NEUROSCIENCE

PAST PRESENT FUTURE

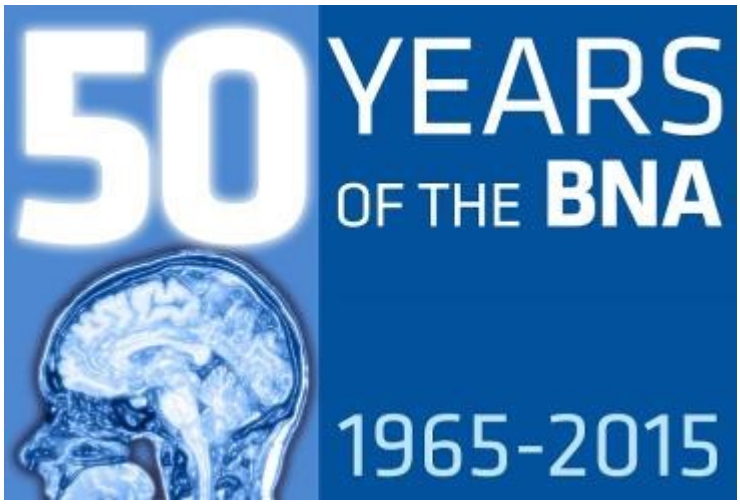
BNA
British Neuroscience Association

The 50th Anniversary Meeting of the BNA

Monday 14th December 2015
Edmond J Safra Lecture Theatre
King's College London, Strand Campus

Join us for this very special seasonal symposium to celebrate 50 years of the BNA!

A top line-up of expert speakers will guide us through the substantial progress that neuroscience has made over the last 50 years. They will also consider the future of neuroscience in their respective areas of expertise.



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Welcome from the President

Dear BNA members (and those who are just about to become BNA members),

Welcome to the annual BNA Christmas Symposium. A day to switch off the emails, enjoy fascinating science, and catch up with old friends. The theme, looking back and looking to the future of neuroscience, was inspired by the fiftieth birthday of the inception of the BNA. Let's all look forward to another fifty years of the BNA.

I would also like to take this opportunity to welcome our new Chief Executive, Dr Anne Cooke. We are delighted to be working with Anne, whose exceptional professionalism and energy will continue to take the BNA forward.

Our sponsors have played in important role this meeting, assisting financially with securing this spectacular venue and being able to provide top speakers, food and refreshments and we thank them for their support.

Finally, let me give a special thanks to Alan Palmer, who has worked tirelessly to put the programme together.

Have a great Christmas!

Professor John Aggleton, FRS
President of the British Neuroscience Association

We'd like to say a huge thank you to all of our sponsors this year. Without their support today's meeting would not take place! - **Please make time to visit their stands during the refreshment breaks.**

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Schedule for the day

Time	Title	Speaker
9:00-10:00	**Coffee/registration**	
10:00-10:15	*50 years of the BNA*	**Steven Rose / John Lagnado**
10:15-10:55	*The neurobiology of the synapse*	**Seth Grant**
10:55-11:35	*Brain rhythms and cognitive processing*	**Miles Whittington**
11:35-12:15	*Understanding the mind through the art of Shakespeare and the science of brain imaging*	**Paul Matthews**
12:15 - 12:25	BNA Awards presentation	**Stafford Lightman**
12:25-1:15	**Lunch**	
1:15	ABCAM video	
1:15-1:55	*MS research: theories and areas of progress*	**Alasdair Coles**
1:55-2:35	*The molecular genetics of brain disease*	**John Hardy**
2:35- 3:15	*Neurodegeneration: from mechanisms to medicine*	**Giovanna Malucci**
3:15-3:45	**Tea**	
3:45-4:05	BNA Student Awards presentation	**Stafford Lightman**
4:05-4:45	*Portraits of British neuroscientists*	**Nick Wade**
4:45-5:25	*Understanding human pain through neuroimaging*	**Irene Tracey**
5:25 – 6:05	*The past, present and future of memory*	**Eleanor Maguire**
6:05 – 6:10	Wrap-up	**John Aggleton**
6:10 - 7:00	Wine reception ***kindly sponsored by the Physiological Society***	

