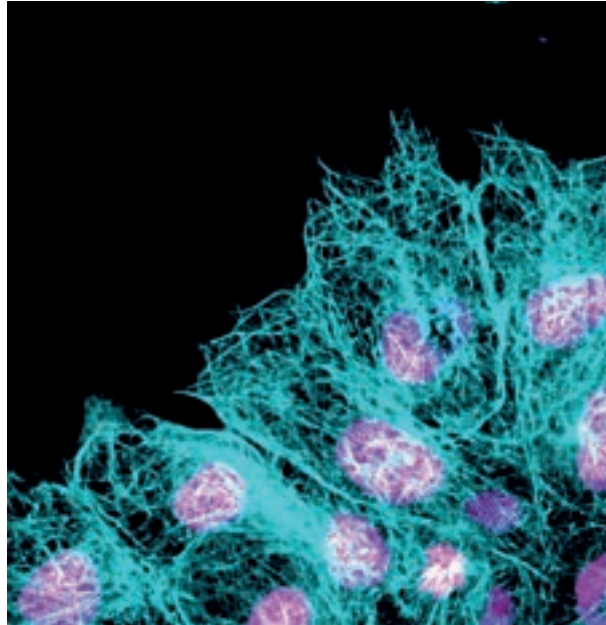
Roberto Mayor

In 1953, Michael Abercrombie, working at UCL, made a ground-breaking discovery that transformed our understanding of cell behaviour: the phenomenon of contact inhibition of locomotion (CIL). CIL is the process by which a migrating cell halts its forward motion and changes direction upon coming into contact with another cell. This mechanism, which plays a crucial role in tissue organisation, wound healing and cancer metastasis, was both conceptually simple and deeply significant.

What made CIL exciting was its profound implications for understanding both normal and pathological processes. Abercrombie's meticulous experiments illuminated how cells navigate space and interact dynamically, revealing a fundamental principle of multicellular life. Abercrombie's work anticipated later discoveries about how genes, chemical signals and the cell structural support, later named the cytoskeleton, orchestrate cell migration, and turned attention to how cells coordinate behaviour in a densely populated environment.

Abercrombie's insights catalysed the development of cancer biology as a distinct research field in the UK. He trained and inspired a generation of biologists, who carried his insights into labs worldwide. Internationally, his discovery of CIL influenced developmental biology and tissue engineering, forming a conceptual foundation for understanding how cells contribute to the formation of organs and tissues. Today, the echoes of his work can be found in research into regenerative medicine and cancer metastasis, fields that continue to benefit from his foundational discoveries.

UCL's long-standing commitment to interdisciplinary research and innovation made it the perfect environment for Abercrombie's work. Known as a hub of intellectual exploration, UCL encouraged cross-pollination between disciplines, which Abercrombie embraced by blending the



Neural crest exhibiting CIL. Cell nucleus in magenta, cytoskeleton in cyan.

precision of experimental biology with the analytical tools of mathematics and the emerging techniques of microscopy. His collaboration with physicists and engineers at UCL to refine imaging techniques was ground-breaking.

Abercrombie's discovery of CIL represents the university's enduring commitment to curiosity-driven research, interdisciplinarity and societal impact. From its modest beginnings in the 1950s to its current role in shaping fields such as oncology and regenerative medicine, CIL is a testament to the far-reaching legacy of UCL's visionary scientists, whose innovative research continues to transform science and improve lives worldwide.

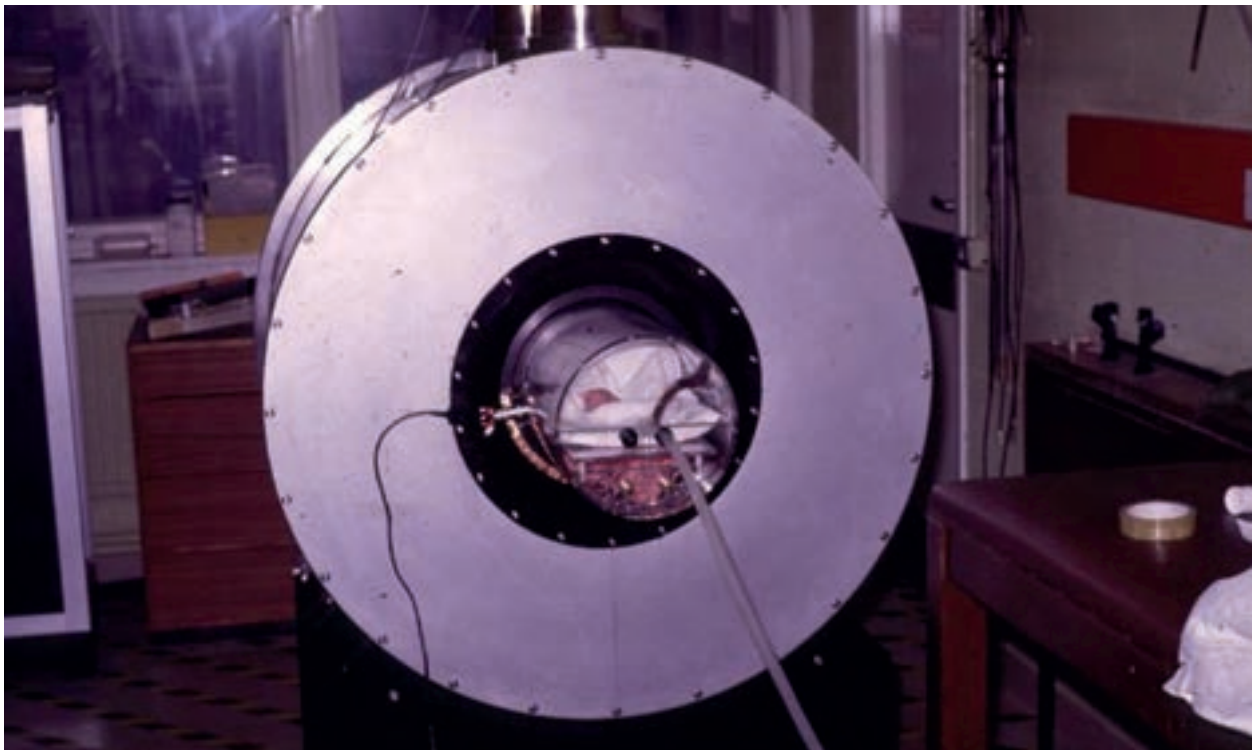
Roberto Mayor is Professor of Cell and Developmental Neurobiology.

