CONTENTS

04. NEWS
The Highlights of Aberdeen Science

06. EVENTS
See What's Going on in the Granite City

07. THE UNTAMING OF THE SHREW
An Interview with Athena SWAN

08. ISSF@ABERDEEN
The Reason behind this Issue

09. SALMONELLA
Lab Rats are Scarce these Days

10. WEARABLES
Are they the Promised Land?

11. CROHN'S DISEASE
Go With Your Gut

12. COLOUR YOUR WAY
Away from Science-Related Stress

14. BUG GRUB
Give that Ant a Chance

15. THE HUMAN GENOME
Don’t Call it Junk No More

16. THE LIFE OF A PROFESSOR
Prof Gordon Brown in Nine Questions

17. BREATH IN
What’s in the Air

18. 6 QUESTIONS ANSWERED
By Dr Angus Macleod

20. FINDING FUNDING
The Eternal Struggle for Cash

21. MEET THE RESEARCHER
And Our New Section

22. PAYNE'S CHAIN REACTION
Roses are red, violets are blue, AU MAG's here with more science for you! It's time for AU Science Mag's annual spring clean. Although we're saying farewell to our editor-in-chief Cara, we are saying hello to Ahmed, who will be taking over her position as co-editor with Laura next issue. And, at the back of our cupboards we've also found the new Spring Wellcome Trust issue!

We’ll be focussing on ISSF-funded research at the University of Aberdeen, for which our writers have been interviewing researchers funded by the Wellcome Trust. To explain the ISSF and its instrumental work, we have Professor Phil Hannaford on page 8. Before we dive into that however, on page 7 Danny Schnitzler interviews the Scottish representative of Athena SWAN about the fight for equality for women in science. Keep your gloves on, as on page 16 Ali Thomson interviews Professor Gordon Brown from the Aberdeen Fungal Group. If you’re more of a lab rat, on page 11, Frances Vaughan will be talking about Indrani Mukhopadhya’s research on Crohn’s disease. In the Editor's pick, Dr Angus Macleod hangs up Parkinson’s disease to dry in an interview conducted by Laura Machado on page 18. But don’t think we have no mercy, we have included two adult colouring pages on page 12 by Olga Jarosinska in the (rare) case you needed to relax from too much science. We’ve also introduced a new “Meet the Researcher” section in which chemistry lecturer Dr John Plater gives us an insight into the historical research of mauveine dye.

Spring is a time of change, and in this issue our lovely Editor-in-Chief Cara Green will be saying au revoir to her position in the magazine after two stellar years of direction. Luckily Cara will still be around to advise us whilst we continue to grow and change as a magazine. We would also like to say thanks to the Wellcome Trust and in particular to the ISSF for funding this issue through advertisements.

As always, if you want to join our team of motivated science writers and help us make this glossy magazine you’re holding in your hands, you can email us at info@ausm.org.uk or tweet us at @AuScienceMag. Don’t forget to also like our Facebook page “Au Science Magazine”!

Cara Green and Laura Machado Toyos

Editors-in-Chief
ENVIRONMENTAL FACTORS SUCH AS THE ABUNDANCE OF FOOD AND WATER AND ZONAL TEMPERATURE ARE AFFECTED BY CLIMATE CHANGE. SOME MAMMALS IN THE WILD ARE ITINERANT, WITH SOME SPECIES TRAVELLING MORE THAN OTHERS TO SATISFY THEIR NEEDS. CONSEQUENTLY, THE SPECIES THAT ARE CAPABLE OF MOVING TO NEW AREAS CAN COPE BETTER WITH THE CHALLENGES OF CLIMATE CHANGE. RESEARCHERS FROM THE UNIVERSITY OF ABERDEEN IN COLLABORATION WITH SAPIENZA UNIVERSITY OF ROME, THE UNIVERSITY OF LIVERPOOL AND THE CENTRE FOR ECOLOGY AND HYDROLOGY, FUNDED BY THE NATURAL ENVIRONMENT RESEARCH COUNCIL, HAVE DEVELOPED A MODEL BASED ON THE ANALYSIS OF DATA COMING FROM ECOLOGICAL OBSERVATIONS, TO PREDICT THE POPULATION SPREAD OF MAMMALS. THIS NEW APPROACH ALLOWS SCIENTISTS TO CORRELATE SPECIES-SPECIFIC DISPERSION RATES WITH CLIMATE CHANGE. THE STUDY SUGGESTS THAT 50% OF MAMMALIAN SPECIES PRESENT A POPULATION SPREAD RATE THAT IS NOT SUFFICIENT TO OVERCOME THE CHALLENGES CAUSED BY CLIMATE CHANGE. IN CONCLUSION, THIS STUDY ESTIMATED THE ABILITY OF MAMMALS TO ADAPT TO CLIMATE CHANGE AND IN THE FUTURE, THIS APPROACH WILL BE USED TO ESTIMATE THE EFFECTS OF CHANGE IN LANDSCAPES CAUSED BY HUMAN ACTIVITIES ON MAMMALIAN POPULATION SPREAD. THIS WILL ALLOW FOR THE DEVELOPMENT OF CONSERVATION STRATEGIES THAT WILL HELP PRESERVE HABITATS AND THE BIODIVERSITY OF THE PLANET.
CHEMICALS CAUSING INFERTILITY IN WOMEN

Researchers from Washington State University, Seattle Children’s Research Institute, the University of Washington in Seattle and the University of Aberdeen, led by Dr Leonardo Trasande from New York University Langone Medical Center, have been studying the effects of a range of chemicals found in plastics, pesticides and cosmetics on female infertility problems. The substances studied, endocrine-disrupting chemicals (EDCs), interrupt the human endocrine system. In women, they have been associated with uterine fibroids (benign growths on the uterus) and endometriosis (when tissue from the uterus is found elsewhere in the body), both contributing to infertility.