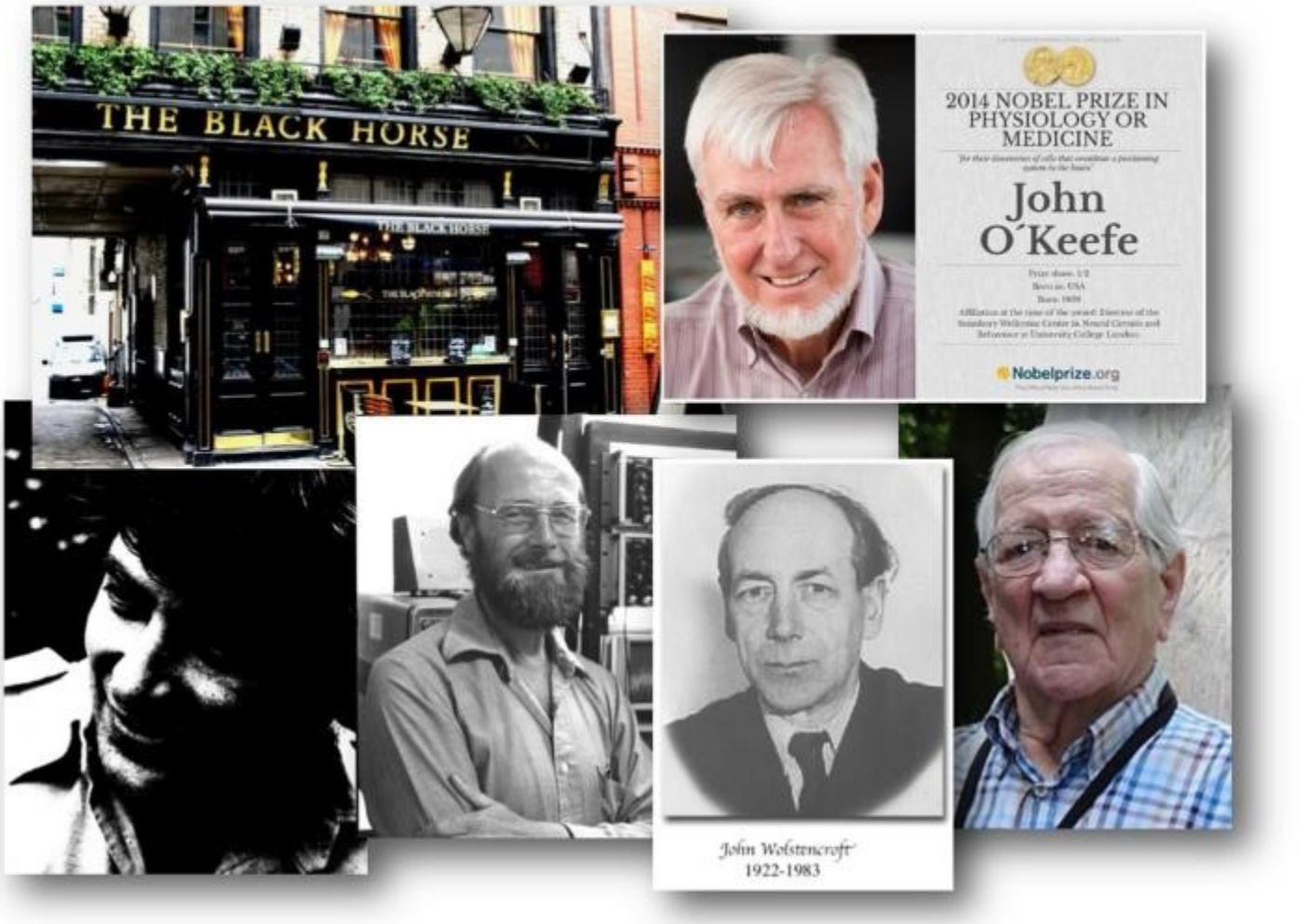
Speaker biographies and talk abstracts

Steven Rose, The Open University

Following a degree in biochemistry at Cambridge, a PhD in neurochemistry in London and post doc periods in Oxford Rome and London, Steven Rose was appointed Professor of Biology and Director of the Brain and Behaviour Research Group at the Open University at the age of 30 in 1969, where he is now Emeritus Professor. His research centred on the neurobiology of learning and memory concerning which he has published more than 300 papers and reviews and which most recently focussed on developing a therapy for Alzheimer's Disease. Throughout his career he has also been actively concerned with the ethical legal and social aspects of developments in science, especially genetics and neuroscience, He has received a variety of medals and international awards including the BNA award for distinguished service to neuroscience. He has written or edited 15 books including *The Making of Memory* (science book prize 1993), *Lifelines* . and *The 21st Century Brain*: *explaining mending and manipulating the mind*. Feminist sociologist Hilary Rose and his joint books include *Alas Poor Darwin* and *Genes, Cells and Brain*s; the *Promethean promises of the new biology*, their current book, *Can neuroscience change our minds?* will be published in 2016.

A full article by Steven Rose on 'The art of medicine': 50 years of neuroscience by Steven Rose' can be found on pages 20-21. This article is reproduced with permission from the Lancet.

Some of the early members clockwise: the Black Horse pub in Rathbone where regular meetings were held, John O'Keefe (2014 Nobel Prize winner), Horace Barlow, John Woolstencroft, Pat Wall, a young Steven Rose



Seth Grant, University of Edinburgh

Seth Grant graduated from Sydney University with a Bachelor of Science (Medicine) in Physiology, Bachelor of Medicine and Bachelor of Surgery. From 1985-1989 he was a Postdoctoral Fellow at Cold Spring Harbor Laboratory with Douglas Hanahan studying transgenic mouse models of cancer. From 1989-94 he studied mouse genetic models of learning and memory with Eric. Kandel at Columbia University. He established his laboratory at the Centre for Genome Research at Edinburgh University in 1994 and in 2000 was appointed Professor of Molecular Neuroscience. In 2003 he was appointed Principal Investigator at the Wellcome Trust Sanger Institute in Cambridge and remained there until 2011, when he returned to Edinburgh University. He has held additional appointments including the John Cade Visiting Professor at Melbourne University, Honorary Professorship at Cambridge University and elected Fellow of the Royal Society of Edinburgh. His work focuses on the molecular basis of synapse function and behaviour. He has characterized synaptic proteome organisation, evolution and function and identified the key role played by supramolecular assemblies of postsynaptic proteins. His synapse proteomic and genetic work has lead to the identification of many diseases impacting on the synapse and the multiprotein complexes that control cognition.

The neurobiology of the synapse

Synapses are the hallmark of the brain and this talk will illustrate some of the major conceptual advances that have arisen during the past 30 years from molecular studies. We now have a radically different view of how synapses are constructed, how neurotransmission is mediated and plasticity is regulated, and how synapses participate in learning and memory and the overall behavioural repertoire.

In the last decade, synapse proteomics and genomics have transformed our understanding of the basis of brain diseases: Over one hundred developmental, psychiatric and neurological disorders are caused by hundreds of mutations in synapse proteins. The centrality of synapse mutations to a wide range of diseases has given rise to the new field of “synaptopathies”.

The molecular Omic approaches have also enabled the evolution of synapses to be comprehensively studied leading to new insights into the origin of the brain itself and how the remarkable complexity of the vertebrate brain arose.

There are major frontiers that have yet to be crossed. Our understanding of the molecular structure of synapses is in its infancy. New microscopy methods including super-resolution nanoscopy and new protein structural methods will enable us to move from studies of single proteins to characterising the supramolecular organisation of molecular machines and their physical organisation within the synapse. We know very little about synapse diversity, it origins and function. Synapses are known to change with age, and almost nothing is known about the molecular biology of synapses across the lifespan.

I predict within the next 20 years that we will have a general 3D structural model of the core mechanisms in presynaptic and postsynaptic terminals, a systematic and comprehensive understanding of synapse proteins and how they are assembled, and an understanding of how synapse diversity arises and changes across the lifespan. These data will be fundamental to a new generation of theoreticians and modellers linking molecular mechanisms, and even evolution, to behaviour.

In the next 50 years, perhaps of greatest interest to the wider public will be the invention of “prosynaptic” drugs that repair, restore or replace damaged synapses. Such medicines could be applied to genetic disorders, brain injury and neurodegeneration. There is also considerable potential to exploit the knowledge of the molecular biology of synapses for the development of new brain imaging tools for diagnostic purposes.

Miles Whittington, University of York

Miles Whittington has been studying the dynamics of local neuronal networks since 1991. He has contributed to the identification of neuronal cell types, their connections and intrinsic properties underlying both physiological and pathophysiological rhythmic circuit behaviour.

His work is mainly aimed at providing experimental models of sufficiently large-scale to capture the electrical behavior of the brain associated with cognitive and motor function seen in non-invasive human recording, but sufficiently reduced to allow the manipulability and interpretability at the single cell/molecule level to provide a bridge to computational models. To this end he has collaborated with computational neuroscientists Roger Traub and Nancy Kopell since 1994 and in the last 10 years with clinical neurophysiologists and brain imaging experts at Newcastle University and latterly at The University of York. In addition he has long-standing collaborations with the pharma industry (Glaxo, Servier, Lundbeck, Eisai) to attempt to apply discoveries from the above models to novel drug design for neurological illness.

His overall long-term goal is to identify the mechanisms behind spatiotemporal patterns of neuronal population activity that give rise to EEG/MEG signatures of cognitive function and, through this, understand the internal representation of sensory stimuli and the computations our brain can perform on them.