The world's first human brain phosphorous NMR spectroscopy study

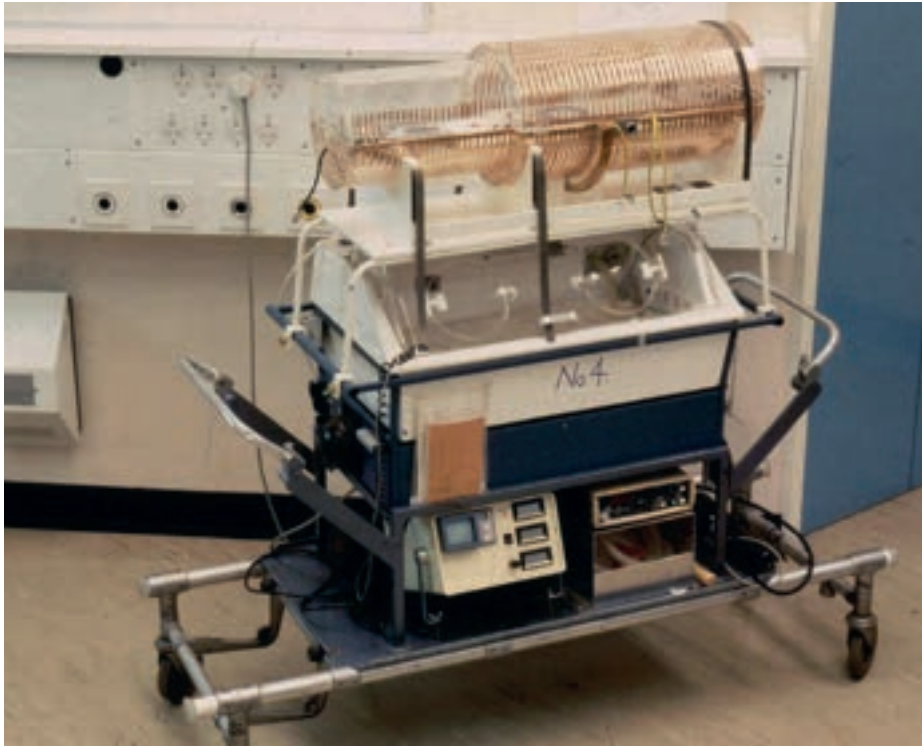
David Delpy

During the 1970s we had successfully developed techniques for blood oxygen monitoring in premature babies (see p. 49), and research was now focusing on the brain and whether the oxygen was getting there and if the cells which during birth had often suffered trauma through poor blood flow or lack of oxygen were still able to use it. Any technique for monitoring brain cell function (i.e. metabolism) had to be totally non-invasive and usable on babies receiving lots of other intensive-care support and monitoring. Cell metabolism is a complex series of biochemical reactions, but in its simplest form, oxygen supplied to the cell via the blood is used together with glucose and phosphorous to produce a biochemical called adenosine triphosphate (ATP), which the cell uses to power all its other functions. One technique that

biochemists had used to measure ATP in suspensions of cells in test tubes was called nuclear magnetic resonance spectroscopy (NMRS), which required placing the cells in the bore of a very high-field magnet and measuring very weak radio signals that the phosphorous atoms could be stimulated to produce (the technique is called ^{31}P NMRS). By the mid-1970s, the development of relatively large-bore (22 cm) high-field superconducting magnets (1.89 Tesla – the Earth's magnetic field is approximately 50 micro Tesla) meant ^{31}P NMRS measurement of muscle cell metabolism was possible by inserting an arm into the bore. Since a premature infant could also in principle fit into this size bore, my colleagues and I thought it possible to monitor intact brain metabolism. Following some successful animal studies



The horizontal magnet of the NMRS system. The bore of the magnet was approximately 22 cm and in the photograph a baby is lying in the cylindrical incubator housing which slides into the bore and is connected to the ventilation and monitoring equipment (>2 m away) via the cable and tubing that can be seen.



The neonatal transport incubator developed for the NMRS studies. The baby lies in the cylindrical housing on the top of a commercial transport incubator. The housing can be removed and slid into the bore of the NMRS magnet with monitoring and ventilation provided via long tubing and electrical cables. The copper strips on the cylinder form part of a Faraday Screen, which prevents external radio signals interfering with those being monitored from the brain.

to prove the principle, the results convinced three funders to support the purchase of an NMRS system, which was installed in a small room on the second floor of the Rayne Institute building.

To get babies into the magnet meant transporting them from the neonatal unit in a specialised transport incubator which could provide all the necessary ventilation, monitoring and heating while not bringing any magnetic material (especially iron) near the magnet. We had to develop a special incubator for this, and on 22 October 1982, the first baby was studied. No one knew exactly what the signal would look like, especially if there had been some brain trauma. The first baby had unfortunately suffered a bleed on the left side of its brain (visible on ultrasound), but the other side seemed normal so we hoped we could in principle compare the signal from one 'normal' and one 'not normal' side.

The results confirmed what we expected to see, with the normal side of the brain showing the

expected large ATP signal and the damaged side a lower ATP signal with a larger amount of unconverted phosphorous. This ability to monitor brain metabolism enabled the team to show subsequently that although brain trauma reduced normal brain cell metabolism, it did not kill the cells if it was reversed reasonably quickly, but over the following 24–48 hours evidence of cell death accumulated. This led to international research into the causes of this 'delayed energy failure', as it was called, and the development of clinical interventions which could be applied immediately after the trauma to prevent subsequent cell death – in particular the use of cooling (which reduces cell metabolic rate), a technique now widely used in both neonatal and adult intensive care following brain injury.

David Delpy is Emeritus Professor of Medical Photonics.

Developing instruments for use in space science missions

Andrew Fazakerley

UCL's Department of Space and Climate Physics is home to the Mullard Space Science Laboratory (MSSL). MSSL has worked with all the world's leading space agencies, providing cutting-edge space instruments for space science satellite missions beginning with *Ariel 1* in 1962. By the end of UCL's bicentennial year, there will have been 75 launches of 88 spacecraft that carried instruments with MSSL involvements, and more to follow.

MSSL has contributed to, or built outright, instruments used to study stars, our galaxy and extragalactic objects, in wavelengths ranging from infrared (*Herschel*) to visible/UV (*Swift*, *Euclid*) to X-rays (*XMM-Newton*). NASA's premier observatory, the enormous James Webb Space Telescope,

hosts the Near-Infra-Red Spectrograph, which uses an MSSL onboard calibration system and is making new discoveries ranging from revealing the composition of exoplanet atmospheres to characterising for the first time objects in the very early universe.

MSSL has helped to build each of the three biggest astronomical camera focal planes to be launched into space, for the *Gaia*, *Euclid* and *PLATO* missions. *Gaia*, which is making exquisitely precise measurements of the positions and motion of a billion stars in our galaxy, is recognised as the world's most fruitful space science mission in terms of number of scientific publications. *Euclid* is measuring the shape and location of billions of



Euclid captures the core of the Abell 3381 galaxy cluster.

distant galaxies in order to answer questions about the nature of dark matter and dark energy, and the expansion of the universe. *PLATO* will discover many new exoplanets and characterise their host stars, to help answer questions about how planetary systems form. *PLATO* is the first mission that will find Earth-sized planets around Sun-like stars elsewhere in the galaxy.

Instruments built wholly or partially at MSSL, and/or calibrated there, have been sent to study the Sun from inside the orbit of Mercury (*Solar Orbiter*) and from the Earth (*Yohkoh*, *Hinode*, *SoHO*). They have visited Halley's Comet (*Giotto*), Venus (*Venus Express*), Mars (*Mars Express*, *Beagle 2*, *Trace Gas Orbiter*), Jupiter and its moons (*JUICE*), and Saturn and its moons (*Cassini-Huygens*). One has orbited Earth on the Space Shuttle and is now back at MSSL, on display.

UCL scientists have successfully proposed several missions to international space agencies. *CryoSat* (Duncan Wingham, MSSL) was the world's first radar satellite dedicated to the study of polar ice-field thickness. Launched in 2010, *CryoSat* is still making crucial long-term measurements of ice loss as anthropogenic global warming has taken hold. *SMILE* (Graziella Branduardi Raymont, MSSL, and a Chinese colleague) is a mission to make the first images of the boundaries of Earth's magnetosphere, due to be launched in late 2025. *Comet Interceptor* (Geraint Jones, MSSL) and the exoplanet atmosphere mission *Ariel* (Giovanna Tinetti, Physics and Astronomy – see also p. 230) are due to launch on the same rocket in 2029.