FOOD WASTE REDUCTION INITIATIVE WINS CITYLAB COMPETITION

Students at the University of Aberdeen and Robert Gordon University have teamed up with Aberdeen City Council in a ‘Dragon’s Den’ style competition to pitch innovative solutions to city wide social and culture challenges. The council led initiative named ‘CityLab’ is a 12-week programme where students design and then present their ideas to a panel of stakeholders. University of Aberdeen students Bogdan Goroneanou and Robyn Hannaford, and RGU student Jordan Pellerin designed the winning pitch, named ‘Fit Dish’. The concept is to source unused food products from supermarkets and make use of kitchen facilities to create meals. These meals would then be sold from a tuk tuk throughout the city, with customers paying what they want to or what they feel the meal is worth, therefore providing an affordable way of eating. As explained by Robyn Hannaford, “A huge amount of food that is still edible gets wasted in the UK every day so this would be a way of reducing that wastage through a social enterprise.” The trio expects to see great success with this venture, after similar innovations have taken off well around other UK cities.

UNIVERSITY OF ABERDEEN INVOLVED IN RESEARCH IDENTIFYING CAUSE OF BLINDNESS IN RARE SCOTTISH BIRD

In collaboration with the Scottish Chough Study Group, the University of Aberdeen have been studying a genetic mutation affecting a rare species of Scottish bird. Populations of the red-billed chough have been drastically declining with only two populations left in Scotland, on the Islands of Colonsay and Islay. Since 1981, the Scottish Chough Study Group have been trying to work out why they are dying. In 1998, a blind chick was first observed and various blind choughs have been identified since then. This new research, funded by NERC and Scottish Natural Heritage, suggesting the blindness is due to a genetic mutation was published in the Journal of Animal Ecology. This genetic blindness is thought to be similar to a condition which can be seen in humans. These chicks can live while being looked after by their parents, however die upon leaving the nest. PhD student Amanda Trask explained, “Our research shows that the blindness mutation is likely to persist in the population into the future despite being lethal in blind individuals. This is because non-blind individuals that carry the mutant gene produce large numbers of chicks per year, causing the mutation to be passed into the next generation.” However, few chough chicks are affected by the genetic blindness meaning this is unlikely to be a major priority in Scottish Conservation. In regards to the future outcome of this research, Amanda Trask suggests, “Conservation strategies to manage these genetic concerns will need to be considered in the future.”
EVENTS

WELLCOME IMAGE AWARDS 2016

Aberdeen Science Centre are exhibiting the winning 2016 Wellcome Image Awards.

Running now until 29 May, 10:00 – 16:00
Aberdeen Science Centre

CAFÉ MED: TACKLING INFECTIONS IN CYSTIC FIBROSIS

Professor Adilia Warris, Professor Graham Devereux and Dr Deborah O’Neil discuss the current treatments for cystic fibrosis, the advances being made and the future for this incurable disease.

25 May, 18:00 – 20:00
Suttie Centre, Foresterhill

CAFÉ SCIENTIFIQUE: SOCIAL INTERACTION – THE EYES HAVE IT

Dr Bert Timmermans talks about why we interact with each other and how virtual avatars could help us answer this.

25 May, 19:00 – 20.30
Waterstones, Aberdeen

SHINING LIGHT ON MEDIEVAL MANUSCRIPTS

Professor Andy Beeby from Durham University discusses the advances in technology that has enabled the study of pigments in medieval manuscripts.

26 May, 18.30-19.30
Special Collection Centre Seminar Room, The Sir Duncan Rice Library, University of Aberdeen

MAY FESTIVAL 2016

A festival for all ages with over 160 events including exciting talks, activities and performances. Themes include science, sport, literature, music and Gaelic culture.

27 – 29 May

To find out more and book tickets visit: http://www.abdn.ac.uk/mayfestival/

Most events take place at the University of Aberdeen Campus or at locations in Aberdeen City Centre.

AU TALKS

We will be hosting another night full of exciting talks from enthusiastic student speakers. If you are a student and wish to give a talk on a topic in science, technology, engineering or maths get in touch.

24 May, 8pm
The Coffee House, Aberdeen

Email: info@ausm.org.uk

TARLAND TALKS: COLLECTIVE ANIMAL BEHAVIOUR

Dr Francesco Ginelli explains the, often spectacular, behaviours of social animals.

4 May, 19:50 – 21:00
MacRobert Hall, Tarland
Admission £4, no booking required

“KILLER FUNGUS” AT THE ROYAL SOCIETY SUMMER SCIENCE EXHIBITION.

The Summer Science Exhibition is the most prestigious annual showcase of exciting cutting edge science from across the UK. The festival features 22 exhibits at the forefront of innovation. You can meet the scientists, try some of the hands-on activities or attend some fantastic talks and events.

Free entry for all ages

Tue 5 July 10am-9pm
Wed 6–Thu 7 July 10am-5pm
Fri 8–Sun 10 July 10am-6pm

www.royalsociety.org/events/2016/07/summer-science/

The Royal Society, 6-9 Carlton House Terrace, London SW1Y 5AG
In our society, few people would deny a woman the chance to go to university and become a scientist, however the issues arise around women succeeding within their chosen academic fields. One main argument for both this issue, and the pay gap, stems from women having children and taking maternity leave. While paternal leave is possible in some cases, it is certainly not the norm in our society. How does Athena SWAN challenge the idea that raising children is solely a woman’s responsibility and help normalise the concept of paternity leave, thereby equalising the “risk” of any gender?

Sadly the dinosaurs are not yet extinct and you can’t take for granted that there are no people left who believe that women can’t be good scientists, and particularly hold senior positions. That’s why it’s so important that institutions tackle their organisational cultures and empower people to challenge these attitudes.

