Foreword

Legend has it that one of the earliest recorded journeys made to St Andrews was by a fourth century monk from Patras. St Regulus is said to have had a dream in which an angel appeared with instructions to take the bones of St Andrew to the very ends of the earth for safe keeping.

As the sun rises over the town that still bears the apostle’s name, it is not hard to see why St Regulus, shipwrecked and exhausted, thought that he must have been near enough finis terrae. Situated on a promontory, sea-bound and windswept, St Andrews is remote, isolated and elemental, yet deeply connected throughout the world. It is a place of ever changing skies and far horizons, of long winter nights and longer summer days and a place where, for the past six hundred years, countless generations of scholars have come to see the world in a new light.

The following pages are as rich in content as any illuminated mediaeval manuscript from the early days of our foundation. They speak eloquently to the calibre and depth of the research conducted here, both within and across a range of disciplines, by academics drawn from over 120 countries.

Accompanying the introductory pieces for each section are personal research profiles from members of our four faculties of Arts, Science, Divinity and Medicine. Thanks to their intellect, creativity, ingenuity and commitment the University of St Andrews maintains an enviable reputation for the quality and impact of our research.

This booklet provides a snapshot of what is happening here, now, as we mark our 600th Anniversary. While by no means exhaustive, it seeks to capture the essence of the intellectual vibrancy that thrives in St Andrews and is nurtured and celebrated here. As we embrace the dawn of our seventh century we continue to bring together scholars from around the globe who journey here to learn, teach, challenge orthodoxies and push at the frontiers of knowledge in pursuit of truth.
The Middle Ages played a key part in determining the political, linguistic and cultural map of Europe, with ongoing consequences for modern attitudes to any number of issues, from gender and institutions, law, literature and language, to politics, religion, universities and violence. The thousand years from the breakdown of the Roman world to the emergence of Reformation and Renaissance saw endless experimentation and change alongside anxiety about the new and an emphasis on authority and tradition. The alternating tensions of war and peace, belief and unbelief, hope and despair, persecution and tolerance, growth and decline, stood alongside linguistic and literary creativity, the introduction of new technologies and new forms of socio-political organisation (for example the plough, the pecia system for copying manuscripts at speed, confraternities, parliaments and assemblies). Meanwhile, Islam and Christianity gradually divided the religious landscape between them. All these and more are themes exposed by researchers on the Middle Ages in a university founded as the period came towards its end.

This combination has made St Andrews a world – leading centre for the study of the Middle Ages, one of the largest concentrations of mediaevalists in existence, hosting major research projects (the current crop includes the pseudo-Bonaventuran lives of Christ and the fabric of Scottish parish churches). Outstanding visiting academics bring their expertise to workshops and share in the vibrant atmosphere of conferences, the weekly seminar of the Institute of Mediaeval Studies and the company of a large body of scholars and students working in intersecting ways.

Frances Andrews – History

What role does religion play in constructing trust as a socially constitutive force? This is one of many questions underlying my research into the employment of men of religion as secular administrators in late mediaeval Italy. Committed to a distinct form of life, they nonetheless acquired social and governmental responsibilities exploiting their separateness, dragging them back into the ‘world’. In a time of fast-moving change not unlike our own, they might be solutions to political strife. Yet their employment was also constantly challenged, revised, or undermined, a process which helped shape the governmental culture of the post-mediaeval world.

Bettina Bildhauer – German and Chris Jones – English

The Middle Ages matter not just to academics, but also to writers, artists, nationalists, believers, politicians, children, tourists and many others. Many of our towns, laws, placenames, holidays, buildings and even the University of St Andrews itself have their roots in the Middle Ages. Our conference The Middle Ages in the Modern World (July 2013) brings together academic and non-academic mediaevalists to celebrate the 600th Anniversary of the University of St Andrews and to explore the continued significance of the Middle Ages after 1500.

Michael Brown – History

The fourteenth and fifteenth centuries represent a formative period in Scotland’s development as a country with its own traditions of government and political society. However major questions remain about its internal character. What was defining and distinctive about the political culture and experience of Scots? How did individuals locate themselves within the kingdom’s structures of authority and society? By looking at the evidence for networks based on royal government, aristocratic households, localities and extended families, I hope to identify and characterise the political culture of this small but self-conscious land and extend understanding of participation in its public life.
Who wrote and who read? Mediaeval texts and the books that physically preserve them (handwritten codices for the most part, until the invention of printing towards the end of the period) provide tangible connections with mediaeval thought, expression, and experience. The study of Middle English writings from the fourteenth and fifteenth centuries, and their continued circulation into the sixteenth, forms the central point of my research: who wrote these texts, and translated them from other languages including French and Latin? Perhaps more importantly, who read, annotated, and adapted these texts for wider or later reading audiences?

How can war be justified? What affects the conduct of soldiers during combat and what drives them to acts of mercy or barbarity? Can the violence of warfare be limited or controlled? In late mediaeval Europe, where warfare was a frequent and ubiquitous phenomenon, such questions are fundamental to a proper understanding not only of mediaeval warfare, but also of its relationship to society, law, religion and philosophy. Mediaeval society’s attempts to deal with such questions, from formulating a legal and philosophical doctrine of a ‘just war’ to creating a code of military behaviour called ‘chivalry’, has left a permanent mark on western attitudes towards war.

A history of glory and ruins. In the Middle Ages, Scotland’s uniquely compelling landscape was crowned with a rich variety of stone-built churches in the Romanesque and Gothic styles. The architecture of Christianity was visually and culturally pervasive, but the Reformation wrought unthinkable changes. Churches were demolished, pillaged and neglected as though their very stones had been infected with the leprosy of a hated religion. We are assessing what remains of the parish church architecture of mediaeval Scotland, revealing a wealth of previously unrecognised architecture, built into post-Reformation work or reused for churchyard walls, mausolea and other structures.

Between the Black Sea and the Caspian, Mediaeval Armenia was a highly contested region throughout Late Antiquity and the Middle Ages, experiencing violent confrontation and upheaval but also absorbing, adapting and refracting a wide range of political, religious and cultural influences from its neighbours. Many of these have been preserved in a vast and diverse body of mediaeval literature, inscriptions and charters. My research focuses on exposing what has been preserved in a vast and diverse body of mediaeval literature, inscriptions and charters. My research focuses on exposing what has been preserved in a vast and diverse body of mediaeval literature, inscriptions and charters. My research focuses on exposing what remains of the parish church architecture of mediaeval Scotland, revealing a wealth of previously unrecognised architecture, built into post-Reformation work or reused for churchyard walls, mausolea and other structures.

Continental Europe in the ninth and tenth centuries was dominated by the rise and fall of the Carolingian Empire – the last pan-continental empire of the Middle Ages – and the emergence of successor states from its wreckage. In the tenth century, queens had a particularly prominent political role, not least because they could transmit dynastic legitimacy to their husbands. They ruled kingdoms, deployed armies and crushed enemies, but their position was always potentially open to attack as illegitimate and improper. Studying the actions and representations of queens can therefore uncover the implicit assumptions and tensions governing political conduct in a period sometimes called ‘the crucible of Europe’.

Cut, Pasted, and Cut Again: how prints embellished manuscripts in the fifteenth century, became detached in the nineteenth, and can be virtually reassembled in the twenty-first. Along the Rhine and Maas rivers in the fifteenth century, experiments in book production utilised the old technology of the handwritten book coupled with the new technology of the printed image to make a hybrid: manuscripts embellished with prints. Using a database, I have begun ‘virtually’ to reconstruct several fifteenth-century manuscripts illustrated with prints. French collectors harvested some, the English harvested the rest. My current research thus explores how teachers made schoolbooks more appealing for students around 1500 by filling them with cheap prints, and how collectors decontextualised them.

I research the archaeologies of Roman and Late Antique Greece, on Crete and in the Peloponnese. I am interested in the diachronic use of religious architecture, the function of religious space and use of memory, and on challenging traditional perceptions of Christianisation as evidenced through the topography and architecture of Late Antique churches. Through the application of theories such as creeping determinism, memory, and spatial analysis, a re-examination of the topography and architecture of the Christian church enables a new view of the Christianisation process as a less totalitarian and more inclusive one.

What characterises the transition between barbarism and civilisation? How did kin-based societies organised into redistributive chiefdoms which equated honour with land-tenure, transform themselves into complex market-oriented societies in which a ruling class increasingly monopolised violence and professional classes, alienated from agrarian production, thrive? My research focuses mainly in the British Isles and the near Continent but has a strong cross-cultural and interdisciplinary comparative element.
Harnessing the properties of light waves has both been a fascination and a necessity for mankind from an early age. Humans are animals of vision, and our eyes are able to detect light down to the level of its smallest quanta, the photon itself. Light waves let us see the environment around us, and the discovery by early humans that they could see by the blackbody radiation of heated carbon particles (firelight) allowed them to extend their working day and become more productive. Many more inventions have since enabled us to turn night into day, most notably the (Edison’s) incandescent light bulb but the quest is far from over. Researchers at St Andrews continue to discover novel means of generating light in the most efficient and cost-effective manner, for example using organic materials, the very building blocks of life itself.

Light waves allow us to see far into distant galaxies. Early work on the reflecting telescope was conducted by James Gregory (1638-1675) at St Andrews, which allowed scientists to see ever deeper into the universe. A telescope was built at St Andrews in the 1960s and named in Gregory’s honour; most remarkably it is still used for frontier research today. David Brewster (1781-1868) is universally known for his studies of light and its polarisation as well as the invention of the kaleidoscope. As Principal of the United College at St Andrews, he was the catalyst for the production of the first experimental work in photography in Scotland.

Brewster’s legacy extends much further. The well-known ‘Brewster angle’ is widely used today for controlling the operation of laser devices. St Andrews scientists have built on this, most notably through the development of the ‘Kerr-lens’ technique, which is extensively used in commercial short-pulse laser systems. Such short-pulse lasers are important throughout the scientific community for time-resolved studies of physical, biological, and chemical events. The continuing improvement of laser sources enables researchers to probe deeply into biological matter, to develop novel methods for cancer diagnostics, even to control neuron growth and to inject particles into living cells. This work is benefiting tremendously from the close interaction with biologists and medical researchers, who are all clustered in close proximity on the North Haugh science campus.

Light is an excellent carrier of information. Having come a long way from caveman’s early smoke signals, optical technology now enables the modern internet, and researchers are developing ingenious methods of squeezing ever more information down tiny fibres of glass that are only as thick as a human hair. St Andrews established itself at the forefront of this research through the Ultrafast Photonics Collaboration, by developing a new generation of devices based on polymer photonics, quantum dots and dilute nitride materials, as well as demonstrating ultra-high-speed optical switches that will enable faster and more efficient optical technologies to drive the internet of the future.

Harnessing light waves has even more potential as researchers are now able to enter the realm of nanotechnology and create materials that can interact with light in an unprecedented way. Building nanostructures on the fundamental lengthscale of light, the wavelength, enables St Andrews scientists to maximise the control they are able to exert over the generation and propagation of light.

Researchers have found ways of generating light efficiently, even in silicon, as well as exploring ways of processing optical signals on tiny microchips. One of the thrusts of the work is to distribute the data signals inside a computer chip optically, for example between the microprocessor and the memory cells. Supercomputers already use this technology on a larger scale, and optical nanotechnology is expected to enter personal computers within the next ten years, making them faster and much more power-efficient. Related groundbreaking theories on the propagation of light in nano-engineered materials (metamaterials) explore effects such as super resolution and perfect imaging, which is the ability to see minute details with unlimited sharpness. Scientists are even considering the prospect of guiding light around objects in an invisibility cloak-like fashion. The first prototypes of cloaking devices have already been made, although it will still be a long time before a real invisibility cloak can be bought from the nearest shop.