Brain Rhythms and Cognitive processing ('neuroscience past present and future')

A correlation between rhythmic electrical activity in the brain and the cognitive state of mammals has been known since Caton's original EEG experiments in the 1870s. As EEG developed into a clinically useful tool from the turn of the last century up until the 1970s, increases in the spectral range of recording cemented this correlation and gave rise to multiple, superficially valid frequency bands (delta, theta, alpha etc.) still used to quantify cognitive performance today.

Over the last 50 years brain rhythms have been increasingly used as an interpolation step for relating macroscopic brain processes down to the activity of individual neurons and their connections: O'Keefe's seminal work in the 1970s bridged the gap between exploratory behaviour – via theta rhythms – to action potential generation in hippocampal neurons; Likewise, the work of Gray and Singer in the 1980s linked primary sensory processing – via gamma rhythms – to the temporal coordination of populations of neurons in the visual cortex.

In the 1990s attempts to mechanistically understand the link between cognition and neuronal activity using computational modelling were fuelled by the advent of *in vitro* models of brain rhythms: The accessibility and manipulability of brain slice preparations provides data at the level of individual membrane conductances ideally suited to the construction of biologically-constrained models of local- and large-scale neuronal networks. This work put the focus of brain rhythm generation firmly at the level of local circuits. However, brain rhythms are 'trivial' in that they represent a stationary state in the dynamics of a neuronal population. Cognition, on the other hand, is complex, and the more complex the cognitive task the less overt the rhythmic nature of the brain electrical activity observed. This supports rather than dismisses a role for local networks as it is becoming increasingly evident that there is complex interplay between multiple oscillatory sub-circuits even within a single cortical column. A detailed understanding of the role played by different neurons within a local circuit thus becomes more and more important. Unravelling this anatomical and functional complexity is a perfect job for the burgeoning field of optogenetics, and a great many insightful discoveries have been made using this technique over the last few years.

For the field to advance in the future we need a framework to quantify and relate higher-order dynamic processes in to cognition. While specific neuron subtypes and their connections are being mapped with great precision, the resulting functional dynamics are harder to pin-down. Non-trivial dynamic signatures such as aperiodicity and spiral temporal geometries need to be effectively quantified. To some extent this is being tackled now using animal models and invasive genetic and surgical techniques. However, in the longer term

we need a way to collect data non-invasively from human subjects with cellular-level spatial resolution and sufficiently high temporal resolution to sample activity changing on millisecond timescales. There are chances for some improvement in the spatial scale of MEG with next generation 'SQUIDS' – atomic clock magnetometers. But the best chance for success probably lies in improvements in fMRI: Enormous increases in signal:noise using spin hyperpolarisation techniques have the capacity to both increase temporal resolution and, more importantly, measure actual neuronal electrical activity rather than a surrogate like oxygen usage. There are many technical challenges ahead in this regard, but the benefits to our understanding of the cellular and molecular processes underlying cognitive function could be enormous.

Paul Matthews, Imperial College London

Professor Paul Matthews is the Edmond and Lily Safra Chair of Translational Neuroscience and Therapeutics and Head of the Division of Brain Sciences in the Department of Medicine of Imperial College, London. He has tried to combine an active interest in the arts with science. While this always risks the label of the "dilettante", it has given him much to explore and enjoy! He has a particular fascination for Shakespeare that started in school with a love for the sound of the words and has progressed into a lasting adult bond with interest in his exploration of the mind. While Director of the Oxford FMRIB Centre, he explored the latter topic in a first attempt at "popular" science in *The Bard on the Brain* and spent a couple of wonderful years presenting Shakespeare in a cognitive neuroscience context. He is currently editing a book on creativity with Suzanne Nalbantian. He is an active member of the Centre for the Creative Brain at St Edmund Hall, Oxford, where he is a Fellow by Special Election.

Understanding the mind through the art of Shakespeare and the science of brain imaging

There are remarkable correspondences between the ages of Elizabeth I and II. Economic uncertainty, security concerns and dramatic social change characterise both. They also share being times of exploration- both of the inner and the external worlds. Key to William Shakespeare's genius is his focus on using observation of human behaviour to infer psychologically plausible models of mind. He used this both to move his plots forward and to craft his theatre. Although he would not have used the word, I think each performance was an experiment for him. What we see as the canonical text is their distilled summary. He was not a scientist (and perhaps would not have understood why such a professionalised guild was needed for inquiry), but his curiosity about who we are and why we act as we do is at the basis of much of modern neuroscience.

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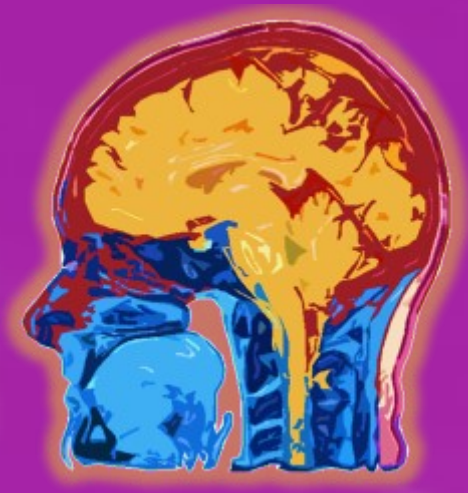

The BNA's flagship biennial neuroscience event is back for the 3rd time. Once again delegates can expect a top line-up of expert speakers delivering the hottest research from the neuroscience arena plus a host of other activities including workshops, public events, career speed dating, social and networking opportunities, don't miss out!

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Alasdair Coles, University of Cambridge

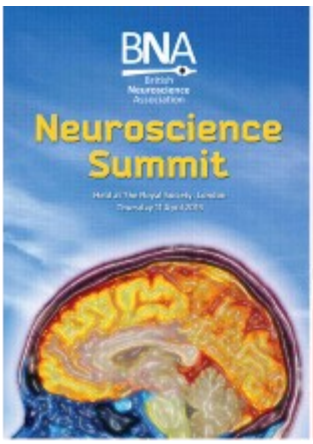
Alasdair Coles is an academic neurologist working in Cambridge. He has been researching treatments of multiple sclerosis, especially alemtuzumab, since 1994. Now the Professor of Neuroimmunology, he is running trials of a potential remyelinating therapy in multiple sclerosis and immunotherapies in antibody-associated psychosis.

MS research: theories and areas of progress
Fifty years ago, multiple sclerosis was well described by the clinicopathological virtuosos. But it was considered to be untreatable and there were wildly varying accounts of its aetiology: degenerative, infective, vascular, inflammatory or toxin-induced. Since then, evidence has accumulated that it is primarily an inflammatory disorder: from the classic finding of oligoclonal immunoglobulin bands in electrophoresis of spinal fluid, and the dominance of genes involved in lymphocyte development associated with the disease. Magnetic resonance imaging has transformed understanding of relationship between inflammation, neurodegeneration and the natural history of the disease. And, in the 1980s and 1990s emerged the first evidence that multiple sclerosis is treatable with immunotherapy, albeit only if started early in the relapsing-remitting phase of the disease. Now attention has shifted to ways to repair damage, particularly by promoting remyelination, and preventing axonal degeneration, the pathological substrate of the late progressive phase of the disease.