The ‘motherhood penalty’ is sadly very real, being borne out by national data. We are very clear that “people with caring responsibilities” does not exclusively mean mothers, and when we updated our application materials in 2015 we reworded the guidance to emphasise further that charter members need to be wary of the influence of traditional gender roles. As normalising a culture of responsibility and help normalise the raising children is solely a woman’s role. To normalise a culture of leadership from the highest levels men taking on caring roles requires the influence of traditional gender cultures and empower people to challenges attitudes. From the mainstreaming of gender equality considerations and it’s not uncommon for people to call out bad practice by saying “that’s not very Athena SWAN”. As a system, partly because of the way it has developed organically, the charter has always been relatively self-policing. There aren’t any quotas or targets because one of the main reasons the charter has been so successful is that each applicant develops its own set of actions and success measures based on its own self-assessment. That being said, this assessment to be honest, and a statement that the information presented in applications is an honest, accurate and true representation is required. Panellists can tell when applicants aren’t providing a true picture, and they also don’t accept it when action plans are insufficiently ambitious. Fundamentally, if applicants don’t progress, they won’t be able to renew their award. We don’t require quotas, but personally I think there is a strong case for their use in some circumstances; the widely held belief that they are automatically non-meritocratic doesn’t hold water.

Finally, do you envisage a future in which Athena SWAN, as it is now, will no longer be required and that equality for all in science has been achieved? What are the key milestones that you think will be achieved to reach this ultimate goal?

I think Athena SWAN will change and evolve, as it already has done over its relatively short history, so it’s impossible to say when we’ll have cracked it under the current system. “Will the charter be required” is a very different question from “will equality for all in science be achieved”, and in the case of the latter we need to define what we mean. What I’d be aiming for are equal respect and equal opportunities, whilst always remembering that providing equal opportunity does not mean giving the same thing to everyone. The milestones to me are cultural: when we don’t think it unusual for a vice-chancellor not to be a white, male, able-bodied man; when microaggressions on the basis of difference and privilege become rarities; when tolerance for unequal treatment runs out; and when considering the need to change policies and procedures is never seen as special treatment.

Danny Schnitzler is an undergraduate student in Biomedical Sciences.
The Wellcome Trust is a remarkable organisation, the legacy of an extraordinary man—the American-British pharmaceutical entrepreneur Sir Henry Wellcome. Wellcome amassed a small fortune during his lifetime, derived from a strong business acumen applied to numerous pharmaceutical interests. Part of the fortune was spent on an extensive collection of medical artefacts and art exploring connections between medicine, art and life (now housed in the Wellcome Collection in Euston Road, London).

The Wellcome Trust was founded in 1936 with a legacy from Wellcome’s will, to fund research to improve human and animal health. The Trust is now one of the largest independent funders of biomedical research in the world. Its stated aim is simple— to achieve extraordinary improvements in health by supporting the brightest minds in science, the humanities and social sciences, education, public engagement and the application of research to medicine. Public understanding of science and open access to research findings are two particular interests that the Trust promotes strongly. Each year the Trust provides more than £700 million of support to thousands of individuals, teams and institutions, through a wide range of funding mechanisms. One funding stream is the Institutional Strategic Support Fund (ISSF), provided to 25 UK institutions to support talented researchers and to create environments needed for world-leading research. The University of Aberdeen is very proud to be a member of this prestigious club.

The strategic remit of ISSF@Aberdeen (www.abdn.ac.uk/clsm/research/issf) is to support activities in:

- Infection, immunity and inflammation, particularly medical mycology
- Understanding the molecular basis of obesity for the development of interventions
- Applied Health Sciences, particularly through our Chief Scientist Office-funded Health Economics Research Unit and Health Sciences Research Unit

Support for these priority areas has been available through a

- Seed Corn Fund for pump-priming projects which support new interdisciplinary collaborations between researchers working in a priority area
- Fellowship Support Fund to help researchers prepare fellowship applications within the Wellcome Trust’s remit
- Supporting Women Returners Fund to provide protected research time to female academic staff returning from maternity leave or a career break
- Aberdeen Clinical Academic Training (ACAT) Scheme to allow clinical applicants to develop a research interest within our priority areas.

ISSF has also contributed funding for a trainee bioinformatician in our Centre for Genome Enabled Biology and Medicine, in recognition of the increasing importance of this discipline to many aspects of our work.

We have now had three highly competitive funding rounds, which have supported 13 seed corn projects (one already leading to a larger grant application), five fellowship development projects (two leading to fellowship applications), two women returners and nine ACAT projects. All projects have been required to have active public engagement plans, supported by a dedicated public engagement person and additional funding from ISSF. Some of these activities include forthcoming exhibitions on fungal disease at Aberdeen Science Centre (formally Satrosphere) and at the Royal Society in London, several events at the University’s May Festival and a number of YouTube videos (ISSF@Aberdeen research shorts on our College of Life Sciences and Medicine YouTube channel).

In this edition of AU magazine several of the researchers awarded ISSF funding provide greater details about their work. The magazine also includes information about other work supported by the Wellcome Trust through their other funding streams. I am sure that like me you will find these of interest. I also encourage you to look at the highly informative YouTube videos.

We have now exhausted the current ISSF funding provided by the Wellcome Trust, and eagerly await calls for the next tranche. Although it is early days, I believe that our use of the current award already demonstrates a strategic approach which will produce a high level of subsequent funding and, crucially, many important new scientific discoveries. Thus, it is a key enabler towards our overall University vision of ‘transforming the world with greater knowledge and learning’. I think Sir Henry Wellcome will have approved of this approach.

**OUR USE OF THE CURRENT AWARD ALREADY DEMONSTRATES A STRATEGIC APPROACH WHICH WILL PRODUCE A HIGH LEVEL OF SUBSEQUENT FUNDING**

Training (ACAT) Scheme to allow clinical applicants to develop a research interest within our priority areas.