Many effects which have now been unravelled were once considered as belonging to the realm of magic and fiction, yet the subtle and awe-inspiring nature of light continues to fascinate St Andrews scientists and students.
Brendan Cassidy – Art History
Sir David Brewster was a friend of William Henry Fox Talbot, who produced the first photographic image in Britain in 1839. Brewster was instrumental in making St Andrews the ‘headquarters’ of the new invention. His enthusiasm for ‘sun pictures’ (photographs) was “a sort of monomania which my dealings with light have inflicted upon me”. The St Andrews group around Brewster, including the then Professor of Chemistry, experimented to improve the new medium and contributed to the commercialisation of photography in Scotland from 1843.

Kishan Dholakia – Physics
The ability to load substances into cells is of great interest to cell biologists. Under normal circumstances, the cell membrane acts as an impermeable barrier to the passage of most molecules and the selective introduction of therapeutic agents to the inside of diseased cells has been a key challenge for scientists for many years. Using our expertise in controlling and shaping light beams, we are developing novel ‘optical transfecting’ devices, where a laser beam works like a syringe that injects compounds into cells. This allows us, for example, to look at cell-to-cell signalling and aspects within the development of Alzheimer’s disease.

Thomas Krauss – Physics
Following Feynman’s quest of looking for “plenty of room at the bottom”, we carve tiny structures into semiconductors that allow us to probe and interact with light on its fundamental lengthscale, i.e. the wavelength itself. This research reveals some of the fundamental limits of light-matter interaction, for example how light signals can be slowed down and stored, or how we can create novel light emitters and novel concepts for processing data signals with light.

Ulf Leonhardt – Physics
The idea of invisibility has fascinated people for millennia and has been an inspiration or ingredient of myths, novels and films, from the Greek legend of Perseus versus Medusa to HG Wells’ Invisible Man and JK Rowling’s Harry Potter. I am working on ideas of designing invisibility devices based on modern metamaterials, inspired by Fermat’s principle, conformal mapping, analogies between mechanics and optics, the optics of illusions and the imagination of my children.

Wilson Sibbett – Physics
We research ultrafast lasers that produce pulses in a picosecond or femtosecond time scale. This has helped to enhance the practicality of these lasers and they can now be used in pioneering aspects of ultrahigh optical intensity science through to the study of disease processes. The field of biomedical photonics has emerged as an active sector of research enabled by the outputs from state-of-the-art lasers that can be designed to be role-specific. The likelihood is that new and exciting light-based therapies can now be introduced that will have great potential for everyday use by clinicians.
The University of St Andrews has been renowned for its application of mathematics to studying the stars and planets since Charles II conferred the position of the first Regius Chair of Mathematics at St Andrews to James Gregory, in 1668. Some 350 years later, his pioneering design for a reflecting telescope (the Gregorian telescope) is still in use today and his proof of the fundamental theory of calculus, the Taylor series and integration techniques, played a key role in founding calculus. St Andrews continues this tradition with our research in the mathematics of the Sun and in astronomy.

The Sun is highly dynamic and it is, of course, essential for the existence of mankind, but it also affects our daily lives. Many aspects of its behaviour are a mystery and as our closest star these have important implications for the rest of astronomy. The solar group in St Andrews (founded by Eric Priest, FRS, the current holder of the James Gregory Chair of Mathematics) is playing a leading role in understanding many of these fundamental properties. They include explaining how magnetic fields emerge through the solar surface, determining the mechanisms that heat the outer atmosphere of the Sun, the corona, to over a million degrees (some hundred and fifty times hotter than its surface temperature) and establishing the causes of the spectacular eruptions and solar flares that often occur. In all these processes magnetic fields are interacting in subtle, non-linear ways with ionised gas (or plasma) – a field called magnetohydrodynamics (MHD).

Solar flares and coronal mass ejections (CMEs) can blast vast quantities of highly charged particles towards Earth. These streams of charged particles can significantly disrupt the Earth’s protective magnetic shield leading not only to beautiful aurorae, but also to major problems with satellites and national power grids and the infrastructures that rely on them, such as banking, navigation (GPS) and communication networks. Here in St Andrews, researchers have determined many of the key characteristics of the fundamental plasma physics process of magnetic reconnection that is the core mechanism that powers flares and CMEs. We are looking at the highly complex structure of the Sun’s magnetic field and how it evolves during reconnection, and how reconnection processes accelerate particles to relativistic speeds. We have produced the most reliable model for the cause of highly twisted structures (called prominences) and how they erupt during CMEs and solar flares.

Seismology is a well known topic in geophysics where it is used to determine the structure of the Earth. Its fundamental principals are now being applied to a new research area called coronal seismology where observed waves and oscillations in the solar atmosphere are used to derive properties (e.g. density structures and magnetic field strengths) of the local plasma which cannot be easily measured directly. The magnetic field is the main driver of solar activity and new magnetic flux appears on the Sun’s surface through the process of flux emergence. We have developed original numerical models of this process which enable us to determine how magnetic structures in the solar atmosphere are formed.

The possibility that other Earth-like worlds might exist elsewhere in the Universe has long intrigued people, but it is only in the last two decades that advances in astronomical technology and computing power have transformed exoplanetary science from a theoretical possibility to an observationally-testable reality. The Las Cumbres Observatory Global Telescope network and the HARPS-North spectrograph are used to carry out pioneering planet studies around red-dwarf stars in the central parts of our galaxy and to determine the masses of super-Earth planets discovered by NASA’s Kepler space mission. The first such measurements suggest a wide range of planetary compositions, from worlds composed almost entirely of water to iron-rich rocky bodies like Earth.

A large proportion of all Sun-like stars are accompanied by families of planets that condense out of the discs of dusty, gaseous material that cocoon young stars. The HERSCHEL space observatory is being used to trace the earliest condensations of rocky material that will one day form planets around some of the youngest stars in the sky. Our supercomputer simulations of the star formation process show how galaxies produce giant gas clouds that are the birth places of stars, and allow us to understand what determines the properties of individual stars such as our Sun.
Ian Bonnell – Physics & Astronomy
The Herschel mission is showing us the intricate structures of giant clouds of gas that form new stars in the Milky Way and in external galaxies. Supercomputer simulations now allow us to model the galaxy-scale flows of gas into such star forming clouds, which collapse under their self-gravity to form large groups of stars. Young stars emit copious amounts of radiation and winds while the most massive eventually explode as supernovae. Including all these physical processes, we can start to model a full galactic ecology and thus understand how stars form and galaxies evolve. We want to understand how the rates of star formation depend on the galactic properties, and how the highest mass stars always form in the same relative abundances.

Andrew Cameron – Physics & Astronomy
The Kepler mission is revealing a bewildering variety of planets that are simply not found in our own system, from dense super-Earths with rock-iron cores to giant waterworlds with deep mantles of water ice. To understand how they form, we must first find out what they are made of. Kepler tells us their diameters, but HARPS-North will tell us their masses, enabling us to determine their likely interior compositions. We want to know if the Earth’s rocky composition and partial ocean coverage is a statistical freak, or a natural outcome of the planet-formation process. If the latter turns out to be the case, truly Earth-like planets with both oceans and dry land could provide potential habitats for life throughout the galaxy.

Ineke De Moortel – Mathematics & Statistics
Observations from today’s solar satellites show the atmosphere of the Sun in such amazingly high resolution that we can see waves and oscillations everywhere, all the time. What a change from 30 years ago, when Bernie Roberts first formulated his theories for coronal seismology in St Andrews! These detailed observations of oscillating coronal loops have revolutionised the field of coronal seismology and it is a great privilege to be part of this development here in St Andrews. We are now extending the original, simple, coronal seismology models to study how magnetohydrodynamic waves and oscillations behave in realistic 3D solar configurations.

Christiane Helling – Physics & Astronomy
Astrophysics is a unique science which combines the small-scale physics of atoms and molecules with the large-scale dimensions of planet and star formation. Dust grains seed at least two important processes for the occurrence of life: the formation of planets and the formation of clouds inside planetary atmospheres. Dust grains and cloud particles easily carry electrostatic charges which can discharge in the form of lightning. This can lead to the formation of bio-molecules, as demonstrated by Miller and Urey in their spark experiment in 1953.

Clare Parnell – Mathematics & Statistics
Over the last two decades the advances in computing power have revolutionised the modelling of fundamental plasma processes of MHD. A raft of novel data analysis tools have had to be designed to analyse the enormous volumes of data produced. I have been lucky enough to work with a series of excellent PhD students and postdocs who have helped me develop a unique tool for locating and analysing the intricate and amazingly complex structures that appear in 3D numerical reconnection experiments. Thus, for the first time, we can reveal and probe the fascinating and often surprising consequences of reconnection for a wide range of different solar phenomena.
D’Arcy Wentworth Thompson, who held the Chair of Natural History at St Andrews for 31 years from 1917, was an extraordinary polymath most famous for his book *On Growth and Form* where he applied the principles of Pythagoras and Newton to explain the shapes of living organisms. At the end of one chapter he describes the physical world of man, then of insects and finally of bacteria, and writes, “we have come to the edge of a world of which we have no experience, and where all our preconceptions must be recast”. Were he alive today, he would have delighted in the world of molecular biology and the atomic structures of proteins that scientists at St Andrews are studying in order to understand infectious diseases with a view to developing new drugs.

Our bodies are under constant attack from microbes and involved in a continuous arms race against bacteria, parasites and viruses that are evolving and outwitting our natural defence mechanisms. Drug resistance is common, leading to a desperate need for new antibiotics and antivirals. Researchers at St Andrews are dissecting the molecular mechanisms involved in this struggle and discovering new therapeutic targets and new drugs.

The interdisciplinary research environment within the Biomedical Sciences Research Complex (BSRC), brings together researchers from the Schools of Biology, Chemistry, Medicine and Physics & Astronomy to tackle these great challenges.

Virologists within BSRC have discovered how certain viruses interfere with normal cellular processes by carrying promiscuous proteins that can bind to several host partners. Through these interactions, the virus is able to modulate the host’s innate and adaptive immune responses, regulate its own replication and subvert cellular signalling pathways for its own advantage. Viruses being studied in detail include human influenza and parainfluenza viruses, foot and mouth disease virus and tropical viruses that are threatening temperate regions of the world as a consequence of climate change. A relatively recent discovery is the existence of a primitive immune system in bacteria that they use to provide resistance to bacterial viruses. Research at BSRC is dissecting the complex mechanisms that bacteria use to acquire resistance and to combat infection, and this has great biotechnological potential.

Visualisation of the atomic structures of proteins through the use of X-ray crystallography is providing a wealth of functional information on key proteins involved in infection, immunity and genetic disorders. St Andrews developed the Scottish Structural Proteomics Facility that utilises high throughput techniques and robotics for cloning, protein expression and crystallisation to accelerate the once laborious task of crystal structure determination. Exciting discoveries include detailed atomic knowledge of how bacteria synthesise and export their protective surface carbohydrate coat, how microorganisms synthesise antibiotics, how drug resistance arises through specific mutations in key proteins involved in pathogenesis and how viruses recognise cell surface receptors and gain entry in order to replicate in the infected cell.

This structural knowledge is also being used to develop small molecules that can be used as chemical tools to dissect cellular pathways, or that might serve as lead compounds for the development of new drugs. A particular focus is the development of novel therapies for the treatment of respiratory diseases such as influenza, tuberculosis and pneumonia.

With remarkable prescience, D’Arcy Thompson pointed the way to the research of BSRC today, where the physical and biological sciences combine to shine light on the molecular mechanisms of life.
Stephen Gillespie – Medicine
With colleagues, I am interested in the molecular basis of cancer, using lasers to detect cancer cells and human pathogens, and unravelling the evolutionary drivers for antibiotic resistance. We are working on the genetic relationships underlying complex traits such as attention deficit hyperactivity disorder and dyslexia. Clinical trials are aiming to find better treatments for tuberculosis, new diagnostics for respiratory infections, studies to determine the best way to redirect young people entrapped in the violence of gang culture, and research to understand the drivers for poor health and deprivation in adolescents. This is a vibrant place to perform medical research.