During UCL's bicentennial year, it is expected that *SMILE* and *PLATO* will be launched, and that MSSL will be delivering instruments for three further missions in 2026/7, namely solar/space weather missions *Solar-C/EUVST*, *Vigil* and the *Rosalind Franklin Mars Rover*.

Andrew Fazakerley is Professor of Space Plasma Physics.



Euclid's view of stellar nursery Messier 78.



Advancing our understanding of the origin of chemical elements: Margaret Burbidge

Kate Pattle

E. Margaret Burbidge (1919–2020) was a UCL graduate who was central to the development of the theory of stellar nucleosynthesis, the process by which the chemical elements are built up by nuclear fusion reactions in the hearts of stars, as well as being a trailblazer for women in astrophysics.

Burbidge (née Peachey) was born in Stockport and grew up in Hampstead in North London. She developed an interest in mathematics and astronomy from a young age, and in 1936 arrived at UCL to study pure and applied mathematics, physics and chemistry. Towards the end of her first year, she chose to focus her studies on astronomy, having become fascinated by the teaching being done in the two telescope domes in the Main Quadrangle.

Having gained her undergraduate degree in 1939, she continued at UCL as a PhD student while also being in day-to-day charge of the UCL Observatory (then called ULO, the University of London Observatory), at Mill Hill in North London, and assembling optical equipment for the war effort. She gained her PhD in 1943, for work on the spectrum of the variable star Gamma Cassiopeiae, and continued to observe at ULO throughout the Second World War. On one dramatic night in August 1944, she recorded two near misses from V1 bombs in her observing log – noting only that the explosion had shifted the star that she was observing out of the telescope's field of view. After the war ended, Margaret continued her research at ULO, and in 1948 she was appointed Assistant Director of the Observatory. In the same year she married the physicist Geoffrey Burbidge, and the couple moved to the USA in 1951. Although the Burbidges remained based in the USA for the rest of their lives, Margaret maintained collaborative links with the thriving astrophysics research group at UCL. Her final visit to the UCL Observatory was in 2005, when she and Geoffrey returned to London to accept the

Gold Medal of the Royal Astronomical Society, the society's highest award, for their lifetimes' work.

Throughout the 1950s Margaret and Geoffrey worked both together and separately on the problems of the composition and evolution of stars. In 1957, the Burbidges and their colleagues William Fowler and Fred Hoyle published their seminal paper 'Synthesis of the elements in stars', a work that is so influential in astrophysics that it is known simply as the 'B²FH paper', after the initials of the four authors. The B²FH paper, of which Margaret was the first author, established the process of stellar nucleosynthesis: the sequences of nuclear fusion reactions by which stars build up the full periodic table of the elements out of the two lightest elements, hydrogen and helium.

The theory of stellar nucleosynthesis resulted in a complete change in our understanding of our origins. Our picture of a static universe where all elements in the periodic table were created *ab initio* in the proportions that we see in the modern universe changed to one of an evolving universe in which the heavier elements were built up over billions of years in the hearts of stars, creating the conditions for life. This fundamental change in our perception of our own place in the cosmos was perhaps best expressed by Joni Mitchell, who only a few years later in 1970 sang that 'We are stardust / Billion-year-old carbon / We are golden'. Margaret Burbidge, along with her colleagues on the B²FH paper, made us all children of the stars.

Kate Pattle is Royal Society University Research Fellow and Lecturer in Astrophysics.



Margaret Burbidge (centre) at UCL Observatory.

How the brain perceives colour: Semir Zeki

Jonathan Ashmore

In July 1789, just before the Revolution, the French mathematician Gaspard Monge showed his fellow Academicians a red square of paper, and asked them to observe it through a red pane of glass from the other side of the room. Rather surprisingly, the square appeared no longer red, but desaturated or even almost white. Despite the received wisdom that the colour of an object should be the wavelength of the reflected light, the colour seemed to be transformed by the context in which it was seen – a fact of course well known to painters, but paradoxical to a physical understanding of light. Equally puzzling was that we seem to be able to know that a leaf, say, continues to appear green, irrespective of whether seen in bright daylight, or in the much redder light of an indoor lamp. This feature is known as 'colour constancy'.

The underpinning science of the brain's perception of colour depends on pioneering discoveries made by Semir Zeki, Emeritus Professor of Neuroaesthetics at UCL. In the 1970s he began a series of neurophysiological experiments to establish how and where colour is encoded in the brain. Cells in the first visual processing area of the mammalian brain (Area V1 at the rear of the cortex) receive an input from the retina but without the specificity to distinguish one colour clearly from another. What Zeki showed in the primate brain was that there was another visual area (termed the V4 complex on the lower ventral cortex) where cells were specific responders to particular colours. In retrospect this may have been anticipated, as neurologists had identified such a region in unfortunate human subjects who, as a result of injury or stroke, found themselves suffering from achromatopsia, unable to identify colours.

In Zeki's laboratory, the paradox named after Monge also yielded to the same experimental approach. As a result of studying individual cells in V4, and in a collaboration with Edwin Land (the Polaroid camera inventor), it was found that such



Collage of coloured shapes (a 'Mondrian') used in Zeki and Land's experiments.

cells performed a computation. Cells assigned very specific colours by including and balancing the light reflected from surrounding coloured surfaces. Although the networks performing the computation of wavelength ratios are still incompletely understood, the result permits a colour to be assigned over widely varying light levels. Zeki's experiments used a coloured pattern termed a Mondrian, as it allows a convenient range of varied colour scenes to be presented to the eye. The results of this collaboration were published in *Nature* in 1980. So that the effects could be appreciated fully, each issue of that journal came with a set of uniquely coloured filters, courtesy of the Polaroid Corporation. Unfortunately the secret of the precise formulae used to construct these filters died with Land eleven years later.

Jonathan Ashmore is Bernard Katz Professor of Biophysics.

Grant Museum of Zoology

Tannis Davidson

Since the foundation of UCL, the Grant Museum of Zoology has been a vital resource supporting research, teaching innovation and scientific advancement, and it continues to have contemporary relevance to transform how knowledge is created and shared.

UCL's Grant Museum of Zoology is home to around 100,000 specimens covering the whole of the animal kingdom. It was established by Robert Edmond Grant (1793–1874) as a teaching collection at the newly founded University of London (later known as UCL). Grant was best known for his work on marine invertebrates and was the first to prove that sponges were a unique group of animals. He was one of UCL's inaugural professors, taking up the Chair of Zoology and becoming the first Professor of Comparative Anatomy at UCL in 1828.

Upon his arrival in London, Grant began to assemble specimens which he used to teach about the origin of life, using ideas of evolution before Darwin's *On the Origin of Species* (1859). Owing to Grant, this museum was the first place evolution was taught in an English university.

The museum's collection has grown over the years beyond Grant's original 11,000 specimens and contains material from several former London university collections, London Zoo and numerous research collections. It is one of the oldest natural history collections in the UK and the only remaining university zoological museum in London. The Grant Museum contains globally important and unique specimens such as extinct and rare species, including one of only seven skeletons of the extinct quagga in the world, one of only four fluid-preserved extinct adult thylacine specimens in the world and the largest collection of (critically endangered) gharial crocodile material in the UK.