John Hardy, UCL Institute of Neurology

John Hardy received his degree in Biochemistry from Leeds in 1976 and his PhD from Imperial College in Neuropharmacology in 1979. He did postdocs at the MRC Neuropathogenesis Unit and the Swedish Brain Bank, in Umea, where he started to work on Alzheimer's disease. In 1985 he took the job of Lecturer in Biochemistry and Molecular Genetics at St Mary's Hospital, Imperial College, where he began working on the genetics of Alzheimer's disease. In 1991 he led the group which found the first mutation in the amyloid gene which caused Alzheimer's disease. This finding led him and others to formulate the amyloid hypothesis for the disease. In 1992 he moved to the United States, to the University of South Florida. In 1996 he moved to the Mayo Clinic where he became Chair of the Department of Neuroscience in 2000. In 1998 he was part of the consortium which identified mutations in the tau gene in Pick's disease. In 2001 he moved to the NIH to become the Chief of the Laboratory of Neurogenetics, where he was part of the group which found triplications in the synuclein gene caused Parkinson's disease. He returned to the Department of Molecular Neuroscience at the Institute of Neurology in 2007.
He has won the Allied Signal, Potamkin, MetLife and Kaul Prizes, for his work on Alzheimer's disease and the Anna Marie Opprecht Prize for his work on Parkinson's disease. More recently he was awarded the 2011 Khalid Iqbal Lifetime Achievement Award in Alzheimer's Disease Research and the IFRAD 2011 European Grand Prize for Alzheimer's Research. In 2014 he was awarded The Dan David Prize endowed by the Dan David Foundation, headquartered at Tel Aviv University; the Thudichum Medal from the Biochemical Society and is the recipient of the 3rd Lord Brain Memorial Medal**.** Then he was awarded the Robert A. Pritzker Prize by the Michael J Fox Foundation. He has been elected a member of the Academy of Medical Sciences and has been awarded an honorary MD by the University of Umea, Sweden. He was made an FRS by the Royal Society in 2009 and in 2010 was awarded an honorary Doctor of Science degree by the University of Newcastle. More recently in 2015 he was awarded the Piepenbrock-DZNE Award, and the Breakthrough Prize in Life Sciences.

The molecular genetics of brain disease
In my talk I will discuss the fact we now have many genes for any individual syndrome. I will start by summarising the state of genetic analysis of Alzheimer's and Parkinson''s diseases and how this is beginning to lead to mechanistic insights into disease pathogeneses. I will then broaden my discussion to cover all neurodegenerative diseases and outline how having many loci for a syndrome is starting to give us insights into why different neutrons have differing vulnerabilities. I will outline the Catastrophic Cliff theory of neurodegeneration and discuss how different neuronal types have differing weaknesses which render them sensitive to differing insults. I will apply this to ataxias, parkinsonisms, dementia and motor neuron disorders.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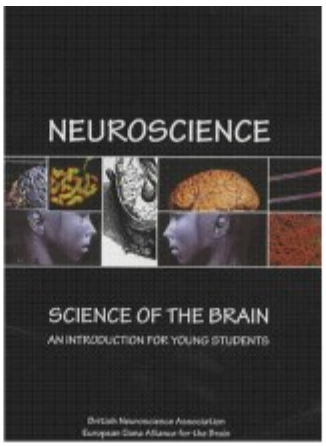
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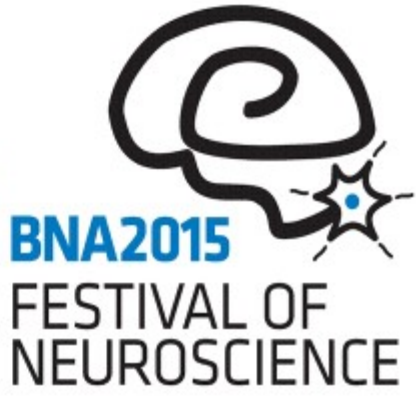
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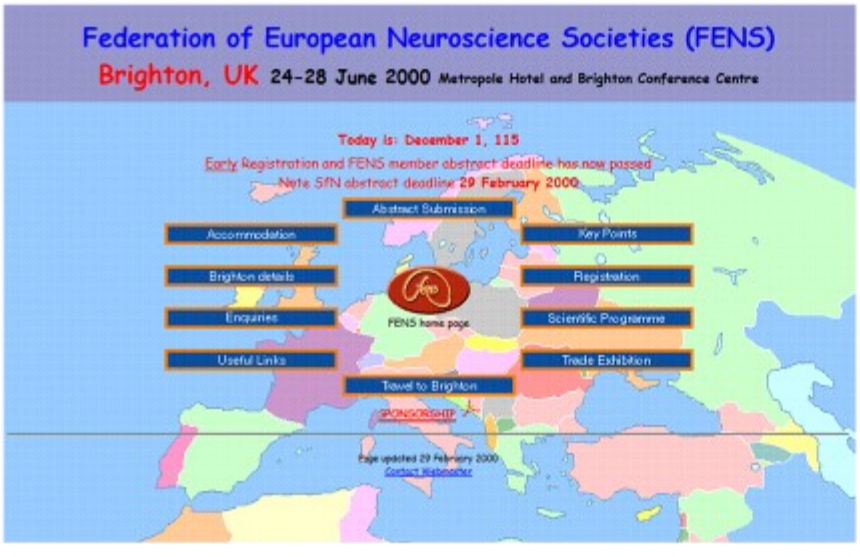
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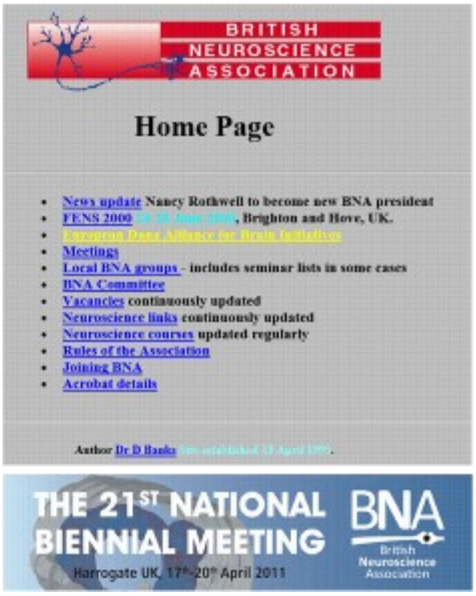
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Giovanna Mallucci, University of Cambridge

Giovanna Mallucci is Professor of Clinical Neurosciences at the University of Cambridge and an Honorary Consultant Neurologist at Addenbrooke's Hospital, specialising in Dementia. Her undergraduate degrees were in Physiological Sciences and Medicine from the University of Oxford, with clinical training at University College, London. She obtained her PhD from London University in Neurogenetics, for which she generated the first adult-onset mouse model of prion protein knockout that paved the way to her discoveries about reversibility of early neurodegeneration and underlying mechanisms. Since her PhD she has combined clinical work and basic research and led groups in the MRC Prion Unit (2001-2008) and the MRC Toxicology Unit (2008-present) before moving to Cambridge. Her lab is pioneering interventions targeting common pathways for treatment of dementia. She has received numerous national and international awards for her work, including a SciAm50 award for leadership in research as one of the top 50 scientific innovators worldwide. She is an ERC Consolidator Fellow.