Tracey Gloster – Chemistry
I was attracted to the BSRC by the mix of scientists from different backgrounds working together on biological problems at the molecular level. The fusion of biologists, chemists, physicists and medics in one unit appears unique to the University of St Andrews and creates a really special and exciting atmosphere to conduct science. I am interested in the mammalian enzymes that process carbohydrates. Gaining an understanding of these enzymes in the finest molecular detail allows us to dissect the roles they play in diseases such as cancer and lysosomal storage disorders, and should provide a platform for the design of therapeutics to aid their treatment in the future.

David Jackson – Virology
I am working with colleagues on the complex molecular interactions that occur between certain medically important viruses and their human hosts, both on a structural and functional level. The goal of this research is to identify new targets for future antiviral therapies. As a newly appointed principal investigator in the School of Biology I feel that I am in the perfect environment to successfully pursue my research goals. The multi-disciplinary nature of the BSRC has allowed me to engage with other virologists, structural biologists and chemists, all of which has helped me get my research off to the best possible start.

James Naismith – Chemistry
Using proteins, biology performs its chemistry in water, with no waste, and re-uses materials. We have been fascinated by how proteins achieve the catalysis and how this knowledge can be harnessed either as tools or as drug targets. We have begun to look at proteins embedded in the membrane, these proteins control the flow of ions, nutrients, large molecules and water in and out of cells. These proteins act as mini machines and we are developing ways to study the motions in these machines. We aim to turn these techniques to study nerve impulses in humans.

Garry Taylor – Biology
BSRC provides a rich environment for the training of postgraduate students. Our work on the structure and function of proteins involved in pathogenesis provides the basis for new therapies for respiratory disease. We have developed a new molecule that shows potential as a treatment for childhood parainfluenza, and are currently exploring a multivalent biologic that targets the host and which shows great promise as a therapeutic for a range of respiratory pathogens including influenza virus and pneumococcus. Traditional subject boundaries do not exist within BSRC and this culture helps train future scientists who can take a more holistic approach to research.

Malcolm White – Biology
Archaea are microorganisms, one of the three major lineages that constitute the tree of life. We study DNA repair enzymes from archaea living in volcanic pools of boiling acid: some of the most extreme environments on the planet. Archaeal proteins are particularly suited for structural studies. The surprising thing is that this can also help us to understand cancer avoidance pathways in humans. Although this may appear counterintuitive it’s a reflection of our shared evolutionary history. The requirement to maintain, replicate and repair DNA as a primary storage medium for genetic information unites all forms of life.
Why do our minds and brains work in the ways they do? St Andrews has long been a leading centre providing answers from the interrelated fields of psychology, behavioural sciences and neuroscience. Numerous collaborations have been forged between psychology and biology as well as internationally.

One key implication of our cross-disciplinary research is that some of the most profound answers to the question of why our minds work as they do lie in our evolutionary past, and studies of other animal minds have generated a series of exciting clues about this over the past two decades. Field studies of our closest living relatives, including chimpanzees and other primates, have revealed unsuspected systems of communication and traditions that have shed light on the evolutionary ancestry of human language and culture. We have developed the influential theory that a key explanation for the intelligence of humans and other primates lies in their complex social worlds, generating a sophisticated ‘Machiavellian Intelligence’. Fascinating studies of a diverse range of other species, from whales and dolphins to birds and fishes, have uncovered ways in which a species’ ecological niche explains the evolution of such phenomena as teaching, tool use, social learning and innovation. In the University’s ‘Living Links to Human Evolution’ Research Centre recently built in Edinburgh Zoo, behavioural experiments complement the group’s field studies and further probe primate psychology. ‘Living Links’ is a pioneering achievement in encouraging public engagement with ongoing behavioural science on a massive scale.

How does the brain enable us to be the people we are? What happens when neural systems are damaged or degrade with time? Such questions about how we function on a daily basis and how we deal with the unfortunate effects of brain damage and degeneration are being addressed by a growing cross-disciplinary group of researchers in St Andrews. They have developed a variety of novel approaches for studying the basic neural mechanisms that support many aspects of everyday behaviour. These include such fundamental processes as our ability to move, to learn new information and remember it, and to pay attention to the most relevant aspects of our environment. The strength and breadth of this research is illustrated by the diversity of research interests in the Institute for Behaviour and Neural Sciences (IBANS). These include uncovering chemical events that are occurring in the early stages of Alzheimer’s disease, and showing that they are potentially reversible. As a result, these researchers are trying to understand what the molecular and cognitive consequences of these newly identified events are for the human brain, that will help develop potential new drugs for the treatment of Alzheimer’s disease.

Whom should we trust? Who will be a good leader or partner? Our first impressions can be shaped by facial appearance. For 20 years, the Perception Lab in the School of Psychology at St Andrews has been developing computer graphics to study the facial cues influencing judgments of others. The influence of hormones, mood, culture and self-esteem on face perception have all been investigated, testing theories from biological and social psychology alike.
Arlene Astell – Psychology

Researchers at St Andrews are investigating how we can support people to live and age well, including people who develop conditions of ageing like Alzheimer’s disease. New technology can play an important role in enhancing people’s later lives and researchers at St Andrews are at the forefront of developing novel applications to support relationships and communication, reduce social isolation and maintain wellbeing.

Frank Gunn-Moore – Biology

St Andrews is a place where true interdisciplinary research occurs, and this is particularly important when tackling diseases such as Alzheimer’s. By working between the disciplines we have identified some of the chemical events that are occurring in the early stages of this disease and shown that it may be possible to reverse them. We are trying to understand how these chemical events affect the working brain, and hence to develop new prototype compounds that will become drugs of the future. I could have never imagined when I first started my own group, that I would have joint projects with chemists, medics, physicists and psychologists.

Julie Harris – Psychology

3D viewing is taking off in TV, cinema and the computer games industry. In the Vision Lab we answer questions like these: why when we move away from objects do they still look the same size? What is the feeling of enhanced depth that a 3D view provides, and can it be achieved without use of two eyes? What are the fundamental computations that underlie the brain’s ability to build our perceptual world? In St Andrews, we collaborate with colleagues in neuroscience and computer science to understand the underpinnings of perception and to inform the development of new visual technologies.

Kevin Laland – Biology

The remarkable ecological and demographic success of humanity is largely attributed to our capacity for imitation, teaching, culture and language. We have had a leading role in uncovering the mechanisms and evolutionary origins of these capabilities. St Andrews researchers organised the social learning strategies tournament, which established why copying is widespread in nature and why humans happen to be so good at it. They led the chimpanzees culture project, which revealed extensive dietary and tool-usage traditions in different populations; and they have isolated the critical social and cognitive capabilities underlying cumulative culture.

David Perrett – Psychology

St Andrews is renowned for developing technology to transform the appearance of faces in a subtle and realistic manner. These tools allow us to discover diverse facial cues to health, attractiveness, mood and behaviour; perceptual cues which have a profound influence on people’s lives. Across different cultures, we have shown that the fruit and vegetables we eat change our skin colour making us look more attractive. Changing diet enhances appearance more than altering sun tan, and this is more effective in persuading people to improve their diet than government health information campaigns! In this way, our work engages the public in a meaningful and accessible way.

Andrew Whiten – Psychology

In St Andrews, a distinctive interdisciplinary group of biologists and cognitive scientists and their research teams are capitalising on the fact that we live in an unprecedented era of discoveries about the animal mind. Even fifty years ago we knew next to nothing about the behaviour and psychology of our closest relatives, the great apes, but our studies of them and many different species over the last couple of decades have revealed an undreamt-of richness of discoveries, with substantial implications for understanding ourselves.
WH Auden famously declared that “poetry makes nothing happen”. Yet the medium of poetic language has performed countless functions throughout human history: the codification of laws, the preservation of folk memory and communal wisdom; the telling of historical narratives, the pursuit of philosophical argument and scientific debate, and the production as well as the subversion of political propaganda. Poetry has provided entertainment, praise, delight, challenge, consolation and disturbance. Today, even though poetry no longer enjoys the mass audience and wide range of functions that it once did, large numbers of people often still turn to poetry at moments of heightened emotional experience in their lives, whether private or public, and whether of grief or joy.

This constant turn towards the poetic register for the performance of these many tasks is a cultural phenomenon which begs reflection and serious inquiry. If language exists merely for the effective and transparent exchange of information, what is the point of poetry? We suggest that poetry has always been that arena in which language most consciously calls attention to itself, to its own resources and limitations. It is the place in which language itself is most heightened, is most ‘languagey’. Only in and through language can human beings make sense of themselves, of their relationship to others and to the environment, and of their place in long historical narratives that affect the way we all choose to live on the earth. Given this fact, it is arguable that the study of poetry and its multiple uses is of central importance to understanding what it is to be human, to understanding how we shape and are shaped by the language available to us. A near contemporary of Auden’s, the poet WS Graham, once asked “what is the language using us for?”. It is with this question that many of the researchers at St Andrews are engaged, in various ways and across various languages and periods, in their study of poetry and poetic language.

The University of St Andrews has long been internationally pre-eminent in the production and study of poetry. The virtuoso mediaeval poet William Dunbar, an unrivalled technical craft-master and court poet to the royal Stuarts, was a St Andrews student in the 1470s. In 1513 fellow graduate Gavin Douglas was the first poet to produce a full translation of Virgil’s Aeneid into any northern European vernacular. Robert Burns’ favourite poet and greatest influence, Robert Fergusson, studied at St Andrews in the 1760s. More recently the poet Douglas Dunn, now Emeritus Professor of English, founded the first Creative Writing programme in Scotland here in 1993. Since then poets including Kathleen Jamie, John Burnside and Don Paterson have taught poetry writing at St Andrews. And in 2009 Robert Wilson and Claudia Rossignoli inaugurated the Lectura Dantis Andreapolitana, the only Lectura Dantis in English in the world, which brings experts on Dante from all over the UK and abroad to deliver public lectures on the Divine Comedy.

Today, St Andrews is a rich centre of activity for the study of poetry from Homer to Heaney and with researchers working on Catullus, Beowulf, Dante, Shakespeare, Pope, Burns, Keats, Baudelaire and Borges to name but a few. The Poetry Forum provides a context in which researchers into poetry from a number of different disciplines can meet and share their work, while the annual international poetry festival StAnza, a highly successful town-gown collaboration originally founded by Professor Nick Roe in the 1980s and subsequently developed as an independent professional organisation by the townspeople of St Andrews, continues to grow, attracting performers, audiences and critics from across the world.
Can reading or writing poetry improve the health of someone undergoing a severe life trauma? I am working on this question with manuscripts of Douglas Dunn's *Elegies*, written after the death of the poet's wife from cancer. The long process of drafting and redrafting these moving poems, now archived in the University of St Andrews Library, is part of what Dunn calls his 'grief-work', a phrase also used by palliative care professionals. Having teamed up with collaborators from health care organisations, we are looking at new ways of using poetry with individuals affected by life-altering events such as cancer and bereavement.

**Emma Buckley – Classics**

When Rome got its first emperor, poetry got a first of its own: the National Epic. Virgil's brilliant *Aeneid* – the story of how Augustus' Rome came to be – has been read both as state propaganda and rebellion against imperialism, creating questions about the use of ‘political’ poetry which still resonate today. I explore the uses – literary and political – that Virgil himself was put to by later poets who wrote new Romes for new emperors. But my research also traces Virgil’s fascinating afterlife into quite different worlds: Renaissance tragedy, for instance, or the Christian universe of Milton’s *Paradise Lost*.