The collection continues to be actively used in teaching, inspiring new generations of students to learn about and learn from the natural world. Each year around 3,000 students use specimens in

teaching modules. Museum staff develop modules with academic colleagues, matching specimens to course themes, providing a distinctly valuable experience for UCL students.

During the Covid-19 pandemic, when teaching moved online with UCL in lockdown, the Grant Museum delivered 40 face-to-face object-based teaching practicals, as these were considered such an essential component to students' coursework. Remote students in one of the biosciences modules were sent 3D-printed mystery vertebrate skulls in the post so that they would have a similar specimen-based identification exercise to the London-based students. This multidisciplinary collaboration between the museum, UCL's Centre for Integrative Anatomy and UCL Bartlett B-made workshop was a ground-breaking solution to support students and teaching during the pandemic.



To understand how species respond to climate change, UCL researchers use bioacoustics (sound recordings) of Seychelles frogs to monitor their behaviour at lower (warmer) and higher (cooler) elevations.



DNA was extracted from these 200-year-old specimens as part of an international project aiming to determine the genetic health of sawfish species to inform conservation of living populations.

New showcases and displays now highlight the diversity of life, history of science, human impact on nature and the value of the collections in research.

The Grant Museum attracts research visitors and collaborators from around the world who use the collection in cutting-edge research including the identification of species and modelling global biodiversity trends. Additional areas of growth in demand for use of the collection include genetic sequencing; as a testbed for new technology and museological pedagogy; critical histories including decolonisation; and health and wellbeing research.

Research use of the collection is featured through displays, exhibitions and public events that highlight

the relevance and value of the collection. As a well-loved, popular London institution, the Grant Museum plays a key role in communicating innovative UCL research to public visitors.

Located in the Rockefeller Building since 2011, the Grant Museum underwent redevelopment work in 2023–4 to upgrade the physical space, provide better care for the collections and improve the visitor experience. New showcases and displays now highlight the diversity of life, history of science, human impact on nature and the value of the collections in research.

The reframing of the museum as a resource for research and teaching excellence celebrates how it has been integral to the fabric of UCL since the foundation of the university and communicates how this historic collection continues to inform and inspire visitors to connect with the natural world.

Tannis Davidson is Head of Zoology and Science Collections, LCCOS.



3D printed skulls sent to remote students for teaching on the UCL Biosciences Vertebrate Life and Evolution course during the Covid-19 pandemic.

Digital anthropology

Daniel Miller

The study of digital anthropology is one field of academic research in which UCL is unequivocally the world's leading institution. We created the first master's programme, the first textbook and the first centre, and we currently host the largest body of researchers and teachers.

At first the juxtaposition of 'digital' with 'anthropology' may itself look surprising. The digital stands for the most dynamic force in the modern world. Every year it has a new focus: social media, selfies, smartphones, drones, algorithms and large language models. Meanwhile, anthropology remains a slow, patient exercise. Our primary method still consists of living for around 16 months within a community and then spending at least the same amount of time analysing evidence and writing publications. Why would such a slow method be appropriate for understanding such rapid developments?

The most important thing we need to know about the digital is surely its consequences for people. And there may simply be no shortcuts to the kind of scholarship this requires. In studying smartphones we encounter a device that mediates our relationship to work, to entertainment, to information, to each other and to almost everything else we do. This is why our research has to be holistic, learning about every aspect of people's offline lives, in order to see what happens as a result of their online lives. As a consequence, the influence of digital anthropology has been largely disseminated through books rather than journal articles. Books can provide the requisite context for understanding individuals, social relationships and communities.

There does seem to be an appreciation of this contribution. For example, the 'Why We Post' project we conducted on the use and consequences of social media in nine fieldsites around the world produced 10 volumes of evidence. Published as a contribution to the emerging UCL Press, these have reached over 1.8 million downloads worldwide. Our teaching

encompasses a broad range of topics, from the nature of data and algorithms to digital archives, the studies of attention, TikTok, digital storytelling and digital China.

There is constant media reporting on the issues with which we are concerned. Are we losing our attention span? Should smartphones be limited for children? Is the online addictive? Are we all subject to fake news? Almost every day the newspapers create anxiety that the impact of digital technologies is diminishing our humanity. Sometimes we hear the opposite: the hype around the digital as the solution to all our problems or the beginning of some kind of future cyberhuman that will go beyond the merely human. All this demonstrates why we need patient, balanced scholarship that is focused on garnering the best evidence and that includes Indian farmers, Chinese factory workers and Latin American suburbs, rather than simplistic generalisations and claimed universals. I hope that the level of respect and interest in the work of UCL digital anthropology is an acknowledgement of the kind of integrity such evidence-based research maintains against the flood of hype and supposition.

Daniel Miller is Professor of Anthropology.

In studying smartphones we encounter a device that mediates our relationship to work, to entertainment, to information, to each other and to almost everything else we do.





Livestreaming of matsutake mushrooms in China.

Sequencing a 3,000-year-old wheat genome from ancient Egypt

Anna Garnett, Michael Scott, Mark Thomas, Dorian Q. Fuller and Richard Mott

UCL's Petrie Museum of Egyptian and Sudanese Archaeology is designated as being of national and international significance and is one of the most comprehensive university teaching collections for any subject in the world. The museum contains more than 80,000 objects from ancient and modern Egypt and Sudan, many of which were excavated by William Matthew Flinders Petrie's (1853–1942) Egyptian and British workforces. The collection contains such unique organic artefacts as the earliest known, most complete woven garment in the world, which is over 5,000 years old, and ancient botanical specimens, grown and harvested over 3,000 years ago.

In 2019, UCL researchers analysed DNA sequences from a specimen of ancient wheat excavated in Egypt 100 years ago, now part of the Petrie Museum collection (UC10164). The fertile Nile river valley provided Egypt with great agricultural wealth for millennia; bread and beer made from wheat and barley were staples of the Egyptian diet. The most common wheat in ancient Egypt was emmer wheat, ancestor of the most widely grown wheats today: bread wheat and durum wheat. Emmer is harder to process than durum and bread wheats but may be preferred for cultural reasons, hardness or because the grain is better protected from pests during storage.

This study, published in *Nature Plants* by an international interdisciplinary research team, mapped the genetic code from this important specimen. DNA analysis allows us to look at museum specimens in a different way, providing clues to tell us how humans have moved and genetically transformed crops through time. Importantly, this study discovered that this wheat already had most of the genetic characteristics linked with domestication at that time, and that it was genetically similar to modern wheats grown in India, Oman and Turkey.

This project shows the potential of the Petrie Museum's collection as a dynamic and living resource, core to the development of innovative and exciting research and teaching across UCL and beyond. Knowledge of ancient genetic variation may also enable us to breed crops that are better suited to future climates; targeted reintroductions of genetic variations used in the past can add a new dimension to crop breeding and global sustainability. This research team, along with Dr Pia Aanstad, is currently investigating DNA extracted from ancient Egyptian bread and beer remains, including those from the Petrie Museum, to better understand ancient fermentation processes.