Neurodegeneration: from mechanisms to medicines

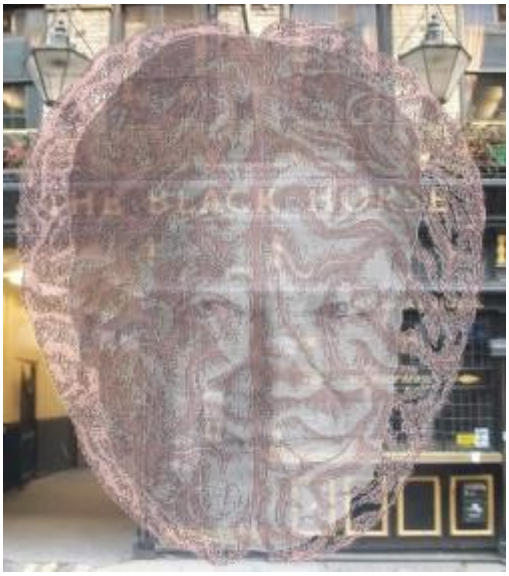
This talk will cover recent progress in understanding mechanisms of neurodegeneration and how this is informing new therapeutic approaches. The central theme is the identification of common pathways across the spectrum of these disorders (which include Alzheimer's and related diseases) that are relevant for both mechanistic insights and therapy. My lab focuses on both 'toxic' processes that can be targeted to prevent neuronal death, and on regenerative processes that can be harnessed for repair. I will discuss how, using mouse models, we described the pathogenic role of the unfolded protein response (UPR) in neurodegeneration, leading to the discovery of the first small molecule - an inhibitor of this pathway - to prevent neurodegeneration in vivo, hailed as a "turning point in the search for drugs that will treat Alzheimer's". I will also discuss our recent findings that synapses are lost due to impaired synaptic repair processes in neurodegenerative diseases, due to failure of a stress response involving 'cold shock' proteins. We have successfully harnessed this mechanism for neuroprotection in mouse models of Alzheimer's disease. These regenerative processes also provide new targets for treatment - and give new insights into the protective mechanisms of hypothermia. These advances bring closer the possibility of developing treatments to protect against onset and prevent progression of dementia, through modulation of common pathways across the spectrum of these diseases.

Nick Wade, Dundee University

Nick Wade received his BSc degree in psychology from the University of Edinburgh and his PhD from Monash University, Australia; his thesis was on vestibular-visual interaction. This was followed by a postdoctoral fellowship from the Alexander von Humboldt Stiftung, at the Max-Planck-Institute for Behavioural Physiology, Germany where he carried out experiments using a human centrifuge. His subsequent academic career has been at Dundee University, where he is now Emeritus Professor. His research interests are in the history of vision research, binocular and motion perception, and the interplay between visual science and art. His books written on these topics include: *Brewster and Wheatstone on Vision* (1983), *Visual Allusions: Pictures of Perception* (1990), *Psychologists in Word and Image* (1995), *A Natural History of Vision* (1998), *Purkinje's Vision. The Dawning of Neuroscience* (2001), *Destined for Distinguished Oblivion: The Scientific Vision of William Charles Wells (1757-1817)* (2003*), The Moving Tablet of the Eye: The Origins of Modern Eye Movement Research* (2005), *Perception and Illusion. Historical Perspectives* (2005), *Circles: Science, Sense and Symbol* (2007) and *Galileo's Visions: Piercing the Spheres of the Heavens by Eye and Mind* (2014). His most recent book *Art and Illusionists* is about to be published.

Portraits of British Neuroscientists

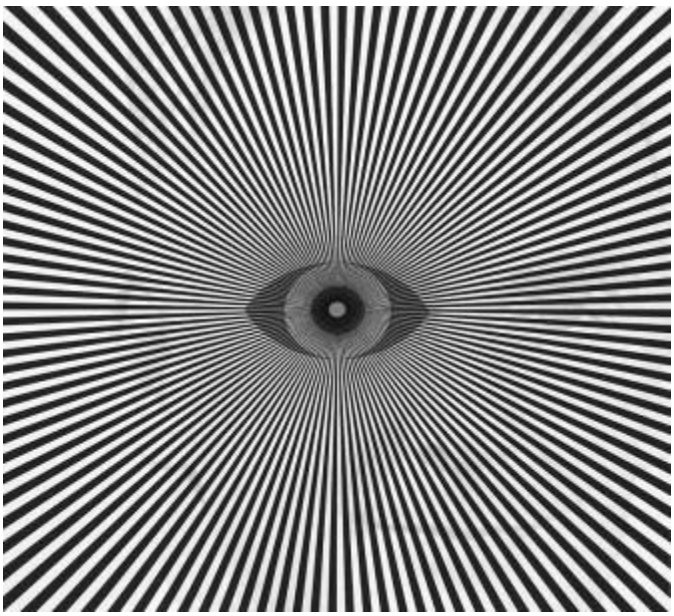
Neuroscience, as a discipline, did not exist until the late 20th century. It emerged as a consequence of the endeavours of many who conspired to illuminate the structure of the nervous system, the manner of communication within it, its links to reflexes and its relation to more complex behaviour, as well as to perceptual experience. Neuroscience is a neologism of recent years: the term was introduced in the 1960s by Francis Otto Schmitt as a convenient term to indicate a multidisciplinary research team investigating brain and behaviour. It is difficult to divine the origins of neuroscience generally, let alone the national institutions supporting its activities. The British Neuroscience Association (BNA) is celebrating its half centenary and so it is instructive to examine its history. This I will do via the vehicle of 'perceptual portraits': they consist of at least two elements – the portrait and some appropriate motif. The nature of the latter depends upon the endeavours for which the portrayed person was known. In some cases the motif was drawn specifically to display a phenomenon associated with the individual, in others it was derived from a figure or text in one of their books, or apparatus which they invented. The portraits and motifs have themselves been manipulated in a variety of ways, using graphical, photographical, and computer graphical procedures. Two examples are given here, both showing 'perceptual portraits' of scientists involved in the early years of the BNA.