**Robert Crawford – English**

As poet, anthologist, critic and biographer, poetry is central to what I do. St Andrews is such a writerly place and there is a marked commitment to poetry in the University and throughout the local community. To some extent writing needs to be a cunningly secret activity, but it is confirmatory to have the company of other writers (and sometimes) to talk to them. As well as making new poems, I am working on a biography of T S Eliot, whom I regard as the twentieth-century’s greatest poet. I would like to go on writing about Scottish poetry too: ideally a book on Scottish independence and the literary imagination.

**Dave Evans – French**

My research explores why so many French poets during the turbulent post-Revolutionary period talk about their own art form in terms of music. At a time when absolute values and long-held beliefs were collapsing, major writers such as Baudelaire, Rimbaud, Verlaine and Mallarmé expressed their enduring belief in poetry through reference to a form which, while wordless, is not meaningless. A generation of composers – Fauré, Debussy, Britten – was inspired to set their texts to music, and to write instrumental music which questioned the nature and value of art in the modern world.

**Chris Jones – English**

Poetry is something language does to itself, and is the natural mechanism that renews human speech; it allows strange and surprising combinations of words to be forged that can keep pace with our changing reality. When the poetic function of our language dies, our language ceases to adequately explain the world. Poets consciously manipulate this aspect of speech, and compose the words it produces into a memorable pattern. What I attempt to teach is that meaning is the real object of our quest in language.

**Eleni Kefala – Spanish**

Jorge Luis Borges described the writer as someone who “sets out to draw the world” by populating “a space with images of provinces, kingdoms, mountains”. Poetry is instrumental in shaping collective, as well as personal, identities. I am interested in this political function of poetry, namely its role in forging and questioning cultural identities within the context of Latin American modernity. Recently, I have been engaged with the conceptual nation-rebuilding that Borges undertakes in his first poetry collection, *Buenos Aires Fervour* (1923) – a result of his quest to redraft nationalism in an era of mass migration and galloping urbanisation in Argentina.

**Sara Lodge – English**

My work on nineteenth-century poetry is interested in play and the ways in which poetry, with its doubtful market value, proves an effective vehicle for questioning market values. Much Victorian comic poetry is violent, grotesque and reticitive. Its energies are critical. Through play with poetry’s form and ‘rules’, it unpacks our acceptance of other arbitrary formal rules, regarding work, hierarchy and decorum and – in the case of Lewis Carroll’s poetry – goes as far as to dispute that meaning is the real object of our quest in language.

**Don Paterson – English**

Poetry is something language does to itself, and is the natural mechanism that renews human speech; it allows strange and surprising combinations of words to be forged that can keep pace with our changing reality. When the poetic function of our language dies, our language ceases to adequately explain the world. Poets consciously manipulate this aspect of speech, and compose the words it produces into a memorable pattern. What I attempt to teach is that meaning is the real object of our quest in language.

**Jane Stabler – English**

My work on Romantic poetry curls around my interests in form and intertextuality: Byron (that most cosmopolitan of Scottish writers) is at the heart of it! I am researching a monograph about how the Byron-Shelley group re-reads English literature from an Italian perspective and what that adds to their poetics. Meanwhile, my life’s work is the Longman Annotated English Poets Edition of Lord Byron – a seven-volume edition for which I am the lead editor of a St Andrews-based team. Textually radical (we are working from manuscripts to preserve Byron’s accidentals), this will be the first fully-annotated edition of Byron.

*Bathtime* installation poetry by Jacob Polley and Imogen Cloët
This question is the major topic of one of the greatest works of human thought, Plato’s *Republic*, and it is a question that all societies at all times must ask. From its inception, the University of St Andrews has had scholars and teachers who studied and thought about ethical questions in the widest sense. Each of the traditional four faculties of the Mediaeval university – Philosophy, Theology, Medicine and Law – could display an ethical aspect, and St Andrews was traditionally strong in the first two. That strength has, of course, remained but other fields of ethical inquiry have opened up, focusing both on the public realm and on private contexts of action.

The Department of Moral Philosophy pioneered the University’s engagement with this sphere. Its members have naturally focused on moral and political philosophy, and in the twentieth century many leading British ethicists have worked here. In 1984 the University and the Department founded the Centre for Ethics, Philosophy and Public Affairs. The Centre hosts conferences, colloquia, and workshops on topics in ethics and public affairs. It convenes an annual lecture, named for the previous Professor of Moral Philosophy and University Principal TM Knox, and it now publishes a book series, *St Andrews Studies in Philosophy and Public Affairs*.

On wider philosophical themes, major and innovative research on relativism, contextualism and the theory of meaning and philosophical methodology in general (particularly the role intuition plays in philosophy), is being undertaken by the members of the Arché research centre in co-operation with the Centre for the Study of Mind in Nature at the University of Oslo. Central to this research is the study of rational, linguistic and moral agency.

Philosophy is, of course, one of the oldest disciplines in the University, and in moral philosophy the ethical engagement is both with individual moral action and with the public sphere. Newer university studies have brought a more general emphasis on the public dimensions of ethics. The School of International Relations, for example, is one of the UK’s pre-eminent centres for work under the general heading of international political theory – a relatively recent but rapidly expanding frontier of interdisciplinary inquiry that mixes political philosophy, intellectual history, ethics, law and international relations. St Andrews hosts a leading journal in this area of study (the *Journal of International Political Theory*) and has, since 2008, convened a regular conference – *Thinking Without Borders* – that has rapidly become a central meeting point for the field. This research-activity – to take one example – is changing ideas about the limits or possibilities of the ethical use of armed force, and St Andrews scholars have been prominent in exploring the logic of recent justifications of the use of preventive force. It is equally refashioning ideas on the relationship between international law and international relations; thus the recently founded interdisciplinary Centre for the Study of Global Constitutionalism is exploring new ways to conceptualise that relationship and thereby rethink the many interactions between ethics, law and global politics.

Similar innovations in studying the dynamic connections between ethical claims and individual and collective action are visible elsewhere right across the University. In Philosophy, Anthropology and International Relations, scholars are investigating ways in which the idea of cosmopolitanism can rework traditional understandings of human ethical action. The research at SASI, the St Andrews Sustainability Institute, is generating knowledge-transfer and outreach activities that impact on an ever wider community in both private and public ethical dimensions. Meanwhile, in Film Studies, scholars are exploring the impact of a variety of kinds of new media on the possibilities of ethical activism and reportage – on ethics-in-action as represented in film.

Over a wide range of activities, the University of St Andrews is inventing and developing new perspectives on the great ethical questions that shape our world for good and ill. Through close research and creative investigation, the University maintains its role as seedbed and disseminator of ideas to broaden and deepen our own generation’s responses to the age-old Socratic question of how we should live.
Sarah Broadie – Philosophy

My work is mainly on ancient Greek philosophy, including ancient Greek ethics, political theory, theology, metaphysics, and philosophy of science. So many of our disciplines in the contemporary university have, in one way or another, their roots in the extraordinarily creative intellectual world where Socrates was at home. My teaching and research aim to communicate the vitality of this heritage – in particular, its ongoing power to remind us by example after example how thinking can be daring and detailed, profound and exact all at once.

John Haldane – Philosophy

Philosophical engagement with matters of broad public interest has been a particular feature of the Scottish philosophical tradition from the fifteenth century when St Andrews was founded. Scots led by John Mair (Provost of St Salvator’s) were active in European debates, through the enlightenment period to the present day. The University’s Centre for Ethics, Philosophy and Public Affairs is now at the forefront of philosophical engagement in the areas of judicial ethics, decision making in health care, ethics, business and economics, educational theory and policy, and ethics, religion and science.

Tony Lang – International Relations

The Centre for Global Constitutionalism, created in 2007, brings together scholars from within the University working on international legal theory and constitutional thought. Unlike other such centres around the world, where constitutional theory is driven primarily by legal scholars, the Centre provides a unique approach to constitutionalism that draws on history, philosophy, divinity, law, and politics. It has therefore been able to provide insights into the post-Arab Spring Middle East that emphasise indigenous religious, historical and philosophical foundations of constitutionalism, rather than assuming that Western legal models are the preferred outcome of the constitution-making process.

Nick Rengger – International Relations

International political theory is generally understood to include the philosophical, historical and normative aspects of the international and global elements of social life. In that respect it covers a huge amount of ground and here at St Andrews we try and emphasise the interconnections between the historical and the ethical. But obviously, if you are looking at justifications offered for the use of force, claims about whether the global economy is just or not or the ethical implications of climate change, you are dealing with some of the central contemporary questions of ethics and action in both the public and the private realms.

Jens Timmermann – Philosophy

Immanuel Kant is a towering figure in the history of moral philosophy. In his *Groundwork of the Metaphysics of Morals* (1785) he argues that we can account for the unconditional nature of moral requirements only if we construe them as autonomous, i.e. as self-imposed. Within a strong and varied research environment at St Andrews, I seek to clarify the philosophical content of Kant’s moral thought in various ways, ranging from new editions and translations, a commentary on the *Groundwork* and several international collaborations to a recent essay on the possibility of moral conflict in Kantian ethics.

Leshu Torchin – Film Studies

How can exposure of human violations lead to justice? I research how film, video, and internet technologies bear witness to human rights abuses and genocide in order to mobilise audiences. I am particularly interested in the role of film, video, and the internet, in documenting genocide. This includes an historical study of media witnessing across a number of key sites of genocide, from the film-based campaign by Near East Relief in response to the Armenian Genocide to YouTube as a site of activism in response to the crisis in Darfur.

*The School of Athens* by Raphael (1510–1511)
The University of St Andrews – 600 Years of Research and Teaching

The University of St Andrews is currently celebrating 600 years of learning and scholarship. The centuries that have passed since its first student, William Yellowlock, graduated as a bachelor in the Faculty of Arts in 1414, have been marked by growth and expansion across the faculties. Research conducted by each succeeding generation of academics has been characterised by its creativity and its uncompromising commitment to the pursuit of truth through knowledge.

Today, the University is recognised internationally as a centre for excellence in the Humanities and the Sciences, and highly regarded for its active fostering of interdisciplinary collaboration. The roots of the University, however, can be traced clearly back to the informal schools that grew organically out of the early presence in St Andrews of a great monastic foundation. Unsurprisingly, the first teaching was religious in content and orthodox in tone. Indeed, it is impossible to underestimate the important influence that prevailing religious landscapes, and subsequent challenges to previously accepted religious truths, has had upon the development of the University throughout its formative history.

Founders and early benefactors of the fledgling institution included Bishop Kennedy, who established the college of St Salvator, John Major, one of the last great logicians of the Middle Ages, and the philosopher Lawrence of Lindores who, in addition to holding office as the Papal Inquisitor of Heretical Pravity in Scotland, was one of the most widely-read authors in Europe at the time. Over the three centuries that followed, the University grew and flourished, educating both the sons of Scotland’s leading noble families, and many a ‘poor scholar’. Its influence extended well beyond academe, into the highest reaches of church, state and monarchy. Despite, or perhaps ultimately because of, its place at the heart of mediaeval Scottish society, the University survived the turmoil of the Reformation relatively well. Andrew Melville, the influential Reformation theologian was Principal of St Mary’s College in St Andrews in 1580, and Rector of the University in 1590. The University was regularly consulted by James VI and I over the union of the Scottish and English crowns in 1603, and St Andrews remained the archiepiscopal seat of Scotland, a position which brought with it much wealth and continued influence.