Anna Garnett is Curator of Egyptian Archaeology Collections, LCCOS. Michael Scott was a Postdoctoral Research Associate at the UCL Genetics Institute until 2020. Mark Thomas is Professor of Evolutionary Genetics. Dorian Q. Fuller is Professor of Archaeobotany. Richard Mott is Weldon Professor of Computational and Statistical Genetics.



Emmer wheat chaff excavated in 1924 by Gertrude Caton-Thompson's Egyptian workforce at Hememiah, Middle Egypt. Dynasty 20 (c.1130–1000 BC), Petrie Museum UC10164.



The 'Tarkhan dress', a linen V-neck shirt named after the cemetery outside Cairo where it was excavated in 1913, has been confirmed as the world's oldest woven garment. It is one of the Petrie Museum's most important holdings.

The archaeology of water in ancient China

Yijie Zhuang

From the legendary tale of the Great Yu's efforts to dredge river channels and found the first dynasty of Xia from the great floods, to the twentieth-century historian Karl Wittfogel's influential theory of 'Oriental Despotism', which posited that kingly power arose from the state's construction and control of large-scale irrigation systems, water remains central to understanding Chinese history and society. However, the uncritical use of historical records and broad-scale generalisations have led to the continued misuse of these legends and theories in historical narratives and political discourses. When and where did large-scale hydraulic engineering works first emerge? Were they universally linked to the rise of coercive power? And were small, local societies, as characterised by Wittfogel, passively subjected to these processes? Archaeology of water, which integrates macro-scale observations of environmental changes with micro-scale analysis of human responses, is indispensable for understanding social governance and power structure in ancient China. The research I lead on Pingliangtai offers a small but significant antithesis to the classic association between centralised control of water and social hierarchy in ancient China.

Pingliangtai site is an enclosed town located on the vast low-lying plain of eastern Henan province in central China, dating back 4,300 years. Despite its modest size of just 3.4 ha, it possesses key characteristics that define a city in Chinese archaeology: an earthen wall, roads forming a central axis, houses following well-planned layouts, and public infrastructure, including moats, gatehouses and water wells. Some of the earliest ceramic drainage pipes have also been found here, constituting a two-tiered drainage system alongside a network of ditches. Outside individual houses were drainage ditches that connected to drainage pipes and more ditches along the central axis. These carried water south towards the south gate, where multiple layers of drainage pipes were



Layout of the Pingliangtai walled town with plans of earthen walls, moat, drainage ditches and pipes as well as other settlement features.

installed and used, before eventually emptying into the wide moats surrounding the enclosed town. The main functions of this drainage system were not for sewage discharge but floodwater management, as vividly illustrated by our excavation. Layers of drainage pipes were found stacked atop one another, and on some occasions, blockages of pipes quickly led to their abandonment and replacement by large ditches to discharge excessive flash floodwater.

Who managed this system, and why was it important? The houses at Pingliangtai were small and uniform, typically accommodating families of



Two rows of ceramic drainage pipes found at Pingliangtai.

three or four people. Similarly, most graves from the communal cemetery were of small to medium size, with modest burial goods. The household- and communal-level practices of drainage suggest that water management was a collective effort, integral to shared interest in Pingliangtai in an environment prone to a monsoonal climatic regime with excessive summer rainfall and frequent floods due to its low-lying terrain.

What does the Pingliangtai example reveal about the origins and development of hydraulic societies in ancient China? Unlike the UNESCO World Heritage site of Liangzhu, where an enormous hydraulic enterprise was closely tied to an expanding urbanism and highly stratified society with the clear presence of an elite, 'ruling' class, Pingliangtai remained largely an egalitarian society without evident social stratification. Here, a shared environmental contingency and societal responses to it were collective, non-elite endeavours that never gave rise to a 'centralised hierarchy' and kingly



Individual pipe.

power. Pingliangtai exemplifies a long-neglected 'social heterarchy' where communal responsibility and technological innovations towards addressing common environmental problems are pivotal to understanding social governance in ancient China.

Yijie Zhuang is Professor of Chinese Archaeology and Geoarchaeology.

Probing the dark side of the universe

Ofer Lahav

What is the universe made of? How old is it? Will it expand for ever? These questions have fascinated humanity for thousands of years. Research over recent decades – much of which UCL has been heavily involved in – has dramatically enhanced our understanding of these fundamental issues.

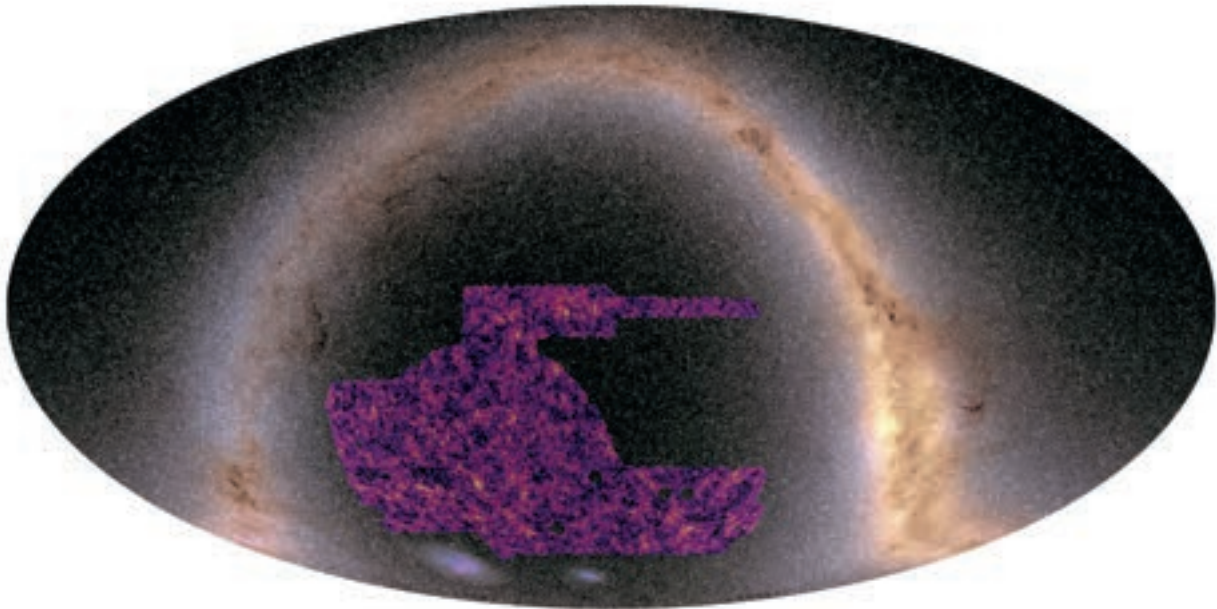
It is now well established that the universe began with the Big Bang approximately 13.8 billion years ago. In the late 1990s two international teams studying Type Ia supernovae – used as ‘standard candles’ to measure cosmic distances – discovered that the expansion of the universe is accelerating. This surprising result pointed to the existence of a mysterious component dubbed dark energy, whose nature remains one of the most profound mysteries in science today. Dark energy is a broad term that

encompasses concepts such as the Cosmological Constant Λ , first proposed by Einstein in 1917.

Currently, astronomers agree that the composition of the universe is an extraordinary mixture: approximately 5 per cent baryonic (ordinary) matter, 25 per cent cold dark matter and 70 per cent dark energy. There are about half a dozen ambitious experiments, at various stages of development, aimed at probing the nature of dark energy. Among them is the Dark Energy Survey (DES), led by Fermilab in the United States. DES is an international collaboration involving more than 400 scientists from 26 institutions across seven countries. The survey commenced observations in 2013 and concluded in 2019, after 758 nights of observations spread across that period.