Prof Phil Hannaford is the Vice-Principal for Digital Transformation and the Head of the College of Life Sciences and Medicine
Animal research has played a vital part in almost every medical breakthrough over the last decade. In fact, the role of animals in scientific research dates back to the days of Aristotle (384 – 322 BC). In an ideal world we would not rely so heavily on the animal models scientists have come to trust, such as mice, fruit flies and nematode worms. Investigators all over the world continue to strive for the three Rs in animal research: reduce, refine, replace. In the case of the Salmonella enterica serovar Typhi (S. Typhi) however, a unique challenge is presented.

S. Typhi, the bacterial pathogen that causes typhoid fever, can only infect humans. It is most common in developing countries with low sanitation and limited access to clean water. Without quick treatment, it can be fatal. Although vaccinations for S. Typhi have proven to be effective, its specificity to humans makes it an interesting candidate for further research. To understand how researchers have dealt with the lack of animal models, we interviewed Dr Stefania Spanò at the University of Aberdeen, who leads a group of researchers investigating the molecular mechanisms of S. Typhi.

Dr Spanò expressed her views on the oddities of this unique bacterium and emphasised that the biggest challenge is the absence of an animal model: “S. Typhi is a relatively ‘young’ bacterium when compared to other bacteria that cause diseases in humans. It has probably evolved from ancient Salmonella that were able to infect a broad range of animal species. During evolution it adapted to infect humans and consequently lost some genes that were required to infect animals. Why it adapted to infect only humans and to become a deadly bacterium, we cannot really say.”

The research team has been using an advanced cell biology approach where imaging and biochemical analysis are used to understand the human adaptation of S. Typhi on a molecular level. Dr Spanò has confirmed that these methods have uncovered the essential components of a transport pathway that restricts infection. A transport pathway is a series of proteins that ensures the transport of molecules occurs at the right time and place; Rab32 and BLOC-3 are the essential components of a transport pathway that limit Salmonella Typhi infection. As Dr Spanò pointed out, “Rab32 and BLOC-3 probably work by transporting a molecule with antimicrobial activity to the compartment where S. Typhi resides.”

Though huge breakthroughs in S. Typhi research have transpired, there are many other challenges that lie ahead. As more and more antibiotics become less effective, it is important to have powerful vaccines to prevent infection. There are still many bacteria for which we don’t have effective vaccines, such as a bacterium very similar to S. Typhi, known as Salmonella Paratyphi. As Dr Spanò pointed out, “Typhoid cases due to S. Paratyphi were once very rare, but are now becoming a significant fraction of the total cases of typhoid. That is the main reason why cases of typhoid due to S. Paratyphi are on the rise”

Before a new vaccine is approved, it undergoes extremely rigorous testing through several pre-clinical and clinical trials. As a result, safety standards are exceptionally high and it takes a very long time (around 10–15 years) for a vaccine to come onto the market. It is therefore important to eliminate the needless use of antibiotics for minor infections and lower rates of hospital-contracted infections by changing medical practice. These types of infection can have a major impact on keeping non-resistant bacteria alive, which act as competition for resistant strains.

Identifying and removing the critical molecules required to eliminate S. Typhi allows us to create mice that are susceptible to infection. What makes this achievement even more exciting is the fact that these critical molecules are also present in humans. This is an intriguing area of research and Dr Spanò has confirmed that her team is “now investigating why these molecules are not active in humans to prevent S. Typhi infection”.

THOUGH HUGE BREAKTHROUGHS IN S. TYPHI RESEARCH HAVE TRANSPRIED, THERE ARE MANY OTHER CHALLENGES THAT LIE AHEAD

Furthermore, there has been data to suggest that soon, we may be able to successfully use specific strains of mice to study typhoid. Dr Spanò mentioned that her team may be able to achieve this as they have indeed found some molecules in mice macrophages that prevent infection. “We recently showed that mice defective for these molecules can be infected by S. Typhi. These results open new and important opportunities to study typhoid.”

AHMED NASSAR IS AN UNDERGRADUATE IN MECHANICAL ENGINEERING
Kristina Harrison explores Dr Heather Morgan’s work on digital health to help identify key areas for future research, policy and practice.

In our tech-savvy generation, there has been a rapid development of self-monitoring technologies. Wristbands, or ‘wearables’, that count the number of steps you take, log how many flights of stairs you climb, and monitor your heart rate are becoming commonplace. Some wristbands can even link to your smartphone, allowing you to text, email and call through a relatively small device. The direction of progression for these technologies is so vast that it can, at times, feel futuristic to many of us, particularly for those who were brought up before the smartphone generation.

There are an increasing number of these health monitoring technologies that are being implemented into our health care services. The scope of these can range from helping someone lose weight by counting calories, to predicting an epilepsy attack by monitoring their movements. Another leap in monitoring has arisen from the development of smart clothing. An example of this is Hexoskin, a ‘smartshirt’ which can measure heart rate, breathing rate, how much sleep you are getting, and how intense your workouts are. Bio-wearable tattoos are being trialled, powered by conductive paint or sweat, which can monitor health in a range of scenarios. A test of this is Hexoskin, a ‘smartshirt’ which can measure heart rate, breathing rate, how much sleep you are getting, and how intense your workouts are. Bio-wearable tattoos are being trialled, powered by conductive paint or sweat, which can monitor health in a range of scenarios.

The potential applications for health monitoring technologies are limitless, influencing new health strategies within health care services and could help to identify the key areas of future research.

Reviewing and analysing the use of apps and ‘wearables’, amongst other devices raises many questions and queries about how these advancements are being regulated and monitored. There can be issues with technical accuracy of such technologies. For example, do the number of steps you actually take correlate with the number shown on a ‘wearable’? A follow-on study aims to talk to a range of individuals, from the doctors prescribing these technologies to those actually using them. Examining experiences of use will enable a better understanding of whether or not they seem to help, and in what ways, or what problems they may introduce.

The health impacts of self-monitoring technologies have a wide scope and it is important to consider all of the potential benefits, adverse effects and opinions of those using them, before they are fully integrated into our healthcare system. There have been new sensationalist ideas that such technologies may one day completely replace doctors. There are other emerging issues, of which data protection is just one concern, as these technologies can supplement personal data with previously confidential medical and health information. Great care needs to be taken to ensure that the advancement of technology remains in line with the regulation and monitoring, particularly in reference to the potential health outcomes.