This was one of the great periods for the study of mathematics and optics in St Andrews, and the tenure of James Gregory as Regius Professor of Mathematics from 1668 to 1674 marked an especially golden time of achievement. In 1679, however, further religious upheaval culminated in the murder of Archbishop Sharp and cessation of the archbishopric at St Andrews in 1697. As a result of these events, the University saw a substantial reduction in its available resources, and the following years brought with them significant challenges and hardships. Nevertheless, as the seventeenth century gave way to the eighteenth, the University continued to endow new Chairs and develop and strengthen the existing curriculum. To give just two examples of innovation at this time – in 1722 Thomas Simson was appointed to a new Chair in Medicine and Anatomy, and Robert Watson, Professor of Rhetoric, was one of the first in the world to teach English literary criticism with a series of lectures delivered between 1752-1756.

The early decades of the nineteenth century were marked by considerable investment by town and University alike; innovation manifested itself practically in substantial improvements in the provision of public health amenities.
and intellectually with the creation of the Literary and Philosophical Society of St Andrews whose members were drawn from the academic and wider local communities. The University pioneered the study of the physics of light with the appointment of David Brewster as Principal in 1838, and it had a leading role in the discussion of the natural history of creation and in the development of photography. The University was at the vanguard of the provision of tertiary education for women, and the first female graduate, Agnes Blackadder, received her degree in 1895. The appointment of James Irvine to a professorship in Chemistry in 1909 brought pioneering research in carbohydrate chemistry to St Andrews and marked the beginning of a new era of research growth and excellence that continues to this day.

The University is small with 500 academic staff and 8,000 students, but it has a strong record of close collaboration between disciplines and in identifying niche areas where it can make leading contributions. It has evolved far beyond its mediaeval remit to encompass 18 academic Schools and 50 Research Centres and Institutes working at the cutting edge of knowledge and understanding. St Andrews has garnered an enviable reputation both for the vigorous variety of scholarship undertaken here, and for the symbiosis between research and teaching, which gives students access at every level to ground-breaking ideas, even those still in development.

Academic staff consistently bring research into the classroom as, for example, in first year undergraduate modules on Great Ideas, in which experts from all faculties address the ‘canon’ of modern thought, including themes such as ‘logic, reason and evidence’, ‘technology’, ‘human rights and justice’ and ‘matter, the cosmos and their representation in the Arts’. As students advance, they have opportunities to participate in top-level research. Examples range from the engagement of Italian Studies students with the ‘Lectura Dantis Andreapolitana’, a series of detailed analyses of the Divine Comedy, one canto at a time, led by the best Dante scholars from around the world; to the numerous study days, publications and research symposia organised by undergraduate committees in (amongst others) International Relations, Art History, and Economics; and the Physics & Astronomy Observatory Programme, which encourages participating undergraduates to measure the size of exoplanets.

### The St Andrews Experience

The University typically has a student body of approximately 8,000, of which more than 12% are research students. National and international student surveys consistently rank St Andrews as one of the best places to study in the UK, or indeed in the world. Scattered across a sea-bound mediaeval town, the University occupies a beautiful location overlooking St Andrews Bay and commanding distant views to the great massif of the Cairngorm mountains. Many of its science units overlook the famous Old Course which holds a unique place in the history of golf. The size of the University and the town, and the presence of a School structure make it easy for students to feel part of the academic and local communities. Regular teaching from academics who are world-leaders in their field also contributes substantially to the make up of an unparalleled educational experience which builds on the great Scottish tradition of the four-year first degree and fosters close links in research and teaching between the Arts and Sciences.

The composition of the student body is unique, roughly one third of its students are Scots, one third from the European Union (including England) and one third international students. This cosmopolitan population produces a stimulating and challenging social and intellectual atmosphere in which to learn and grow.

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**From A Rector’s Memory by Rudyard Kipling**

Though a stranger shall he understand,  
As though it were old in his blood,  
The lives that caught fire ‘neath Her hand –  
The fires that were tamed to Her mood.  
And the roar of the wind shall refashion,  
And the wind-driven torches recall,  
The passing of time and the passion  
Of youth over all!

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600 Years of Research and Teaching / 17

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Religion and belief continue to play immensely significant roles in the world today. Zealously championed by some and no less fiercely opposed by others, religious faith exercises a profoundly powerful impact on the ideas, behaviour and aspirations of millions of human beings. For good and for ill, it affects social and political structures, local and international relations, education, commerce, the arts, and popular culture – just as it has done for centuries.

At St Andrews, researchers are exploring the logic, resources and effects of religious faith in a wide array of contexts. With its long and distinguished history as a centre of excellence in Divinity, and in keeping with the genesis of the University in the remarkable educational ambitions of Scotland before and after the Reformation, St Andrews has natural strengths in the study of the history, thought and practices of Christian faith in particular. St Mary’s College, established in 1539, has been the academic home of some of the world’s leading scholars and thinkers in the fields of biblical studies, Christian theology and history. These researchers have probed the texts, traditions, arguments and activities of Christian belief across the ages – their long and complex histories in the ancient Near Eastern and Mediterranean worlds; their expression, interpretation and influence over the centuries; their interactions with other faiths, philosophies and ideas; their transmutations and impacts under the forces of modernisation and globalisation; their enduring intellectual and cultural pertinence in a postmodern, pluralist world.

Divinity in St Andrews has its roots in deeply formative traditions. But it is far from narrow in its preoccupations or insular in its methods. Here, the discipline has long been a self-consciously expansive affair, interested in tracing the ways in which faith, ritual and practice reflect all manner of human investments, and might be said to contribute to all kinds of human flourishing. Scholars have sought to pay attention to the particularities of these forces – to do justice to the specific structures of ancient Israelite history and religion; to explore the literatures of Jewish, early Christian and other beliefs in the realities of their original contexts; to assess the evolution and nature of theological claims in a world of many different convictions, religious and otherwise; to investigate the grey areas as well as the sharp edges of intellectual and spiritual history; to locate faith and its expressions at every point in the density of social and political circumstance.

Yet all this demands study on a large canvas. The breadth and depth of Divinity’s research strengths can be glimpsed in its array of activities, and the flourishing intellectual community they represent. The areas of interest naturally include classical territory – the advanced study of biblical and cognate languages and texts; the investigation and reconstruction of Christian origins; systematic, historical and pastoral theology; the study of church structures, rituals and worship; and contemporary developments in the hermeneutics of scripture. The results embrace definitive studies of ancient texts, exciting reappraisals of historical influences, and different approaches to doctrinal debates or ethical questions. They frequently involve fresh ways of assessing material, such as the use of performance studies in the reading of the gospels, or the deployment of social-scientific categories or political-cultural models in the interpretation of early Christian epistles.

But there are also whole new spheres of enquiry being developed – the relationship between theology and the arts, and the roles played by imagination in human aesthetic and creative engagement with the world; the articulations of religious experience in culture, ‘popular’ as well as ‘high’; the nature of human personhood, and the implications of a theological anthropology for contemporary debates about religion, ethics and science; theology and the environment, including questions of sustainability; the roles played by digital technologies and surveillance practices in today’s societies, and how these might be assessed in terms of human identity and current perspectives on social relationship, privacy and visibility; the study of religion, politics, nationalism and identity in specific historical settings – Latin America, Africa, Tibet, Scotland, the UK. Researchers at St Andrews are breaking open fresh and exciting areas of knowledge, and offering vital assessments of the remarkable impacts of religious faith – not only in texts, practices and structures from the past but also in today’s world.
Ivor Davidson — Divinity

I work in systematic and historical theology. I am interested in the formation and logic of Christian doctrine, particularly the interrelations between accounts of God, Christ and salvation in theological reasoning. I explore some of the ways in which theological arguments take shape in early Christian and later settings, and the effects of cultural circumstances on the articulation of faith. But I am also fascinated by the capacity of Christian theology to challenge as well as be formed by its environment, and by its obligations to be at once open and engaged, transformative and countercultural.

Kristin De Troyer — Divinity

There is nothing more amazing than working with biblical manuscripts. My research on Old Greek papyri, especially the Martin Schoyen codices of Exodus, Leviticus and Joshua, helps to outline the history of the biblical text, and to fine-tune the debate about the Bible’s uniformity and pluriformity. I have addressed some of the challenges posed by multiple texts in my studies of the books of Samuel and Kings, and I have a major interest in a series of other seemingly innocent – but actually pretty complex – biblical books, such as Esther and Ezra-Nehemiah. All the details help to assemble a remarkable picture of Second Temple Judaism.

Kelly Iverson — Divinity

My current research focuses on exploring the New Testament gospels within the context of ancient media studies in order to understand how a performance is something “palpably different... [than] turning pages in a detached textual artefact” (John Miles Foley). The aim of this research is to provide critical argumentation that justifies such a hermeneutical shift and to locate the discussion in conversation with broader fields of enquiry. It is also to offer specific methodological tools that can be utilised and applied to biblical studies and to demonstrate the interpretative difference that performance makes in opening fresh avenues of enquiry.

Grant Macaskill — Divinity

My current research involves the systematic examination of the theme of ‘union with Christ’ in the New Testament, against the background of Early Jewish and Classical thought. This study is unusual in two regards. First, it is concerned with the points of contact that exist between the various New Testament writings, where most contemporary research is focused on individual authors and books. Second, it affirms the necessity of systematic and historical theology to the enterprise of biblical studies, since those disciplines employ precise categories and concepts without which biblical scholarship is at best crude and at worst misleading.

Eric Stoddart — Divinity

I have just published the first extended theological consideration of contemporary surveillance practices, ranging from CCTV systems, through commercial data-collection and analysis, to peer monitoring via social networking sites. I enhance the notion of a right to ‘privacy’ with a new concept, (in)visibility, understood as skill in negotiating how we are seen in social space. By using a critical ethics of care to interrogate ‘risk’, I engage with a culture of fear and its ideological underpinnings. Deploying the theme of the ‘crucified God’, I seek to reframe traditional Christian theological notions regarding God’s surveillance of humankind.

Tom Wright — Divinity

What holds together a community without traditional ethnic boundary-markers? Faith, said the apostle Paul – the fresh revelation of Israel’s God in the Messiah, Jesus, crucified by imperial authorities but raised from the dead. ‘Theology’ for Paul was not an abstract study, but feet-on-the-ground prayer, thought, teaching and practice, rooted in scripture and extending outwards – as scripture itself promised – to the world. To study Paul is to see him using this theology to maintain the unity and holiness of these communities, thereby articulating a worldview to outflank the philosophies of the day and evoking a loyalty to Jesus to trump that demanded by Caesar.

The Bible, that is, the holy Scriptures (London [Amsterdam], 1599), bound with the metrical Psalms (Edinburgh, 1640), in an embroidered red velvet chemise
For many years, the University of St Andrews has pioneered world-leading research and teaching in these interlinked areas, across a variety of disciplines and through the development of diverse approaches to these important subjects. Historians, psychologists, philosophers and theologians have all made powerful contributions, and the School of International Relations has provided a particular centre for research and teaching in these fields of war, terrorism, International Relations and society. St Andrews scholars have helped to explain why and how religion has remained so persistent a force in moulding various competing kinds of politics; to show how distressingly explicable have been our violent attempts to resolve cultural and political differences; to account for those cases in which political violence has been successfully ended; and yet to explain our depressing failure to achieve peaceful solutions more speedily and effectively than we have done in the past.

In all this, three main elements determine the approach to work in these fields at the University. The first is the profound link at St Andrews between research and teaching. Whether at undergraduate, MLitt or PhD levels, the teaching and supervision by St Andrews scholars is emphatically research-led, with the academics’ own original research feeding into the teaching of their students, but with the students’ perspectives also illuminating the research culture in important ways.

Second, there is a commitment at St Andrews to pluralistic approaches to intellectual inquiry: the study of war, terrorism, International Relations and society at St Andrews is determinedly interdisciplinary, and many interpretive frameworks are evident in the work of scholars at the University in these fields, as is evident in the individual case studies featured here. Just as the linkages between different phenomena — violence, the ending of conflict, economics, religion, nationalism, the nature of the state — are central to our work, so too the various insights distinctively brought by different disciplinary approaches are all cherished, and exist in fruitful dialogue with one another at the University.