Blanco Telescope, Cerro Tololo Inter-American Observatory, Chile.



The amount of matter (both visible and dark matter) within the irregular 5,000-square-degree area imaged by the Dark Energy Survey. Lighter colours indicate regions with more matter. The map is superimposed on an image of the full sky, where the bright band represents the Milky Way, and the Large and Small Magellanic Clouds are visible below the mapped region.

UCL has been one of the leading institutions contributing to both instrumentation and scientific analysis. In early 2004, all the stars were aligned for UCL's involvement. I had just joined UCL as the Perren Chair of Astronomy and established a cosmology group, including Sarah Bridle and Jochen Weller. At the same time, the instrumentation team, led by Peter Doel and David Brooks, was prepared to embark on a new optics project. Over the past two decades, staff, postdocs and PhD students in the Astrophysics group have contributed to DES science, with support from the Science and Technology Facilities Council, the European Research Council and the Perren Fund.

DES is an imaging survey, utilising a 570-megapixel camera (called DECam) mounted on the 4-metre Blanco telescope in Chile. DES imaged about an eighth of the sky to a depth of approximately 24th magnitude – about 16 million times fainter than the dimmest star that can be seen with the naked eye.

Photometric redshifts (approximate distances to galaxies) were obtained using AI methods developed in part at UCL and applied to multi-band photometry, producing a three-dimensional map of 300 million

galaxies. The primary goal of DES is to determine the dark energy equation of state (w) and other key cosmological parameters with high precision. DES has measured w using four complementary techniques within a single survey: galaxy clustering, counts of galaxy clusters, weak gravitational lensing and thousands of Type Ia supernovae in a 'time-domain' survey. Among the key DES studies, its probes have tested consistency with the standard Lambda Cold Dark Matter model, with some exploration of possible deviations from a constant dark energy equation of state.

DES has also generated one of the largest ever maps of the distribution of dark matter using weak gravitational lensing (see above), generated at UCL by Niall Jeffrey and collaborators. Unplanned at the time DES was designed, it has served for follow-up observations of gravitational wave events, enriching multi-messenger astrophysics. DES has paved the way for UCL's involvement in the next generation of projects: DESI, Euclid, Rubin-LSST and others.

Ofer Lahav is Perren Chair of Astronomy.

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The collective efforts of all those involved have helped shape a volume that reflects the richness, range and diversity of academic work at UCL. We are proud to present this book as part of the Bicentennial celebrations where it serves as a testament to the collaborative spirit and intellectual generosity that define our institution.

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Index

Illustrations are indicated by *italic* page numbers.

- Abercrombie, Michael 232
Accountability for Gender Equality in Education (AGEE) 193
Adams, John 170
ageing, biology of 218, 219
airborne hazards (public health) 56
Alcalá Galiano, Antonio 79, 80–1
algae, microscopic (diatoms) 174
Alzheimer's disease 24, 218
Amazon rainforest 169
Amos, Andrew 178, 179
amputation 21
amyloid plaques 24
anaesthesia 20–1, 20–1
annuloplasty ring 25
anthropology
 digital 244, 245
 medical 157–9
antiretroviral treatment 42
Archaeology South-East 92–3, 92–3
Archer, Louise 164, 165
Ariel 1 (satellite) 226, 227, 235
Ariel Space telescope 230, 236
artificial intelligence (AI) 54, 159, 220, 221
Art Museum 66–8, 197–9
Atkinson, Robert William 212
Austen, Jane 91, 91
Austin, John 178, 185–6
autism, social nature and 138
automatic speech recognition (ASR) technology 106–7, 107

Baddawi camp, Tripoli 166, 167
Bailey, Patrick 164
Baldwin–Farmer chamber 52, 53
Ball, Stephen 164
Bangham, Alec 50
Barendt, Eric 128–9
Barlow, Harold 116
Barthes, Roland 73, 90
Bartlett School of Planning (BSP) 172
Bayliss, William 28
Beacon School Programme (Holocaust Education) 200
Bentham, Jeremy 178, 185–6, 187, 211
 auto-icon 190–1, 190–1
benzene structure 112–13

Bernstein, Basil 164
Biodiversity and Environment Research, Centre for (CBER) 122–3
biopharmaceutical manufacturing 22
birth cohort studies, national 126–7, 127
Blackwell, Elizabeth 26
Blanco Telescope, Cerro Tololo Inter-American Observatory, Chile 250, 251
block plan (1935) 11
body mass index (BMI) charts 33
Bonarjee, Dorothy 194
Boott, Francis 20
Borodale, Sean 94
bosons 104–5, 104–5
Bowring, John 190
Bradbury, Alice 164
Bragg–Gray cavity theory 52
Bragg, Sara 165
Bragg, William H. 112
breastfeeding study 39–40
Brighton Corn Exchange 93
British Library 78
Brougham, Henry 60, 78, 190
Brown, Christopher L. 162
Burbidge, E. Margaret 238, 239
Burbidge, Geoffrey 238
Burriesci, Gaetano 25
Burt, Cyril 171, 209

calcium 222, 223
cancer
 biology 232
 breast 40, 40
 cells 223
 prostate 44, 45
 treatments 30–1, 52, 53
cardiac care 25
 valve prosthesis 25
 modern 28
CAR T-cell programme 31
catheter-tip electrode 49
cells, surviving/thriving 222, 223
Chadwick, Edwin 229
challenges, societal and economic 168–9
Chamberlain, Neville 41, 41
chemical elements, origin of 238
chemistry, organic 211–13
China 119, 244, 245, 248–9, 248–9
'Chōshū Five' 212–13, 212

Civil Engineering, Department of 56
Clark, W.A.V., *Ten Views in the Island of Antigua* 163
Clarke, Fred 171, 214
classical past now 76–7
climate change crisis 120–1, 120, 183–4
Coast, Steve 60
'Colour & Poetry' events 83, 95
'Colour and Emotion Toolkit' 83
colour, brain perception and 240, 240
Comfort, Alex 218
Constitution Unit 132–3
contact inhibition of locomotion (CIL) 232, 232
Controlled Active Ventilation Environment (CAVE) laboratory 56, 57
Cook, Betty 156
corpus linguistics (CL) 130
Covid-19 pandemic 38–9, 50–1, 50–1, 56, 140, 158–9, 172, 241, 243
CPAP (continuous positive airway pressure) 38, 38
cranially conjoint twin separations 35, 35
crisis recovery, inclusive 172, 172
Crookes, Sir William 148
CryoSat spacecraft 236
crystallography 112–13
Cushny, Arthur 28

Dale, Revd Thomas 84
Danaci, Goksu 8
Dark Energy Survey (DES) 250–1
Darwin, Charles 108, 122, 206
data-empowered societies 184
Dean, Austin 94
Dennis, Ian 178
Diachronic Corpus of Present-Day English (DCPSE) 130
Diaghilev, Sergei 96, 98
digital anthropology 244, 245
Digital Language Inclusion, Centre for 106
digital literacy 203
Digital Nutrition Report (2025) 203, 203
diversity and its evolution 122–3
DNA 174, 220, 242, 246
Donaldson Reading Room 62
Douglass, Maureen 155

drainage systems 248–9, 248–9
Draper, Nick 162
Drossart, Pierre 102
drug-testing facility, first 41, 41
Dworkin, Ronald 128, 186