The Black Horse by Nicholas Wade

The one on the left depicts the facial features of Steven Ro4se combined with a brain and *The Black Horse* pub where early meetings of neuroscientists took place. That below shows a ray figure associated with Donald MacKay, whose right eye is located at the centre of the pattern, marked by a schematic eye; his whole face will be dimly discerned when the ray pattern is blurred in some way. What we would now consider to be neuroscience was practiced long before the term was coined.

Accordingly, I will examine a range of possible origins of British neuroscience in terms of 'neuroportraits'. These include brain anatomy (Thomas Willis), microanatomy (Robert Hooke), studies of the senses (Isaac Newton), electrical activity of nerves (John Walsh), electrical stimulation of the brain (David Ferrier), recording from the brain (Richard Caton), brain surgery (William Macewan), brain injury from gunshot wounds (George Riddoch), a law of nerve activity (Charles Bell), a medical text (Thomas Sydenham), award of a Nobel Prize (Charles Sherrington, Edgar Adrian, Alan Hodgkin, Andrew Huxley), foundation of a medical school (William Hunter), medical societies (John Hunter), or a *Brain* journal (John Hughlings-Jackson). Thus, the search for links between brain and behaviour has a distinguished heritage but it is being refined by novel techniques that are now available.



MacKeye figure by Nicholas Wade

Irene Tracey, University of Oxford

Professor Irene Tracey holds the Nuffield Chair of Anaesthetic Science and is Head of the Nuffield Division of Anaesthetics and is Associate Head of the Medical Sciences Division/School at the University of Oxford, England. Irene did her undergraduate and graduate studies at the University of Oxford and held a postdoctoral position at Harvard Medical School. Over the past 16 years her multidisciplinary research team has contributed to a better understanding of pain perception, pain relief and nociceptive processing within the injured and non-injured human CNS using neuroimaging techniques. More recently, they have been investigating the neural bases of altered states of consciousness during anaesthesia. In 1998, Irene helped to co-found the now world-leading Oxford Centre for Functional Magnetic Resonance Imaging of the Brain (FMRIB) – the centre integrates research into key neurological and neuroscientific problems with cutting-edge developments in MR physics and data analysis (http://www.fmrib.ox.ac.uk). The Centre has approximately 110 scientists and clinicians from a range of backgrounds and Irene was its Director from 2005 until 2015. She has been appointed the new Head of the Nuffield Department of Clinical Neurosciences – a 450 person strong department comprising the FMRIB Centre, Division of Neurology, Nuffield Division Anaesthetics, Nuffield Laboratory Opthalmology and the Division for Prevention of Stroke and Dementia. She will take up that post September 2016.

Irene has served and continues to serve on many national and international committees, including the International Association for the Study of Pain as an elected Councillor until 2014 (Chair of the Scientific Program Committee for the Milan 2012 biannual world congress), Deputy Chair of the MRC's Neuroscience and Mental Health Board until 2014, the REF 2014 Psychology, Psychiatry and Neuroscience panel until 2014, and is co-Chair of the Canadian CERC panel and a member of the Brain Prize selection committee. In 2008 she was awarded the triennial Patrick Wall Medal from the Royal College of Anaesthetists and in 2009 was made an FRCA for her contributions to the discipline.

In 2015 she was elected a Fellow of the Academy of Medical Sciences. She is married to Professor Myles Allen, a climate physicist, and they have three irrepressible children: Colette (18), John (14) and Jim (9).

Imaging Subjective Experiences – Lessons From the Pain Field

The ability to experience pain is old and shared across species. It confers an evolutionary advantage and provides a warning of harm or impending threat. This highly adaptive 'acute pain' can unfortunately become maladaptive and chronic that as a consequence brings tremendous suffering. Chronic pain is one of the largest medical health problems in the developed world affecting 1 in 5 adults and costing society hundreds of millions of pounds per annum in care, treatment and days lost from work. Treatment is poor and many sufferers are left with unmanaged pain that significantly reduces their quality of life.

From the time of Hippocrates it was known that subjective experiences like joy, grief and pain arise from the brain. Descartes too stressed the importance of the brain as where pain arises. However, it's only recently that we've been able to obtain reliable objective information regarding the neural underpinnings of this private and subjective pain experience. It is needed as over-reliance on the verbal report and description of pain makes diagnoses and determination of treatment efficacy challenging. With the advent of modern brain imaging tools (generally called functional neuroimaging), such as functional magnetic resonance imaging (FMRI), positron emission tomography (PET), electroencephalography (EEG) and magnetoencephalography (MEG) this has been made feasible. Applying such noninvasive brain imaging tools over the past several decades, we can now identify what brain regions activate during painful experiences and relate this to an individual's specific pain experience or measure of pain relief, bringing potential diagnostic value as well as a better neuroscientific understanding of pain perception. As such, we now have a better appreciation regarding how, for example, anxiety, depression, expectation, and peripheral/central sensitisation mechanisms alter the pain experience at a neuroanatomical level. Many experiments have specifically isolated areas of brain and brainstem central to these processes; particularly those involved in the transition from the acute to chronic pain state.

Current research aims to identify predisposing vulnerabilities to developing chronic pain states based upon aberrant brain networks. Additionally, advances have been made that illustrate the neural correlates of analgesia (pain relief) in the human brain.

New thoughts related to how pain and pleasure interact force us to broaden our understanding of relief mechanisms and wellbeing. Having a better neuroscientific understanding of the mechanisms that are related to and subserve various everyday and clinical painful experiences should not necessarily threaten the notion that pain will always be a private and subjective experience felt by the living organism. This talk will walk the audience through the journey that pain researchers have taken over the past few decades to understand better this complex perception.

Eleanor Maguire, University College London

Eleanor Maguire undertook her PhD at University College Dublin, Ireland, where she first became interested in the neural basis of memory while working with patients as a neuropsychologist. She is currently a Wellcome Trust Principal Research Fellow and Professor of Cognitive Neuroscience at the Wellcome Trust Centre for Neuroimaging at University College London, UK. In addition, she is an honorary neuropsychologist at the National Hospital for Neurology and Neurosurgery, Queen Square, London. Eleanor heads the Memory and Space research laboratory at the Centre, where her team uses structural and functional magnetic resonance imaging in conjunction with the neuropsychological examination of patients in order to understand how memories are formed, represented and recollected by the human brain.

She has won numerous prizes for outstanding contributions to science including the Ig Nobel Prize for Medicine for her study of London taxi drivers, the Royal Society Rosalind Franklin Award, and she is a Fellow of the Academy of Medical Sciences.

The Past, Present and Future of Memory

In this talk I will consider the past, present and future of memory on two levels.

First, how has the field of memory research changed over time? Traditionally, memory has been regarded as separable from the rest of cognition, supported by a dedicated brain region called the hippocampus, which has a time-limited role. But the last 10-15 years in particular have seen some big shifts in how memory is viewed, and many of the key beliefs about memory and how it is supported by the brain, which have stood firm for many decades, have been challenged.