Third, there is a distinctively international — indeed global — dimension to our work on these subjects. Just as the scholars and students come from an enrichingly diverse range of international contexts, so also the topics studied and researched, and the academic and practical influence of our work in these areas, are global in reach, attitude and scope. We engage with other leading scholars from around the world on a frequent basis, and the largest and most urgent topics are the ones on which we aim to define scholarly debates. The work of the people focused here in this thematic summary testifies to the highly ambitious nature of scholarly work at the University.

Our aim is to provide durably powerful and innovative research, and to offer our students an experience which reflects our own commitment to pioneering scholarship, and to life-changing teaching in one of the world’s most prestigious universities, as we aim to address subjects of the highest significance.

United Nations Building and the Sphere within a Sphere
John Anderson – International Relations
I am interested in the complex relationship between politics and religion in the developed world. For many in the USA, only re-discovery of the country’s religious heritage will enable it to remain a great power. In Europe, the leaders of the Roman Catholic Church fear that refusal to include explicit references to Christianity in the EU constitution has contributed to undermining a strong moral, spiritual base to the European project. In post-communist Russia, leaders of church and state have sought to provide a new value base for a country that has rejected its communist past.

Gerard de Groot – History
‘How easy it is to kill.’ So said a physicist after Hiroshima. The flip side is: ‘How hard it is to make peace.’ These two statements bookend my research. Everything I have done is contained within. My work on the twentieth century has revealed how easy is the turn to violence, especially when science lends a hand. My research in peacekeeping has shown how difficult it is for nations to emulate every individual’s capacity for good.

Richard English – Centre for the Study of Terrorism and Political Violence
How should we respond to terrorism? After 9/11, many state policies were hampered by amnesia (a failure to remember and learn from our past experience), and by a failure of intimacy of understanding (why did so many normal people carry out such abnormally brutal violence?). My work has engaged with terrorism through understanding its long historical roots, and through first-hand research with people who have actually been involved. It suggests that our response too often relies on militarisation and political misdiagnosis, and too little on legal orthodoxy and high-grade intelligence, for it to work effectively in combating terrorist threats as well as we might.

Karin Fierke – International Relations
My earlier work on language and security has developed over the last decade to address questions of trauma, emotion and memory as they relate to political violence and war. I have published work on topics such as Trust and Terrorism in Northern Ireland, Humiliation and Political Violence in the Middle East, and the role of memory in the Israeli/Palestinian conflict. My current project focuses on Self-Sacrifice, Agency and Emotion in Global Politics, examining a range of forms of political self sacrifice, from suicide terrorism to hunger strikes to self-burning and non-violent martyrdom.

Sibylle Scheipers – International Relations
My research focuses on legal constraints on warfare and irregular fighters. It traces the development from the exclusion of ‘savages’, rebels and rioting peasants to the emergence of the ‘unlawful enemy combatant’. My research is intended to unearth the subsequent layers of moral and legal reasoning linked to irregular fighters and how they impact on the contemporary discourse surrounding insurgents and terrorists. It refutes the frequently voiced concern that the law of armed conflict is outdated, as it was made with a view to conventional wars and regular armies. The law was created precisely as a response to the challenge of irregular fighters, though the legal answers to this challenge evolved over time.

Rashmi Singh – Centre for the Study of Terrorism and Political Violence
My areas of interest include the role of nationalism, culture and religion in the promulgation of terrorism, most particularly suicide terrorism. I work on the violent groups engaged in campaigns of national independence like Hamas, LTTE, for example, and transnational terrorist groups Al Qaeda and Islamist proxies Lashkar-i-Taiba, Jaish-e-Mohammad. I have developed a conceptual frame of analysis for suicide attacks in the Israeli-Palestinian conflict. Using the concepts of rationality, nationalism and political Islam I seek to explain how and why suicide attacks emerge and disappear in scenarios of sustained conflict and why groups like Hamas resort to and move away from such forms of violent engagement.

Andy Williams – International Relations
My career aim is to develop a greater awareness among scholars of International Relations of the historical antecedents of much of what passes for received wisdom in the field. This has meant continuing to write ‘proper’ international history, mainly to do with Great Power relationships in the twentieth century, while also using the forensic tools of the historian to trace the evolution of certain key ideas and themes of International Relations, with an emphasis on those that pertain to war, conflict and development.

Tim Wilson – Centre for the Study of Terrorism and Political Violence
From Belfast to Baghdad, sectarian conflict has proved a challenge to state-building that large doses of democracy and economic liberalism have not assuaged. Yet, understanding of the dynamics of sectarian violence often remains constrained by a liberal condescension that sees such conflicts as politically unintelligent and unintelligible. My work presents sectarian conflicts as total systems in which none can feel safe because all are potential targets – a state of affairs easily deplored, but not transcended.
Life has existed on Earth for more than three billion years, a testament to its resilience and adaptability in the face of often-capricious natural processes. How, over that immense time, did Earth’s surface first become and then remain habitable? Can humanity use the ‘laboratory notebook’ of the rock record to identify conditions that controlled past global change and to predict how best to maintain Earth’s wellbeing in the future?

The town of St Andrews lies at the interface of the land and sea. Researchers here have studied the Earth, its life and oceans for over a century, ranging from the molecular and microscopic to global scales, and from ancient rocks and minerals to living organisms. We are interested in the circumstances that have influenced the pattern of Earth’s evolution as a habitable planet; the growth of the continental crust, the patterns of chemical recycling through the hydrosphere, atmosphere, and oceans, and the conditions under which Earth’s biosphere evolved and responded to sudden and prolonged environmental crises throughout its history. Accurate reconstruction of past temperatures is critical for understanding how and why past climates varied and for predicting twenty-first century climate change.

The CO₂ content of the atmosphere is linked to the acidity of the oceans, and to the conditions under which carbonates form. As part of an international team we have shown that these can now be unravelled using changes in the stable isotopes of carbon, oxygen and boron in ancient carbonates, and they highlight the robustness of global environmental systems that have recovered from significant changes in past acidity and alkalinity. New techniques have been developed to interrogate mineral archives, such as zircon, as to when and how the continental crust was generated, and these techniques are also being applied to new studies into the causes of the increase in oxygen in the atmosphere, on which we now depend. A new centre interested in the formation of economically viable deposits of rare elements has been set up, in parallel with a new programme into the potential of geothermal energy sources.

The ocean presently covers almost 75% of Earth’s surface and it plays a central role in regulating the habitability of the biosphere. A major research goal is to provide innovative solutions for sustaining the integrity of the ocean in the face of pressure from human exploitation. Current systems of fisheries management have been shown to lead to over-exploitation and our research shows that adoption of the rules used by natural predators are more likely to lead to sustainable fisheries. We design and build instruments that we attach to marine mammals, and to unmanned vehicles, that provide information about the ocean climate and the way in which organisms respond to changes and to human activity. We study the effects of sound in the ocean because many important marine organisms use sound to visualise their environment in the same way as terrestrial organisms use light. Some estimates suggest that man-made sound in the ocean, from ships, sonars and industrial activity is doubling every decade and we have shown that in some locations this has exceeded the thresholds that stress organisms. Other leading research includes studies of the molecular structure of fish muscle aimed at improving productivity in aquaculture, the development of methods for assessing the risks to marine wildlife from major offshore industrial developments like wind, wave and tidal energy, and understanding the dynamics of zooplankton communities at the scale of the whole ocean.

This diverse range of pure and applied research allows us to provide new perspectives on the governance and management of the ocean, recognised by the award of the Queen’s Diamond Jubilee Anniversary Prize in 2011. Looking at processes in the geological record and the sea, St Andrews’ researchers have championed a holistic approach that balances innovative explorations of processes at small scales with large-scale perspective necessary to understand Earth’s interactive systems.
The chemistry of the carbonate skeletons of marine organisms is an archive of past environmental conditions and seawater temperatures. We have shown that skeletal chemistry is also affected by biological (relating to the organism) and kinetic (relating to crystal growth) processes, which may distort any environmental signal. We seek to identify the key processes which control the chemistry of tropical coral skeletons by culturing corals and monitoring and manipulating their metabolic and growth processes. We are developing methodologies to correct for biological and kinetic effects, allowing the accurate interpretation of past climates from fossil coral specimens.

**Nicky Allison – Earth Sciences**

**Lars Boehme – Scottish Oceans Institute**

The polar oceans play a pivotal role in the Earth-climate system. They support globally important fisheries and ice-dependent polar seabirds and mammals, from penguins to polar bears. Studying these parts of the oceans is difficult and expensive and so we use animal-borne technology to measure the changing polar environment and, at the same time, animal behaviour. Sensors carried by animals show the sensitivity of top predators to climate change and allow us a view beneath the waves. We have established where some of the coldest liquid water on the planet is created, which is partly responsible for driving the global circulation of the oceans.

**Ian Boyd – Scottish Oceans Institute**

Seals and whales are a barometer by which we can measure the sustainability of human influence on the ocean. They eat the same seafood as we do and they have similar physiology and complex social structures to humans. If they are sustained then the ocean is a healthy place for us. I am quantifying the functional relationships between these animals and changes in their environment brought about by human activity. This shows, for example, if we catch fish in the kinds of quantities that we do at present we can expect this to affect the structure and function of marine ecosystems.

**Peter Cawood – Earth Sciences**

The continental crust is the archive of Earth history. To understand how the Earth has evolved over 4.5 billion years to form the environment we live in and the resources we depend on, we need to understand and interrogate the rock record. Critically, this record is episodic with ages of rock units and events distributed about a series of peaks and troughs that in part correspond with the cycle of supercontinent assembly and dispersal. Our work is showing that these well-established peaks of ages do not represent the rate of crust generation, which we can show is continuous, but are an artefact of preservation.

**Maria Dornelas – Scottish Oceans Institute**

Coral reefs are enormous geobiological structures, which harbour thousands of species, provide the main source of protein for over 300 million people, and sustain a multi-million pound tourism industry. I study how hundreds of coral species coexist, share resources and build these structures – the reefs – that sustain one of the most diverse ecosystems on earth. For this we need to quantify the abundance, distribution and life history of species and functional types of corals. This knowledge helps predict how reefs respond to disturbance such as cyclones, disease and warmer ocean temperatures.

**Tony Prave – Earth Sciences**

Of the many events that shaped the co-evolution of Earth and life, two stand out: the transformation of Earth from an anoxic to a uniquely oxygen-rich planet, and Earth’s descent into and recovery from the ultra-severe global glaciations known as Snowball Earth, and the subsequent advent of animals. We document and interpret sedimentary rocks that record those hallmark time periods: A combination of field geology, geochemistry and stable isotopic datasets are used to construct and test ideas about cause-and-effect relationships, their timing, and how geobiological events combined with physical processes to modify Earth’s surface to being habitable.

**Tim Raub – Earth Sciences**

Biomineralisation, the protein-controlled synthesis of different minerals that enhance organismal fitness for natural selection, is the most direct expression of geobiology. Some bacteria and most Orders of animals use biological magnetite to migrate efficiently. Others mineralise sulphides or carbonates as metabolic waste depositories. These crystals survive for billions of years as indicators of water column chemical crises, atmospheric compositional change, and biospheric innovation. Microscopic eukaryotes and animals mineralise skeletons and predatory apparatuses in an ever-escalating ‘evolutionary arms-race’. We investigate mechanisms of biomineral growth, the significance of chemical traces, and the patterns of biomineral change during mass extinctions and global warming events.