Ear Institute 46
economy, political 195–6
Education, Institute of (IOE) 126, 164–5, 170–1, 192, 200–2, 209, 214–15, 214
education
 gender equality in/through 192–3
 Isaacs and progressive 208–10, 208–10
 legal 194
 sociology of 164–5
 supporting learning about the Holocaust 200–2, 201
Egypt 199, 246, 246–7
electricity markets, reforming 118–19
electrocardiograph 28
endothelial-derived relaxing factor (EDRF) 224
English Department 73, 84–5, 84
English language and literature 84–5
English Longitudinal Study of Ageing 177
English Usage, Survey of 130, 131
epidemiology, modern 39–40
ether, use of 20–1
Euclid (telescope) 235, 235–7
European Languages, Culture and Society, School of (SELCS) 81
Events Research Programme (ERP) 56
ExoMol project 103, 230–1
exoplanet (HD 189733b) 230–1, 231
eye imaging 54, 55
Ezra 75

fall prevention 70–2
Faraday, Michael 112, 134, 234
Farr, William 228–9
Firth, Rhiannon 164–5
Fiscal Studies, Institute for 176–7
Fisher, Ronald (R.A.) 109–10, 122
Flaxman, John 197, 198
Fleming, Ambrose 116, 117
Forensic Sciences, Centre for the (CFS) 174–5, 174–5

- Fowler, William 238
Francis Wall Oliver Field Station, Blakeney Point 122, 123
Freeman, Jenny 32
free speech 128–9, 128
Freud Museum 76–7, 77
Freud's Antiquity: Idea, Object, Desire 76–7, 77
Frith, Uta and Chris, *What Makes Us Social?* 138
Front Quad 7
fruit fly 219
- G20 168
Gallenga, Antonio 78
Galton, Francis 108–9, 110, 111, 198, 206
garden plots 143
Gardner, Dorothy 210
Garrett Anderson, Elizabeth 26–7, 26
Garthwaite, John 224
gender equality (education) 192–3
General Register Office (GRO) 228
gene therapy 48
genetics and eugenics 108–11
Genetics, Evolution and Environment, Department of 109, 122–3
Genn, Dame Hazel 7, 178
Geographic Information Systems (GIS) 60
geography and migration 152–4
Geyl, Pieter 81
Gillborn, Dave 164
Glass, Ruth 134
Global Health, Institute for 42
Global Informality Project 142–3
Global Prosperity, Institute for (IGP) 180
Global Tapestry Journal 75
Graham, Thomas 211
Grand Challenges (collective insights) 182–4
Grant Museum of Zoology and Comparative Anatomy 197, 199, 241–3, 241–3
Grant, Robert Edmond 122, 197, 241
Grant, Sir Malcolm 191
Great Ormond Street Hospital 35, 36
Greek and Latin, Department of 76
Greenman, Leon 200, 201–2
Green, Peter 32
Green, Tony 164
Gregoriadis, Gregory 50–1
Jerrard, Walter 215
Grote, Charles 197
growth charts 32–3, 32
- Gunea, Noemi 141
Gwynne, Andrew 204
- H₃+ (Jupiter) 102–3, 103
haemophilia treatment 48
Haldane, J.B.S. 109, 122, 218
Hall, Catherine 162
Hampstead smallpox hospital 228
Hart, H.L.A. 185–6
Hasidic language and culture, contemporary 86, 87
Hawking, Stephen 96
Hazell, Robert 132, 133
HeadStart Learning Programme 29
health data science, birth of 228–9
Health Equity, Institute of 158, 204
health inequalities 204–5, 205
Healthy Ageing, Institute of (IHA), 218
hearing loss, restoring 46
Hebrew & Jewish Studies, Department of 86
heights, of fathers/sons 206, 207
Higgs, Peter 105
Hill, Julie 34, 34
HIV research, population-based 42, 43
Holocaust
complicity and perpetration during/after the 144–5, 144–5
research-informed teacher education, supporting learning about the 200–2, 201
Howard, Jeff 129
Hoyle, Fred 238
- immunotherapy treatments 30–1
Impington Village College, Cambridgeshire 215
Ingold, Sir Christopher 112–13
Innovation and Public Purpose, Institute for (IIPP) 168–9
INSIGHT (Moorfields) 54
International Corpus of English (ICE-GB) 130
intra-company transfers (ICTs) 154
Iraqi refugees 167
Isaacs, Susan 171, 208–10, 208–10
Islam: Life in a North African 'golden age' 144, 144–5
- Jacob, Sir Robin 178
Jallad, Mayssa 180
Jarman, Derek 94, 96
Jeffery, G.B. 171
Jerrard, Luke, *Gaia* 183
Jevons, W. Stanley 195–6, 195
- John, Gwen, *Studies after Old Masters* 66, 67–8
Joiners Arms, Tower Hamlets 136
Jones, Bronwen 164
Jupiter 102–3, 102–3
jurisprudence 185–6
- Kao, Charles 116
Kekulé, August 112
Kermode, Frank 73, 84, 85, 90
Ker, William Paton 81, 84
Keynes, John Maynard 196
King's College London 190–1
Kirstein, Peter 116–17
Kirubi, Christine, *Wildplassen* 94–5
Klein, Melanie 209
Knights, Winifred, *Study for 'The Deluge'* 66, 68, 199
Korah, Valentine 178, 194
- 'Lady Justice', Old Bailey 185
Lancet Countdown 120–1
Land, Edwin 240
Lane-Clayton, Janet Elizabeth 39–40, 39
Lankester, Ray 122
Lashua, Brett 165
Lawrence, Reina 194
Laws, Faculty of 179, 194
Lebanon 166, 167, 180–1
Lee, Alice 206, 207
Legacies of British Slavery, Centre for the Study of (CSLBS) 162–3
legal profession, women in the 194
legal reform 178–9
Leonard, Diana 164, 192
Letsas, George 129
Lewis, Thomas 28
LGBT Placemaking Toolkit (2019) 136
LGBTQ+ venues, vitality of London's 134–7, 134–7
libraries 62–4, 62, 64–5
Liebig, Justus 211
lion incense burner 213, 213
liposomes 50–1, 50–1
Liston, Robert 20–1, 20
literary criticism and 'the common reader' 90–1
literary journalism 73
Lloyd, Lord (Dennis) 178
London Day Training College (LDTC now IOE) 170–1, 170–1
London Review of Books (LRB) 73
Lonsdale, Dame Kathleen 112–13, 113
Loschmidt, Josef 112
- McClelland, Keith 162
Mace, Georgina 122–3
- MacKusick, Ivy, *Portrait of a Man in His Shirtsleeves* 69
MacMillan, Kenneth 96
Malting House School, Cambridge 208, 208–10
Mannheim, Karl 164–5, 164–5, 171, 214
Mantouvalou, Virginia 179
map making 60, 61
Marconi, Guglielmo 116
Marmot, Michael 177
Marmot Review 204, 205
Massey, Harrie 226
Masson, David 84–5
Matheson, James 212
Maynard Smith, John 122, 218
Medawar, Sir Peter 30, 218
medical anthropology 157–9
Medical Physics and Engineering, Department of 49
Medical School, UCL 26, 27, 52
Meghir, Costas 176
Mendel, Gregor 109, 206
mental health
and wellbeing 182–3
policies/practice 29
Merlet, Pierre-François 81
Messier 78 (nebula) 235–7
microeconomic policy analysis 176–7
Migration Research Unit (MRU), Geography 152–4
Miller, Karl 73
Mill, John Stuart 128, 186, 195
miners' strike (1984–5), women's experiences in the 155–6
Mitchison, Avrion 30
modern foreign languages (MFL) 78–81
Moncada, Salvador 224
Monge, Gaspard 240
Morley, Henry 85
Morocco 144, 144–5
Morris, Sharon, *Gwales/Wales* 95
Morton, William 20
MRI (Magnetic resonance imaging) scan 44, 45, 139
Mühlenfels, Ludwig von 80–1, 80
Mullard Space Science Laboratory (MSSL) 235–6
Museum of Dreamworlds research project 76, 77
MY Heart Centre, Rwanda 36–7, 36–7
- Nahr el-Bared refugee camp, Lebanon 167
nanofibres 22, 23
net zero 118–19, 184
neuroprostheses 34, 34
neuroscience 224, 225
New Hospital for Women, Euston Road 26, 27
Nightingale, Florence 229