Heather shared her findings with a range of stakeholders at The Wellcome Trust on 12th April, discussing the health and well-being impacts of using such devices as well as discussing the personal, social and ethical questions which need to be addressed and considered. The project has a Twitter account (@selfhealthtech) where members of the public can follow the progress of the study and interact with Heather.

Heather Morgan has been examining that, amongst a range of other factors regarding health technologies, within her Wellcome Trust Institutional Strategic Support Fund (ISSF) project. The work aims to examine the monitoring technologies being used for chronic conditions, such as diabetes or asthma. Through an extensive literature review, the efficacy of what health care providers are implementing will be assessed. The outcomes of such a study could influence new health strategies within health care services and could help to identify the key areas of future research.

VISIT AUSM.ORG.UK TO CHECK OUT OUR SCIENCE BLOG!
The bacteria in our guts have never been so popular. From autism to obesity, a flurry of recent research has highlighted the fundamental role that these microorganisms play in human health. In fact, there are more bacteria in our digestive tracts than there are human cells in our body. But they are not alone: our bowels are also home to trillions of fungi and viruses, with some estimates suggesting that viruses outnumber gut bacteria ten to one. Regulation of the complex symbiosis between these microorganisms, as well as their interactions with the human immune system, is critical for digestive health. Even small imbalances between the different species can have major consequences for the function of our gastrointestinal tracts.

Dr Indrani Mukhopadhya, a Research Fellow at the University of Aberdeen, is investigating the role of such imbalances in the development of Crohn’s Disease (CD). CD is a chronic condition that causes inflammation of the digestive system, resulting in abdominal pain, anaemia and fatigue. With millions of people suffering from CD around the world, researchers are working to advance the treatment of this currently incurable condition. Dr Mukhopadhya’s research aims to characterise the interactions between viruses, bacteria and fungi in CD patients, with the hope of identifying new targets for therapeutic development. She explains: “Research in Crohn’s Disease is entering an exciting phase with the advent of newer and better molecular techniques in assessing and evaluating the entire gut microbiome. Newer research suggests that gut viruses may have a key role in the onset of CD. My background in virology and my experience in looking at specific bacterial pathogens in Inflammatory Bowel Disease led to a keen interest in elucidating the role of gut viruses in CD.”

Until now, the majority of research in CD has focused on the bacterial population of the gut, and recent advances in molecular techniques have helped to characterise the role these bacteria play in the onset of the disease. However, far less is understood about the roles of fungi and viruses, and their interactions with bacteria. Viruses called bacteriophages, for example, can directly influence the composition of gut bacteria. Recent research suggests that these bacteriophages may be key determiners of the type of bacteria in our gut, by promoting or reducing pathogenic bacterial growth. If the composition of viruses (known as the ‘virome’) changes in the digestive system, bacteria will be altered as a result. Dr Mukhopadhya is investigating whether gut virome differ between healthy individuals and patients with CD, and whether viruses may be the “prime drivers” of the inflammatory processes which lead to CD. As she points out, this could lead to exciting advances in the way in which we target gut bacteria for therapeutic purposes:

“Recently, there have been a lot of attempts at modifying the gut microbiome through interventions like 'probiotics' by which the gut microbiome is altered by introduction of beneficial bacteria. Our research could herald treatment with beneficial bacteriophages that alter the pathogenic gut bacteria.”

Her work comes at a critical time, as recent research suggests that the global incidence of CD is rising. The reasons for this worrying trend are currently unclear, but Dr Mukhopadhya believes that food choices may play a critical role. Processed food and diets rich in polyunsaturated fats and simple sugars are known to influence the composition of the gut microbiome which in turn influences the onset of various diseases. Going forward, researchers must bring together their understanding of genetics, microorganisms and environmental factors in order to characterise the processes which lead to CD. Dr Mukhopadhya concludes:

“Future interventions need to harness the full potential of this amazing ‘pharmacy’ that resides within our gut lumen. Strategies addressing the positive modulation of microbiome functionality offer huge potential to the food and pharmaceutical industries to innovate and provide therapeutic solutions to many of the health issues affecting modern society.”

Frances Vaughan is a masters student in Human Nutrition.
COLOUR ME IN!
ILLUSTRATIONS BY OLGA JAROSINSKA

VISIT AUSM.ORG.UK TO CHECK OUT OUR SCIENCE BLOG!
Imagine you are on your weekly food shop. You are walking around the supermarket, basket in hand and you make your way to the meat aisle. You scan the variety of animal products, seeing what takes your fancy, when something strange catches your eye: “Locust Burgers”?! Although this would indeed be a strange sight in a British supermarket, insects are eaten in many other countries around the world. So why don’t we eat insects? Have we been missing out on a healthy and tasty food source all this time?

There are nearly 2000 species of edible insects worldwide and many of them are actually highly nutritious. A recent study found that five commonly eaten insects contain all of the essential amino acids which are required for human growth and repair. They also contain vital minerals that are hard to find in other foods, such as iron, zinc and calcium. Many edible insects also contain high levels of healthy unsaturated fats and are low in cholesterol. Furthermore, insects such as crickets and locusts have over double the protein content of beef. We should be incorporating more of these types of nutritious, low fat protein sources into our diet, and it seems that insects are a great way to do this.

Not only that, but an insect based diet is also better for the planet. Livestock production is one of the biggest producers of greenhouse gases and maintaining large herds requires huge areas of land, often at the expense of areas such as rainforests. Insects produce a negligible fraction of the greenhouse gases and are far better at converting food into body mass. For example, it takes around 10 kg of feed to produce one kg of beef, whereas only 1.7 kg of feed is needed to produce one kg of crickets. Therefore, insect farming could produce more food per area of land compared to conventional livestock. Additionally, current livestock production requires large quantities of water for growing the animal feed and maintaining grazing pasture. For example, producing one kg of beef requires around 15,000 litres of water. Insects such as crickets and locusts have over double the protein content of beef. We should be incorporating more of these types of nutritious, low fat protein sources into our diet, and it seems that insects are a great way to do this.