**Luke Rendell – Scottish Oceans Institute**

As products of life’s evolution on Earth, humans have some unique features, for example complex language and culture. I am interested in how similar cultural features are distributed across other species. In whales and dolphins we find examples of both complex communication and apparently widespread social learning, a simple form of culture. I study the communication and societies of sperm whales, the largest of the toothed whales, showing how long-lasting social groups use distinctive vocal dialects. This demonstrates how evolution can produce solutions to life’s challenges that are surprisingly convergent between land and sea.
Energy and sustainability are more important today than at any time in history. Interest in the former is driven by the inexorable rise in global energy demand, increasing energy insecurity and the threat of global warming. Interest in the latter arises from the implications of climate change for societies, politics and economies, raising questions about equity, justice and the social acceptability of proposed technological solutions. The St Andrews Sustainability Institute provides a focus for interdisciplinary research at the University and a spark-point for new collaborations across the whole breadth of sustainability. It explores the complex issues behind what we mean by prosperity, how the transition to sustainability might come about and different ways in which knowledge from a variety of disciplines might shed light on such debates. Climate change adaptation strategies, current and future, open new questions for research such as social and environmental resilience or procedural and distributive justice.

Addressing the long-term challenges of transforming the electricity grid from one based on fossil fuels to electricity generated by renewables (wind, wave, solar) and transforming transport from its dependency on fossil fuels, requires the exploration of new concepts, the development of new understanding and the investigation of new ideas; in short it requires research. Of course such research alone is not enough but must partner with engineering and technology in academia and industry, as well as engage with public bodies. St Andrews recognised the importance of energy-related research long before it became fashionable. We invested in establishing research groups in Chemistry, on electrochemical energy conversion and storage, specifically lithium batteries and fuel cells, and in Physics on solar energy. These activities are united by a common theme, recognition that materials chemistry and physics holds the key to advancement in these fields.

The rechargeable lithium battery is the most successful electrochemical technology of the last few decades. 12 billion cells are manufactured annually, representing a US$ 3 billion industry. The positive electrode in almost every rechargeable lithium battery manufactured to date (lithium cobalt oxide) was developed in the UK and we continue to innovate. The rechargeable lithium battery has transformed portable electronics (mobile telephone, iPad and laptop). New generations of such batteries are required for the electrification of transport and the storage of renewable energy. Research at St Andrews explores new materials as negative and positive electrodes, and as electrolytes, electrode materials that store more energy, deliver energy faster, are able to sustain more cycles and longer life at lower cost and with enhanced safety. New concepts under investigation include the lithium-air battery with a theoretical energy storage tenfold greater than the lithium batteries of today and hence capable of transforming energy storage.

Fuel cells and lithium batteries are highly complementary electrochemical technologies. Unlike a battery, the fuel (e.g. hydrogen) is stored externally, the fuel cell acting as a reactor converting the fuel to electricity. Fuel cells will find application in many fields including electric transport, grid storage, off-grid electricity generation in domestic or remote locations and can significantly enhance utilisation of renewables, or indeed waste. Research at St Andrews is tackling established challenges in novel ways, such as hydrogen storage in ammonia and new photocatalysts for hydrogen generation from sunlight. In addition, new concepts in fuel cells, such as solid carbon as a fuel or reversible fuel cells, are being pursued, as well as generating synthetic fuels from excess renewable electricity whilst simultaneously capturing carbon dioxide.

Solar power is by far the most abundant renewable energy source. The conversion of solar energy to electricity can be achieved directly in solar cells or electrochemical solar cells, or indirectly by biologically inspired approaches. The first of these categories is, perhaps, the most intensively pursued, with mass market application. However, such devices are dominated by hard solids, mainly silicon, and their use is limited by their high cost. We are investigating soft, hence flexible, polymeric semiconducting materials capable of converting sunlight into electricity. We are addressing the challenges of increasing conversion efficiency and long term stability. The promise is of a shape-variable solar material that could be moulded with a variety of curvatures and would be inexpensive and of low toxicity compared with current thin film solar cells.
Jan Bebbington – Management
I work on how to realise low carbon economies. A number of studies into emission trading schemes have shown how organisations are reflecting these schemes in their financial and non-financial reporting, and the way in which governance regimes are failing to emerge in time to respond to these regulatory changes. I have looked at how organisations are responding to climate change, and governance regimes designed to address climate change. This points to a need to support organisations to make step-wise transitions in how they conceptualise their core business activities which itself has the potential to radically alter their energy needs.

Peter Bruce – Chemistry
We have synthesised new nanostructured materials, nanowires and nanotubes (e.g. TiO2), as well as mesoporous solids (e.g. LiMn2O4). These compounds embody, in one material, nano and micron dimensions. We are investigating if these multi-dimensional materials possess exceptional properties as lithium battery electrodes. Replacing liquid electrolytes with solid polymers is a Holy Grail in the field. Most polymer electrolytes are amorphous, viscous, liquids. We discovered crystalline conducting polymers and are studying the mechanisms of conduction and their exploitation. The lithium-air battery can take energy storage far beyond the horizon of today’s lithium batteries. Work at St Andrews is focused on understanding the chemistry and electrochemistry that underpins this device and by so doing optimise its performance.

John Irvine – Chemistry
Fuel cells seem certain to make a significant contribution to the future energy economy. Future development relates to efficient electrolysis, novel systems and carbon neutral fuel production. Efficient electrolysis to produce clean hydrogen is of key importance to the possibility of utilising renewable energy in transport. Similarly, reversible fuel cells with careful thermal management can provide good buffering for intermittent power supplies. Discovery of new materials is important to achieving new, more efficient, technologies and the development of alternative systems. The efficient conversion of carbon dioxide or nitrogen to useful carbon-free fuels is perhaps our ultimate goal.

Darren McCauley – Geography & Sustainable Development
The true impact of climate change is felt across the whole energy system. A sustainable energy future involves security, justice and equity between and within each energy system. I am investigating the challenges facing the future security of the UK nuclear energy sector and coastal energy supply as a result of changing patterns of temperature and rainfall, sea-level rise and storms. The issues surrounding nuclear energy and policy are highly topical and crucial to our future electricity generating strategy. We are also investigating discourses of energy justice in Europe and the US (EPSRC) and public opinion on waste-to-energy plants in Europe (British Academy).

Charles Warren – Geography & Sustainable Development
A key barrier to the rapid expansion of renewable energy is social unease about the installation of renewable energy infrastructure in the (often) unspoiled landscapes where the best resources are to be found. Focusing on onshore windfarms, my research into the spatio-temporal patterns of opinion formation and change has explored the nuances behind the polarised media portrayals of the issues, in particular the significance of different modes of ownership and governance influencing public attitudes. A current project on the attitudes of land managers to new policies promoting energy crops is investigating the ‘policy disconnect’ between top-down policy formation and stakeholder delivery.
How individuals are defined and understood – their capacities, responsibilities, behaviour and relationship to their wider environment – is a focus of research at St Andrews. Identities are analysed in contexts that range from the social to the cultural, linguistic and organisational. The aim is to gain insight into how people are classified, join or are excluded from social groups, positively attract each other or negatively discriminate against each other. The resources they use to express identity positions are studied through a range of theoretical perspectives, applied to matters as diverse as rhetoric, performance, mythological systems, apparel, artistic production, negotiating tactics and the social construction of identity.

Research findings explain the nature of social bonds which develop when there is a shared sense of fate or direction and integrating ties between self-identity and collective identities. Research emphasises the degree to which social relations can be founded upon difference and partial communication; societies and communities can be conceived as organisations of diversity as much as uniformity. Integrating ties are brought about through social practices that symbolise place within community, dialogue in which individuals influence and are formed by their community and leadership that plays a role in a process of framing social identity. The outcomes relate to how cohesive and resilient communities can be fostered, how knowledge and understanding can be shared in communities, how that knowledge sharing can transform the community, and what it means to take an ethical position in society.

As well as generating theoretical insight, research outcomes have had an impact on the lives of individuals and communities. Understanding the roots of individual identity and collective behaviour has influenced policing policy across the UK and Europe with regard to the role of police in communities and informing specific actions such as crowd management. Equally, understanding the ways in which rundown neighbourhoods can be restored and new sustainable places built has influenced policy and design and investment in housing provision.

Analysis of the nature of leadership, showing the way that creativity can be fostered rather than frustrated through the way companies are organised, has influenced creative companies where there is a dual role in artistic and organisational leading. Tracing the flow of knowledge in professional networks, for example in healthcare and retail, has led to a questioning of the efficacy of best-practice-mimicry and replacing this with an understanding of professional practice as essentially innovative, hence requiring creative skills. Research on sustainable business has impacted on reform of banking and investment, governmental policy towards community-accountable forms of management as well as corporate behaviour and reporting. Sustainable development research conducted in collaboration across multiple disciplines has focused on how individuals and communities can make responsible use and conservation of resources through recognising environmental impact in accounting techniques and providing examples of re-prioritisation in communities. As well as being global we are also local, studying the nature of Scottish identity and how it shapes values and priorities as a nation.
Nic Beech – Management
Who we are in the world and how we impact on others are concerns that shape our understanding of organisations. The relationship between who we are and what we do can be understood by analysing the stories we live through – our unwritten autobiographies and the aspects of self that appear in other people’s stories. Our storied sense-making enables new practices and foster relationships, constrains action and embeds conflict or sometimes results in self-frustrating and paradoxical situations. My research with musicians, creative organisations and businesses undergoing change identifies possibilities for re-narrating experience, changing the flow of stories and fostering the conjunction of organising and creative practices.

Huw Davies – Management
Exploring how to create and share knowledge between the academic and wider communities is an important part of my research. What shines out from the research is the importance of dialogical relationships – the notion that knowledge construction and sharing are deeply social processes, shaped by values and passions as much as they are by technical expression. Learning about the relationships between research data, and what is counted as evidence and knowledge, and seeing how such knowledge can flow or get stuck, has helped shape government thinking on reordering public services including healthcare, education and policing.

Colin Hunter – Geography and Sustainable Development
We are interested in how the costs and benefits of natural resource use are distributed across societies, how individuals and groups might behave in more environment-friendly ways and adapt to environmental change. This relates to how decisions are taken and policies formulated by international, national and local governments and agencies that impact on the well-being of individuals and groups. Running through this research is a keen commitment to working with local communities, from Fife to Ecuador, South Africa and the Solomon Islands, to generate knowledge together that enables people to live better and more sustainably.

Duncan Maclennan – Geography & Geosciences
The major global changes in society, the environment and the economy impact not just the nation but cities, neighbourhoods and rural hinterlands. Each of the places has different capacities to create change and to be flexible and resilient in the face of change. Connecting the local and the global is about the big policy outcomes of competitiveness, sustainability, cohesion and inclusion. Addressing our key challenges requires connecting global and local through choreographing our understandings of how different sectors, health, housing, employment interact to fashion better outcomes. Understanding place as central to the well-being of individuals and communities, and improving policies, lies at the heart of what human geography does.

Nigel Rapport – Anthropology
The individual transcends the state insofar as one is a concrete living entity and the other an abstract or symbolic one. Only human individuals live. And yet we are often carried away by our own abstractions; especially when it comes to evocative terms such as ‘community’ or ‘religion’ or ‘nation’ or ‘race’. But the same truth applies: the individual human life always transcends these; their existence is only justifiable as long as they further individuals’ fulfilment and dignity. My work considers society as a moral space in which the ontology of individual human capacities for dignifying their own lives can be given its fullest recognition.

Steve Reicher – Psychology
The question of social identity – of who we are – and how it relates to what we do together is endlessly fascinating. A sense of shared identity is the glue that binds people together and enables them to work effectively together. At the same time, identities create boundaries between people, lead to social exclusion or even hatred against the ‘other’. To understand the dynamics of social identity is therefore crucial to building a society that is cohesive but not exclusive, resilient but not reactionary. To master these dynamics is the key to promoting behavioural change in areas as diverse as energy conversation, healthy eating and equal rights.