On another level, I will consider memory itself. We know that learning about the world and ourselves is central to cognition, and memory provides us with the chronology or autobiography of our lives. But there is increasing recognition that in fact the purpose of memory is not to faithfully record the past; it is to inform the present and in particular the future, to help us behave in ways that ensure our survival. By moving away from a narrow view of memory as being solely to do with the past, and instead looking at how it relates to other aspects of cognition including future-thinking, this is starting to promote a better understanding of the mechanisms of memory.

With such progress on both of these levels, coupled with ever more sophisticated methodologies and analysis techniques in human and animal memory neuroscience, I will argue that at present, the future has never been brighter for studying the past.

2015 BNA Awards

Outstanding Contribution to Neuroscience
Professor Angela Vincent, University of Oxford

This Award is given for making an outstanding contribution to international brain research. Previous winners include some of the great names in neuroscience - Professors Patrick Wall, Steven Rose, Richard Gregory, Uta Frith, Horace Barlow, Sir Gabriel Horn and more (see full list at bna.org.uk/BNA_Awards.html).

Professor Angela Vincent of Oxford University is this year's winner in recognition of the significant advances she has made in understanding the science of autoimmune disorders such myasthenia gravis.

As well as her research, she has also improved the diagnosis and treatment of people with such disorders, given her time to funding committees and academic societies, has (and is) a role model to other women in the biosciences and extremely supportive of young researchers, and is a an ambassador for UK neuroscience around the world.

Public Understanding of Neuroscience
Professor Mark Lythgoe, University College London

Professor Mark Lythgoe epitomises the best of public engagement.

During his tenure as Director of the Cheltenham Science Festival, it has become one of the largest science festivals in the world. Through a multitude of TV and radio programmes, innovative art-science initiatives, numerous public events and lectures – alongside an active and highly successful research career – Mark has well and truly taken neuroscience beyond the lab and into wider society.

Importantly, Mark has also enabled and encouraged students to get involved in public engagement activities, ensuring that young researchers gain an understanding of its importance right at the start of their career and integrate it into their role as a scientist.

The future of neuroscience is of course dependent on those just starting their career, and BNA is delighted to offer two student Prizes:

Postgraduate Award 2015
Dr Kathryn Mills, Oregon Health & Science University, USA

Kate completed her PhD on developments of the adolescent brain under the supervision of Professor Sarah-Jayne Blakemore, in whose words Kate was, *"one of the best PhD students I have ever supervised, or even come across"*. Before even arriving at UCL Kate had published seven papers on student placements; her PhD research resulted in a further eight high quality peer review publications with several more in the pipeline. She somehow also finds time to run a website www.kathrynlmills.com, write for the learningandthebrain.com blog, give talks to teachers and students and take part in public festivals in the UK and abroad.

Undergraduate Award 2015
Veselina Petrova, University of Cambridge

The Undergraduate Award goes to Veselina Petrova for the work she completed whilst studying for her degree at the University of Edinburgh. In June 2015, Veselina graduated as the best of forty students in the Honours Neuroscience class, the only student to gain a first class mark in all of her courses.
Veselina is now undertaking a PhD at the University of Cambridge with Professor James Fawcett, studying the ability of adult CNS neurons to regenerate after spinal cord injury.

The BNA congratulates all this year's winners for their amazing achievements

The art of medicine

50 years of neuroscience

The British Neuroscience Association (BNA) is teaming up with the Edinburgh International Science Festival for its annual conference this April. The BNA will be celebrating the 50th anniversary of its origins as a small discussion group meeting monthly upstairs in a London pub. The Science Festival is just half as old. The very term neuroscience was unfamiliar half a century ago—it had been coined in the early 1960s by a far-seeing Massachusetts Institute of Technology biophysicist, Francis Schmitt. Schmitt had raised the funds to publish an irregular bulletin packed with provocative thoughts on everything from synaptic function to artificial intelligence, and more importantly, to support a month long summer school for budding neuroscientists at Boulder, Colorado, USA, to which my then boss, penicillin Nobel Laureate Ernst Chain, duly dispatched me. In the 1960s, most researchers on the brain still spoke of themselves by their primary discipline, as neuroanatomists, neurochemists, neuropharmacologists. Schmitt's Neuroscience Research Program (NRP) was intended to bridge and hopefully integrate these many disciplines studying brain and behaviour. Interdisciplinarity was to be its means and bridging theories to connect the many levels at which the brain could be studied its goal.

Back in London, though, brain researchers were scattered not just across many disciplines, but also many institutions. In the spirit of the NRP, half a dozen of us agreed to contact as many as possible of the researchers in the London area with the idea of establishing a regular discussion group. After the first meeting in a university lecture theatre, we quickly realised that a more informal setting would work better, and opted for the Black Horse pub in Rathbone Place, in central London, with, importantly, beer on tap. To ensure informal speculation, we discouraged heads of department and senior professors from attending, and to encourage interdisciplinarity each meeting was organised around a topic—memory, sleep, or whatever—which could be approached at many different levels, from the molecular to the systems and behavioural. Still shy of the term neuroscience, we were initially simply the Black Horse Group.

Our enthusiastic informality was put onto a more regular footing in 1967 by the arrival in London of the neurophysiologist Patrick Wall, who had a small grant from a US foundation to foster neuroscience communication. Together with Pat came John O'Keefe, fittingly the 2014 Nobel Laureate in Physiology or Medicine for his work on—in the words of his and Lynn Nadel's groundbreaking 1978 book—*The Hippocampus as a Cognitive Map*. The next goal that some of us espoused was the creation of an interdisciplinary Brain Research Institute to match those already existing elsewhere in Europe and the USA. The project foundered on the rocks of institutional rivalry, so there's an agreeable symmetry in watching the huge new Sainsbury Wellcome Centre for Neural Circuits and Behaviour, directed by O'Keefe, rising from a building site close to that we had found all those years ago.

The London group soon spawned regional equivalents, and we became—still informally—a national society—the Brain Research Association (BRA). Such a relaxed approach was not to last. Prodded by the International Brain Research Organisation and its UK representative, Derek Richter, we formalised the membership, adopted a constitution, and elected a national committee. Annual meetings and schools soon followed, along with all the trappings of a learned society, with the exception of a house journal, which we resisted—a gap later filled by the successful *European Journal of Neuroscience*. Finally, in 1996, the BRA bowed to the inevitable and became the BNA.

The BNA's half-century thus parallels the transformation of the small-scale sciences of brain and behaviour into one of today's most prominent and fashionable areas of biomedical research. The neuro- prefix has entered into popular discourse, joining and even threatening to eclipse DNA as a selling point. It is hard to imagine what Schmitt would have made of neurogastronomy or neurohomoeopathy, to say nothing of the brightly coloured so-called neuro soft drinks which claim to enhance mental activity—although he could well have endorsed neurophilosophy and neuroaesthetics. Neurolaw ("it wasn't me, it was my brain made me do it") is impinging on judicial decisions, while last year the Wellcome Trust enhanced the prospects of neuroeducation by way of a £6 million grant.