Although eating insects is part of many cultures around the world, it may take a bit of convincing for them to be accepted into Western culture, but not impossible. Foods that were first considered alien and are now widely accepted—take sushi, for example; who imagined eating raw fish would be so appealing? So, now that you know insects are tasty, low in fat, high in essential minerals, packed with protein and better for the environment—if you were given the chance, would you put that locust burger in your basket?
THE HUMAN GENOME AND DISEASE: HAVE WE BEEN LOOKING IN THE WRONG PLACES?

Elizabeth Hay cleans out ‘junk’ DNA.

Previously, it […] would have cost hundreds of thousands of pounds. We can now do this in weeks for a tiny percentage of the cost.

As well as genetic variation, Dr MacKenzie investigates epigenetic variation in enhancers. Epigenetic variation is the change in gene expression without alteration of the DNA sequence itself. For example, specific chemical groups, such as a methyl group, can be attached to a DNA sequence such as an enhancer, blocking or altering its activity. These changes can be passed between generations. For instance, early life stress has been associated with abnormal methylation of DNA which, in turn, is associated with later life disease states such as depression or obesity. Therefore, environmental factors, your lifestyle, or even your parents’ lifestyles could alter your DNA and affect your health in the future.

Dr MacKenzie says that “Previously, it would have taken years to manipulate these enhancers and would have cost hundreds of thousands of pounds. We can now do this in weeks for a tiny percentage of the cost.”

Thanks to Welcome Trust ISSF funding, as well as funding from the Wellcome Trust, Dr MacKenzie’s team are using a new technology called CRISPR/Cas9 genome editing. This allows them to quickly and accurately delete or manipulate the enhancer sequences in animal models to find out more about their functions in mood and feeding behaviour.

Dr MacKenzie’s lab explores this altered activity in enhancers and the effect it can have on health and disease. A change in one base (a letter in the DNA code) is referred to as a Single Nucleotide Polymorphism (SNP) and often, SNPs are associated with disease. A SNP could change the function of an enhancer, leading to the faulty expression of a gene and therefore disease progression. The group investigates SNPs associated with obesity, addiction and depression, how the SNPs contribute to the disease progression and whether there is a different response to drug treatments depending on the genetic variation.

Dr Alasdair MacKenzie’s team have been studying enhancer sequences in the ‘junk’ genome which can be considered to act as switches, turning genes that control processes such as addiction, mood and appetite, on or off. These switch sequences, often referred to as ‘enhancers’, have been identified because of their extreme sequence conservation. “By comparing the genome sequences of animals as diverse as humans, mice, chicken and fish, many of these enhancer sequences show up as being highly conserved because they are so important to species survival,” says Dr Mackenzie. He adds that, “Rather than being caused by changes in proteins, it is very likely that the majority of diseases are caused by altered activity of enhancer sequences whose job it is to ensure that genes are expressed properly in the correct cells and in response to the correct stimuli”.

The human genome was sequenced 13 years ago and because of the vast information that could be gleaned from this, scientists promised that cures for many diseases would be developed within ten years. This, however, hasn’t happened and as hundreds of millions of pounds have been invested in genome sequencing technologies, the public are now asking why these promises have not been fulfilled. Many now believe that by concentrating on studying protein coding genes, making up only 1.9% of the human genome, geneticists have been looking in the wrong place for the causes of disease. Consequently, the 98.1% of the genome that does not code for proteins is often referred to as ‘junk’ DNA, and has been largely ignored. The results of hundreds of different genetic studies, called genome wide association studies or GWAS, suggest that up to 97% of the DNA mutations that make us susceptible to diseases as diverse as depression, heart disease, cancer, addiction and obesity, occur in this ‘junk’ DNA.

Previously, it would have taken years to manipulate these enhancers and would have cost hundreds of thousands of pounds. We can now do this in weeks for a tiny percentage of the cost. Most importantly, CRISPR/Cas9 technologies use less mice than previous methods. This permits us to explore these enhancers more closely than has ever been possible before.”

He adds that “In addition to deleting enhancers, CRISPR technology also allows us to reproduce disease associated DNA changes seen in human enhancers, in mice, so that the effects of these changes can be studied.”
**Professor Gordon Brown** is a 6th Century Chair in Immunology at The University of Aberdeen. Professor Brown is the director of the MRC Centre for Medical Mycology and a member of the Aberdeen Fungal Group. Here Ali Thomson helps us get to know him better!

Describe yourself in 5 words! Focused, happy, ambitious, lazy, energetic (contradictions, I know, but weirdly true).

You are part of the legendary Aberdeen Fungal Group. Can you tell us a little bit about your research? I am interested in understanding how cells of the immune system recognize invading microorganisms. During my postdoctoral research, I discovered a novel type of cell surface molecule (a receptor called Dectin-1) that could recognize fungal pathogens. This discovery formed the basis of my research career, which focuses on understanding how Dectin-1, and other similar receptors, function in immunity. My main area of interest is anti-fungal immunity, and is one of the reasons why I came to Aberdeen to be part of the Aberdeen Fungal Group (see below), but the study of these receptors has also led me into other exciting areas of medical science, including tuberculosis and arthritis.

How many PhD students and post docs work for you? I have a fantastic team of 2 Research Fellows, 4 PhD students, 5 post docs and 2 technicians.

What’s your favorite aspect of working within the AFG? Working in the AFG is like being part of a big family. It’s a very unique and supportive atmosphere, and rare in academia, and I feel privileged to be part of such a dynamic group.