Katherine Hawley – Philosophy
How do we collectively generate and share knowledge? Philosophers have traditionally taken the individual as the prime location of knowledge, but the development of big science and instant communication means that we must rethink this approach. My work on trust and distrust raises ethical issues about sharing knowledge – when can we trust one another, and how? How do we damage ourselves and others if we over-trust, or if we allow our prejudices to limit our trust? The nineteenth-century term ‘epistemology’, or theory of knowledge, was coined by James Ferrier as Professor of Moral Philosophy at St Andrews; we are proud to continue his work today.
For over twenty centuries Mathematics has provided theoretical, abstract tools by means of which thinkers could turn their ideas into precise form, and subject them to rigorous examination. Rigour and precision have long made it the language of choice for natural sciences. Time and again, unexpected branches of Mathematics have provided foundations on which whole new disciplines are built. In addition to its classical preoccupation with numbers and equations, modern Mathematics is also concerned with qualitative descriptions, often involving patterns, symmetries, and intricate networks of relationships. This has made Mathematics relevant to an even wider range of disciplines, including genetics, linguistics and social sciences. And because of this dual character – a purely theoretical discipline which nevertheless is at the core of scientific rigour in our attempts at grasping the reality – Mathematics has always been in dialogue with Philosophy.

The rise of computer technology has had a major impact on sciences and all other aspects of our lives. Today, use of computers enables scientists to test their models on large amounts of data, and see how well they fit reality. It has enabled mathematicians for the first time to adopt a more experimental approach to discovery: an intricate hypothesis involving natural numbers, checking of which for anything other than a few small cases is entirely beyond human brain’s computing power, can now be tested within seconds on millions of cases. As is typical of interactions between Mathematics and other disciplines, this has turned into a two-way dialogue, whereby Mathematics provides the key notions and methods for the foundational theory of computing.

Mathematics research in St Andrews reflects the full spectrum of contemporary trends mentioned above. The Statistical Ecology Group develops and uses state-of-the-art statistical tools to model a variety of natural systems. They are world-leaders in estimating population sizes and development of associated computer packages, such as their Distance Sampling software. The distance sampling methods are widely used for wildlife management, for example to monitor populations of antelope, bears, deer, elephants, gamebirds, primates, songbirds, seabirds, seals and whales. Their interdisciplinary expertise has an impact on conservation policies / management, and is used by governmental organisations to inform the decision and policy making.

The Vortex Dynamics Research Group considers the ways in which large-scale coherent circulation patterns in the atmospheres and oceans, such as the atmospheric jet stream, the ocean Gulf Stream, or the visible bands on Jupiter, co-exist alongside comparatively unstructured turbulent motions. This typically involves a simplification or reduction of the full problem into one that contains only the core physical processes, but which is more amenable to numerical or analytical solution. Work has focused on how different forms of external forcing mechanisms, and the intensity of that forcing, influence the character of jet-like structures, from wavy and meandering to straight and narrow.

Research into abstract patterns and configurations includes Combinatorics, Group Theory and Fractal Geometry. Researchers have developed rigorous foundations for the theory of multifractals, where a single mass or energy distribution gives rise to a whole hierarchy of fractals. They have developed intricate calculations to calculate the ‘dimension spectra’ of many multifractals such as arise in natural phenomena, which in turn give an insight into the structure and behaviour of the phenomena themselves. Complementing this, there is vigorous research into various algebraic objects which exhibit a fractal structure or behaviour.

Computational methods are intensively used in all of these activities, providing a common thread for our research effort. With colleagues from Computer Science we have an interdisciplinary research centre for computational algebra. Part of the Centre’s remit is the development of the GAP package (www.gap-system.org) freely available to the academic community. On the foundational level we engage in study of automata and languages, and their algebraic counterparts – semigroups. Our research into semigroup (and group) presentations, or generators and relations, is a key example of a classical mathematical trend: how can infinite objects be described by finite means, and what can (or cannot) be deduced from such descriptions. Our expertise in linking automata and semigroups has recently found a new application in the theory of permutation patterns, with applications for queueing and sorting problems.
Foundational work in Philosophy is concerned with the logicist programme in Arithmetic and the theory of logical consequence. The former was abandoned after the discovery that Russell’s contradiction follows directly from a very natural principle about class existence. But this principle is not necessary for the deduction of Frege’s theorem: that from a compelling and provably consistent principle about the equinumerosity of concepts and axiomatic second order logic, the standard axioms for Arithmetic follow. This result can be extended to Real and Complex Analysis. The research centre Arché has also pioneered alternative non-classical treatments of logical consequence making it a leading centre in the study of logical pluralism.

Kenneth Falconer – Pure Mathematics

Many natural or scientific phenomena are far from smooth, for example clouds, trees, mountain skylines, topographical surfaces, turbulent fluids, graphs of share prices. Highly irregular objects, or ‘fractals’ as they are known, also arise from a very simple and regular process applied repeatedly. Fractal Geometry can relate the irregular outline on photographs of a cloud with the shape of the cloud itself – important for example in meteorology since the heat absorbed by a cloud (and thus whether it will rain!) depends on its shape. Fractals are a wonderfully visual subject – there is a constant exchange between equations, the irregular figures that they represent and the natural phenomena that they describe.

Ruth King – Statistics

Statistics uses data to find out about phenomena that are clouded by randomness or uncertainty. In statistical inference we try to separate ‘signal’ from ‘noise’ by modelling both. My specific areas of research are motivated by different research questions and different forms of data (for example, ecological, environmental and epidemiological) and hence my research is largely applied and interdisciplinary in nature. I am interested in the development of new and interesting methodology that has clear applications, and yet is mathematically elegant in nature.

Steve Linton – Computer Sciences

I am interested in the virtuous circle connecting mathematics, algorithm development, implementation and experiment. Our GAP software incorporates new algorithms, a testbed for implementations of those algorithms and allows us to make experiments that suggest new mathematical results. New error correcting codes have been discovered, potentially speeding up data transmission over power lines, finite matrix groups in up to twelve dimensions have been classified, and we have worked on the modelling of human fertility. GAP is being re-engineered to use the latest supercomputers, to extend our mathematical results from finite to infinite structures and to generate automatically super-efficient specialised solvers for families of optimisation problems.

Nik Ruskuc – Pure Mathematics

Semigroups are one of the simplest and most ubiquitous abstract mathematical structures. Many familiar mathematical objects – numbers, matrices, functions – come together as semigroups. They provide a crucial link between the theory of computation and one of the key classical mathematical disciplines, algebra. This link enables intricate mathematical study of the frontiers of computability – what is the boundary between problems that can or cannot be treated by computational, algorithmic methods? It gives us a glimpse at the language and theories that will be called for in the future.

Richard Scott – Applied Mathematics

Geophysical fluid dynamics provides the theoretical underpinning for weather forecasting, understanding extreme events such as hurricanes and tsunamis, and predicting long-term trends in the climate. We focus on fundamental issues, developing theories and models that guide more applied work in specialised areas, or establishing simple constraints on the basis of robust physical laws. For me, much of the motivation comes from the satisfaction of reducing highly complex problems to ones containing a few ingredients that capture the essential features of a particular phenomenon, and using these to gain real insights into the physical processes at play.
Creativity is a highly prized value in contemporary society, a trait that must be cultivated if we are to thrive, or even simply survive, in an increasingly challenging world. But what is creativity and how can we nurture it? Does it represent a merely individual achievement or has it a social and cultural dimension? Can it benefit from being managed? Is it a rupture with the past or does it demand a dialogue that inflects rather than abandons tradition? At St Andrews these and other questions about creativity are pursued across a variety of disciplines, including Philosophy, Social Anthropology, Management and Film Studies.

Some of the most creative thinkers have been the great philosophers of the past, and philosophy, in studying their work and aiming to extend, confirm or challenge it in light of our contemporary understanding of the world, seeks both to grasp the creative insights of the philosophical tradition and develop that creative thought in new directions and apply it to new areas. Great philosophers such as Plato and Kant, besides being eminent creative thinkers, have also said much of enduring interest about the nature of creativity; Plato with his view that poetic creativity is a matter of divine inspiration and Kant with his claim that genius is an innate, essentially inexplicable talent that cannot be taught. Recently the study of creativity has re-emerged as an area of research within philosophy, and drawing on the insights of previous philosophers, it also employs findings from disciplines such as psychology, art theory and anthropology, to construct a systematic, philosophical theory of creativity.

Social Anthropology examines the nature of human beings as creative animals, responsible for making sense of the world around them and designing environments in which to live which are at once practical, rewarding, comfortable, satisfying and viable. Human creativity leads to different expressions of humanity in different times and places, as a result of different natural environments, different social organisation, different cultural traditions and different practices and the organisation of festivals; changing business models; and the interrelationship between social, cultural and economic capital that allows creative industries to flourish.

Film Studies explores an art form that has become the primary creative expression of modern life, a medium that is flourishing in nearly every nation in the world. Beginning with the analysis of aesthetic style and the history of innovation in technology, including sound, wide screen, and special effects, Film Studies has begun to develop a varied range of research projects, now encompassing alternative exhibition formats, the role of cinema as a vehicle of geopolitical influence, and the emergence of powerful and compelling film cultures from outside the metropolitan centres. Some of the most powerful work in recent years involves the rediscovery of the lavishly coloured work of early cinema pioneers, such as the films of Georges Méliès featured in the recent film Hugo, directed by Martin Scorsese, works that Scorsese presents in 3D. Rendering some of the earliest works in the history of the medium by way of the most modern technology, Scorsese and Méliès come together here to create an extraordinary moment in which past and present, archaic and contemporary, awaken in each other a fabulous sense of possibility. In a similar way, Film Studies makes the creative process central to our research activity, drawing on the past with the tools of the present.
Stephanie Bunn – Social Anthropology

A great deal of human endeavour is applied to using natural materials, from plants to petro-chemicals, to make artefacts that figure in social relations. This involves skill and creativity in use of resources, engagement with materials and practical dexterity. It is impossible to imagine our human world without such products of creation. The challenge of anthropology, in changing social and economic times, is to understand how such creative activity both draws on the past and builds for the future, as we human beings improvise our way from one set of circumstances to another.

Robert Burgoyne – Film Studies

The study of film brings the entire spectrum of creative expression into view. Our research theme – the Transnational Life of Film – illuminates both the global and the local forms of creativity that are beginning to emerge as the primary cultural documents of our time.

Berys Gaut – Philosophy

What is creativity? Can we explain how creative ideas are generated, or does the apparently mysterious nature of creation mean that we cannot in principle do this? Is creativity a rational or, as its popular linking with madness would suggest, an irrational trait? What is inspiration and what role does it play in the creative process? Is creativity properly contrasted with what is traditional, or does creativity require a tradition to make creative achievements intelligible? Such questions are addressed by the philosophy of creativity, which seeks to understand the concept and nature of creativity.

Nigel Rapport – Social Anthropology

Creativity is an aspect of the process by which human beings make sense of the world and hence make an environment in which to live. The vital question is how best to accommodate an individual’s capacity to author their own identities, worldviews and life-projects in just and global social arrangements, given the diversity of cultural traditions and communities to which human beings would also pay allegiance.

Barbara Townley – Management

With economic imperatives requiring creative solutions in both private and public spheres, we have to ask ourselves: do we have the flow of ideas necessary for new products and services and different ways of working. Do we have the networks, both social and technological, to ensure their quick and effective communication; and do we have the cultural education necessary to ensure we are open to new ideas, appreciating their significance while still respecting what went before? The creative industries have many lessons to teach us in this, both individually and institutionally.
“Considering also the peace and quietness which flourish in the said city of St Andrews and its neighbourhood, its abundant supply of victuals, the number of its hospices and other conveniences for students, which it is known to possess, we are led to hope that this city, which the divine bounty has enriched with so many gifts, may become the fountain of science.”

Pedro de Luna, Pope Benedict XIII of Avignon, 1413