- nitric oxide (NO) 224, 225
 Nobel Prize winners 12–13, 28, 30, 116, 220
 nuclear magnetic resonance spectroscopy (NMRS) 233–4, 233–4
 Nunn, Percy 170–1, 171
- object-based learning (OBL) 197–9, 197–9, 241
 Oliver, Caroline 164
 Oliver, Francis Wall 122
 Olympic Legacy regeneration 140
 Open Science Office 64
 OpenStreetMap (OSM) 60
 Ophthalmology, Institute of 54
 Orme, Eliza 194, 194
 oxygen measurement, continuous (newborn babies) 49
- Page, Tiffany 165
 Palestinian refugees 166, 167
 Panizzi, Anthony 78, 78
 Paraisópolis, São Paulo 172
 Parkinson's disease 54
 Paths to Justice methodology 178
 PEARL (Person–Environment–Activity Research Laboratory) 70–2, 70–2
 Pearson, Karl 109–10, 198, 206, 207
 Pedner, Sir John 116
 Pepoli, Carlo 78
 Petch, Lily 94
 Petrie Museum of Egyptian and Sudanese Archaeology 199, 246, 247
 Pharmacy, School of 41, 41, 51
 Pigment Collection/Farm 83, 83
 Pigment Timeline (Volley) 82
 Pingliangtai walled town site, China 248–9, 248–9
 'place-making' to 'making place' 140–1, 141
 PLATO mission 235, 236
 Pleasence, Pascoe 178
 Poland 142
 policy analysis, microeconomic 176–7
polski sklep 153
 Portico 11
 Preece, Mike 32
 premature babies 233–4, 233–4
 Preseli Hills, west Wales 88–9
 PROCOL Lebanon 180–1
 prostate cancer pathway 44, 45
 Protein Data Bank (PDB) 221
 Punnett, Margaret 170–1
 Puridify 22
 Quirk, Randolph 85, 130
- 'Rachmanism' 178, 179
 Rag Magazine 10
 Ramsay Archive 148, 149
 Rapoport-Albert, Ada 86
 Rasul, Imran 177
 Red Lion playhouse, Whitechapel 92
 refugees hosting refugees 166, 167
 REGAIN Consortium 46, 47
 Rego, Paula 199
 Rent Act (1965) 178
 respiratory failure, managing (Covid-19) 38
 RETFound (ophthalmology) 54
 Ricardo, David 195
 Richardson, Mary 194
 Ringer, Sydney 222, 222
 river map 61
 Rivers, W.H.R. 157–8
 Robinson, James 20
 Roby, Henry 178
 Rosenberg, Isaac 94, 94
 Royal Vauxhall Tavern, London 134–5, 137
 Ryman, Brenda 50
- Sakurai, Joji 212–13
 sawfish species 242
 Scargill, Anne 155–6
 School of Oriental and Asian Studies (SOAS) 81
 Sen, Amartya 204
 separation and turbulence 114–15, 114–15
 Shinsuke (Hirobumi) Itō 213
 Showunmi, Victoria 165
 signalling molecule 224, 225
 skulls 199, 241, 243
 Slade Material Research Project (MRP) 82–3, 82–3
 Slade Poetry Shed 94–5
 Slade School of Fine Art 66–9, 82, 94–5, 96, 197, 197, 198
 slavery, legacies of British 162–3
 Slavonic and East European Studies, School of (SSEES) 81, 143
 smallpox 228, 228–9
 Small Press Collections 74, 75
 Soar, Geoffrey 74
 social media 129, 130, 203, 244
 Society for the Diffusion of Useful Knowledge (SDUK) 60
 sociology of education 164–5
 solar panels 37, 118–19, 226
 Sonnabend, Yolanda, *Tournier: Masks and Reflections* 96, 96–9
 Southwood Smith, Thomas 190
 space instruments 235–6
 Special Collections 74, 148
 Spence, Michael 6
 Squire, Peter and William 21
- Starling, Ernest 28, 39
 statistical research methods 206, 207
 stellar nucleosynthesis 238
 Stewartson, Keith 114
 Stonehenge 88–9, 88–9
 Stopes, Marie 110
 structural bioinformatics 220–1, 220
 sustainability 37, 118–21, 168–9, 172, 180, 182–4, 205, 246
 Sutherland, John 73, 85, 91
 Syrian refugees 167
- Talrich, Jacques 190
 Tanner, James 32
 Tansley, Arthur 122
 'Tarkhan dress' 199, 247
 T cells 30–1, 30
 telecommunications engineering 116–17
 Tessenyi, Marcell 231
 Thomas Coram Research Unit (TCRU) 150–1, 151
 Thomlinson, Natalie 155
 Thornton, Janet 220–1
 timeline 14–17
 Tizard, Jack 150
 Tomlinson, Roger 60
 Torres Strait expedition (1898) 157, 158
 transcatheter valve, synthetic 25
 Transmission Control Protocol (TCP) 117
 Travers, Maurice W. 148
 turbulence, separation and 114–15, 114–15
 Twining, William 191
- UCL Press 10, 64, 244
 Uganda 192, 193
 universe, dark energy of the 250–1
 Urban Lab 140–1
 Urban Room, UCL East 140, 141
- Van Horn, Erica, *A Healthy Rosemary Plant* 75
 Veale, Michael 179
 Vesalius, Andreas, *De humani corporis fabrica* 62, 63
 Vincent, Carol 164
 Violence in Adolescence study, Context of 193
- water, archaeology of 248–9
 water vapour, exoplanet 230–1, 231
 Wellbeing Measurement Framework (WMF) 29
 wheat, ancient 246
 Whitechapel market 152
 Whitehall, London 132, 204
 Wijns, William 36
 wildfire, Okefenokee Refuge, Georgia 120
- Wilkins Building 9
 Williams, Eric, *Capitalism and Slavery* 162
 Williamson, Alexander 211–13, 211
 Williams, Peter 114
 William Squire Lecture 21
 Wittfogel, Karl 248
 Woolf, Lord 179
 World Health Organization (WHO) growth standard 32–3
- Yacoub, Sir Magdi 36
 Youdell, Deborah 164
- Zeki, Semir 240
 Zhou, Yukun 54



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