You started your career at the University of Cape Town, what brought you to Aberdeen? I came to Aberdeen for three reasons: 1) the excellent fit of my scientific interests with those of the AFG (see above), 2) the quality of life in Aberdeen (I have always wanted to get away from big cities, and have easy access to the countryside), 3) my mother is a Scot, and I felt at home in Scotland after visiting regularly during my childhood.

What do you like to do in your spare time? I enjoy spending time with my family and pottering around the house (cooking and DIY, mostly, but I am often put to work in the garden). I also enjoy taking advantage of the wonderful countryside in Scotland for walking.

What do you feel is your biggest achievement (Science related or otherwise)? The discovery of Dectin-1 really made my career, so I guess I have to list this as the major achievement in my career. However, over the last 5 years, my research into the functions of these immune receptors has led to the discovery of a potential cure for a very nasty fungal skin infection called Chromoblastomycosis. We have tested this cure on 4 patients and it worked, and we are now setting up to do a proper clinical trial. If this trial pans out, then my research would have directly led to the cure of a human disease. This would undoubtedly be my greatest achievement.

If you could have one super power, what would it be and why? I would love to have a photographic memory. I am lucky to have a good memory for concepts, but details get easily lost. How wonderful it would be to recall everything in perfect detail.

When you were a kid, what did you want to be when you grew up? Did you see yourself being where you are now? When I was in high school I did a project on DNA replication, and from that point on knew I wanted to be a molecular biologist. I was very lucky to get into University at the end (I was on a waiting list, because my school marks were so bad). I was also very fortunate to have had excellent mentors at all stages of my career (even when I was an undergraduate).

And finally, tell us a joke! (The cheesier the better!) A biologist walks into a bar and asks for a pint of adenosine triphosphate. The barman passes it across and says that’ll be 80p.

Ali Thomson is a PhD student in developmental biology.

A PEEK INTO THE LIFE OF A PROFESSOR

**Image: Vincent Charrot**

**Ali Thomson**
Every minute of every day, we breathe in millions upon millions of particles and microorganisms. These often pass harmlessly through our systems, rarely causing illness, let alone life threatening disease. However, in a small percentage of the population, certain microorganisms pose a risk of causing debilitating and potentially fatal disease. Patients with Chronic Granulomatous Disease (CGD) are one such at-risk group. CGD is a rare, inherited immune disease which impairs the patient’s ability to form reactive oxygen species, leaving them susceptible to infection from otherwise harmless organisms. Dr Jill King has been researching how the condition leads to increased susceptibility to fungal pathogens of the genus Aspergillus.

Dr King is a clinical PhD fellow, working with the Aberdeen Fungal Group at the Institute of Medical Sciences in Aberdeen. Her research, funded by the Wellcome Trust Strategic Award for Medical Mycology and Fungal Immunology, is supervised by an international team consisting of Aberdeen’s own Professor Adilia Warris and Professor Gordon Brown, as well as collaborating with Professor Don Sheppard from McGill University in Canada and Professor Steven Holland from the National Institute of Health in the United States. Eighteen months into her three year PhD, Dr King has been closely studying Aspergillus models of infection in CGD.

Aspergillus species can cause a range of diseases in patients suffering from conditions such as asthma and cystic fibrosis as well as those receiving immunosuppressive therapy or cancer treatment.

However, people with CGD are especially susceptible to infections by this fungal pathogen, with Aspergillus infection being the largest cause of death in CGD patients.

While the universal environmental organism, Aspergillus fumigatus, is the species of Aspergillus which most commonly causes infections in vulnerable patients, CGD patients are uniquely susceptible to a different species, Aspergillus nidulans, which does not appear to cause infections in other at-risk patients. “Over half of all deaths in CGD are due to invasive fungal infections, and the majority of these are due to Invasive Aspergillosis,” stated Dr King. She hopes that by the end of her PhD, her research will provide understanding as to why A. nidulans specifically targets those suffering from CGD. “Although CGD is rare, understanding why these patients are susceptible and what’s going wrong with their immune response may help us to understand why other patients are at increased risk of Aspergillosis,” she told AU Magazine. From research carried out, it has become increasingly clear that, as well as direct tissue damage from the fungal pathogen, CGD patients’ own dysregulated immune response towards the organism is damaging the host.

By targeting this excessive inflammatory response, in combination with anti-fungal treatments, Dr King aims to develop novel approaches to treating this devastating disease. One such potential anti-inflammatory strategy currently under investigation by Dr King involves using an immunomodulatory, called Anakinra, which is currently used to target excessive inflammatory responses in diseases such as rheumatoid arthritis. This drug specifically targets the pro-inflammatory IL-1 family of cytokines which are excessively produced in CGD patients during Aspergillus infection.

Recent breakthroughs in Dr King’s research include using novel cell imaging techniques to analyse the innate immune cells, the first line of cellular immune defence, recruited to the CGD lung following Aspergillus infection. This has provided new information on the smaller cell populations involved in the initial immune response to infection and has, in turn, provided new paths for Dr King and her team to explore.

By the completion of her PhD, Dr King hopes to improve the lives of those vulnerable to fungal infections by increasing our understanding of Aspergillus infections in patients with Chronic Granulomatous Disease. Hopefully, one day, they will be able to breathe as easily as you or I.
Questions Answered by Dr Angus Macleod

Dr Macleod is a Clinical Lecturer at the Institute of the Applied Health Sciences at the University of Aberdeen. Dr Macleod’s research focuses on predicting and measuring the progression of Parkinson’s disease.

Laura Machado interviews Dr Macleod to find out the frontier developments in Parkinson’s disease.

Q1. How does your work aim to improve the life of patients with Parkinson’s disease and/or the treatments available to them?