In the USA, the Society for Neuroscience, founded a few years after the BRA, is now a mighty behemoth whose annual meetings attract up to 40 000 participants. Somewhat hubristically, the 1990s became the Decade of the Brain, and for at least some neuroscientists the first decade of this millennium was to be the Decade of the Mind. Despite the labels, neither mind nor brain had been solved by the end of these decades, and 2012 ushered in two giant initiatives, Europe's Human Brain Project and the US Brain Research through Advancing Innovative Neurotechnologies (BRAIN). In 2014, the Japanese weighed in with their Brain/MINDS project—yet another tortured acronym, standing for Brain Mapping by Integrated Neurotechnologies for Disease Studies. The hopes are that pumping billions into "solving the brain" will both generate wealth and cure diseases from Alzheimer's to schizophrenia—although many neuroscientists remain sceptical.

What has driven this vast expansion? During the 1960s, biological psychiatry was in optimistic mode and

pharmaceutical companies were busily hunting for new generations of psychotropic drugs to treat the growing numbers of those suffering from depression and anxiety. But for many of those of us entering the fledgling field, it was the sense that now the DNA double helix had "solved" genetics, the brain was biology's last great frontier. Had not the great Francis Crick moved on from DNA to neuroscience, claiming, as he did in *The Astonishing Hypothesis*, "You're nothing but a pack of neurons"? I shared this reductionism, even writing a book grandiosely called *The Conscious Brain*, a title I would now renounce, as in my older and hopefully wiser age, I recognise that it is people, not brains, who are conscious, albeit we need our brains to be so. But despite our optimism, "solving" the brain, or even "curing" mental and psychic distress, was then beyond our empirical or theoretical capacity.

Fast forward the half-century, and where are we now? Techniques inconceivable then have transformed neuroscience labs. Genes can be modified or novel ones inserted into mice, designed so that they can be turned on or off in specific brain regions at the experimenter's whim. The new imaging techniques make it possible to visualise processes from the movement of ions across the synapse to the coordinated activity of ensembles of many millions of neurons in the living brain. The false colour images of regions of the brain lighting up when taxi drivers navigate a virtual map of a city or a person empathises with another's pain have become familiar not just to researchers but to the wider public. Brain-computer interfaces to repair the injuries of age and accident, or even to enhance attention and memory, are being actively pursued—not least by the US Defense Advanced Research Projects Agency (DARPA), in response to the rising numbers of brain and mind-injured veterans returning from the USA's overseas wars. Whole new fields of research, such as social neuroscience, are developing around these technologies.

But many of the problems that had beset the early days remain unresolved. Neuroscience may be a singular label, but it embraces a plurality of disciplines. Molecular and cognitive neuroscientists still scarcely speak a common language, and for all the outpouring of data from the huge industry that neuroscience has become, Schmitt's hoped for bridging theories are still in short supply. At what biological level are mental functions to be understood? For many of the former, reductionism rules and the collapse of mind into brain is rarely challenged—there is even a society for "molecular and cellular cognition"—an elision hardly likely to appeal to the cognitivists who regard higher order mental functions as emergent properties of the brain as a system.

Many years before the term neuroscience was invented, the great neurophysiologist Charles Sherrington, who provided the abiding metaphor for the activities of the myriads of signals flashing through the cerebral cortex as "an enchanted loom", at the end of his lifetime of research on the brain, doubted that it would ever be possible to make

Jason Reed/Reuters/Corbis

the leap from brain to mind. The instigators of Europe's Human Brain Project, whose metaphor for the brain is a computer—interestingly a technology in linear descent from the earliest of mechanical looms—concede that although the brain may indeed be "the world's most sophisticated information processing machine", it operates on unknown principles "that seem to be completely different from those of conventional computers".

Meantime, and—except to the theorists—more urgently, the prospects for improved therapies for the worldwide wave of psychiatric distress seem as distant as ever. The 1960s hopes for a biological psychiatry have faded in the absence of new drugs and there are few new insights. It is increasingly recognised that the phenomenology of the latest version of the psychiatrists' bible, the *Diagnostic and Statistical Manual of Mental Disorders*, can't readily be translated into the molecular language of disordered molecules. Now that the brain can no longer be conceptualised as a sea of neurotransmitters whose abnormalities are the causes of depression, anxiety, or schizophrenia, many big pharmaceutical companies are retreating to the safer terrains of cancer and coronary heart disease.

Just as half a century ago, it is an exciting and challenging time to be a neuroscientist. What's certain is that this year's BNA Festival of Neuroscience will have plenty to talk about. And as one who was there not only at the beginning of the BNA but also at the origins of the Edinburgh International Science Festival, I will be looking forward to this double celebration.

Steven Rose
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I was a founder member of the BRA/BNA and served on its early committees.

Further reading

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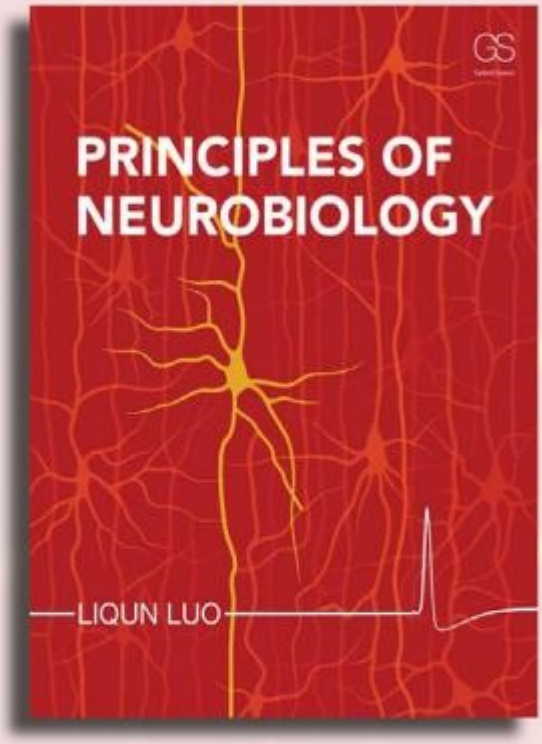
1982-1983	Adam Sillito	Vicki Sterling	Ray Hill
1981-1982	Adam Sillito	Vicki Sterling	Paul Lewis
1979-1981	John Wolstencroft	John O'Keefe	Paul Lewis
1978-1979	John Wolstencroft	John O'Keefe	Sandra File
1977-1978	Geof Einon	John O'Keefe	Sandra File
1976-1977	Horace Barlow	Geof Einon	Sandra File
1974-1976	Horace Barlow	Geof Einon	John Wolstencroft
1973-1974	Pat Wall	Chris Evans	John Wolstencroft
1968-1973	Pat Wall	Chris Evans	John Dobbing

PRINCIPLES OF NEUROBIOLOGY



Liqun Luo, Stanford University, USA

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