Most of my work to date has been focussed on improving our understanding of the prognosis of Parkinson’s, that is, how people with the condition fare over time, and trying to predict prognosis based on an individual’s characteristics. Research into prognosis has three main benefits to people with Parkinson’s. Firstly, it enables clinicians to provide them with more accurate—and ideally tailored—information about their prognosis. Secondly, it opens up the possibility of personalized treatment – whereby treatment decisions can be made according to individual prognosis, which would hopefully result in more optimal treatment of people with Parkinson’s. Thirdly, there are many benefits for research, for instance, using prognostic models—statistical tools which combine an individual’s characteristics to predict prognosis—in the design of clinical trials can make them more efficient. This would hopefully lead to new treatments becoming available to patients more quickly.

Q2. When receiving funding from the ISSF in Aberdeen, you stated that one of the purposes of your research was to develop a new disability scale, since currently there are no viable ways of measuring the disability in Parkinson’s disease patients. How is this being carried out and what methods are being used?

Currently, the main measurements used in studies of Parkinson’s are measures of the severity of the signs of the disease, such as how severe a person’s tremor is, or how bad their stiffness is. Such measures, in themselves, are not necessarily relevant to those with the disease. I believe it is much more useful to measure how it impacts on their activities of daily living, for example, their ability to go shopping, or whether they can dress themselves without help, and so on. Currently I am evaluating existing measures of disability. I will then discuss with people who have Parkinson’s to identify what aspects of disability are most important to them. I will then use the latest psychometric techniques to develop a new scale which measures disability well and reliably, and is able to sensitively identify change in disability.

Q3. One of your studies published in Movement Disorders in May 2014 concluded that patients suffering from Parkinson’s disease showed a higher mortality rate than people without Parkinson’s disease. From a medical point of view, how is this explained?

The studies I reviewed consistently showed that people with Parkinson’s disease, on average, have higher mortality rates than people of the same age without Parkinson’s. This was also what I found in an analysis of a study of patients with Parkinson’s disease in Aberdeen. The effect seems to be about a 50% increase in mortality in Parkinson’s. The reasons for this are probably mainly to do with the problems people with Parkinson’s can get as the disease progresses, including swallowing difficulties and immobility, which make certain other illnesses, such as pneumonia, more likely.

Q4. A consistent feature of your studies seems to be the application of a statistical approach to existent data about Parkinson’s disease. During the implementation of such analytical procedures, how does one make sure that factors such as the heterogeneity of the population in the study group do not affect the certainty of the conclusions? Also, how are both the methodology and the reporting of the outcomes from each individual case been kept consistent throughout the data?

I believe it is very important to review previous studies, and to combine the data from them, where possible, as doing this maximises the value of previous research. Much time and many resources have been wasted on duplicating research, and it doesn’t make sense that several researchers in different institutions do similar studies without harnessing the additional statistical power of combining the studies together. You highlight an important limitation to the combination of different studies. There is no doubt that heterogeneity—the variation in the patients...
studied and the methods used – can influence results. It is important to investigate this possibility by quantifying the amount of heterogeneity and determining how variations in study design and patient characteristics influence the results. To try to reduce heterogeneity in the measurement used, there has been a drive to define “core outcome sets” for particular clinical areas, a minimum set of outcomes that should be reported in every study performed. This should make it easier to combine results of different studies, but it also vitally important to try to minimise bias when carrying out research.

Q5. In June 2015 you published a study on the European Journal of Neurology on motor complications related to Parkinson’s disease, especially dyskinesia, concluding that cumulative doses of levodopa, one of the major prescribed medicines in the treatment of this disease, were the strongest predictor of both motor fluctuations and dyskinesias. According to a study recently published on December 2015 in The Lancet Neurology by a group of researchers from Coronado (Portugal), additions of opicapone to levodopa treatment have been shown to reduce the occurrence of dyskinesia. Some researchers have already predicted these findings to “substantially affect clinical practice”. What do you think will be the implications of these results on the treatment of Parkinson’s disease? How will it affect your own research, specifically?

A group of drugs called COMT inhibitors have been used for many years for the treatment of motor fluctuations, a complication of treatment of Parkinson’s with levodopa, whereby the effect of individual doses wear off too quickly and people experience good and bad control of the symptoms at different times throughout the day. The COMT inhibitors prolong the time that levodopa provides good control of symptoms. Opicapone is a new COMT inhibitor which has the advantage of once-a-day dosing. The study you refer to was a “non-inferiority trial” which showed that Opicapone was not worse than Entacapone, a thrice-daily COMT inhibitor. Thus, the advantage is in convenience, rather than efficacy, and given that patients with motor fluctuations will already be on other drugs that are taken three times a day – and often four or five times a day—I see this as only a small step forward for people with Parkinson’s. Unfortunately, drug companies tend to bring in such new drugs at great cost so I’m not sure it will be cost-effective.

Q6. Co-careldopa intestinal gel, commercialised as Duodopa, has been found to help control the symptoms of advanced Parkinson’s when all other treatments have stopped working. Its use, however, was ruled out by the Scottish government last December due to concerns related to cost-effectiveness. What do you think will be the consequences of the rejection of Duodopa from routine care in Scotland? Has the pursuit of cost-effective policies by the Scottish government ever affected your own research?

Duodopa is incredibly expensive—nearly £30,000 a year for what is just a different formulation of a drug which has been around since the 1960s. I fully accept that the government must take decisions about the cost-effectiveness of treatments, so long as this is done equitably, and it does not seem unreasonable to decide the such amounts of money could be better spent elsewhere in the NHS (for instance, to employ an extra nurse). I think that part of the problem is the high profit margins in the pharmaceutical industry. If the Government, health professionals, and patient groups could join together to lobby the relevant drug companies, cost of such interventions could come down.

In terms of effects on my own research, the Chief Scientist Office of the Scottish Government previously gave me a research fellowship to develop the prognostic models I mentioned earlier; I think that the hope of greater efficiency in clinical trials arising from this research was an attraction to them. If anything, their pursuit of cost-effectiveness has benefitted my research!

Laura Machado is an undergraduate in Chemistry

"IT DOESN’T MAKE SENSE THAT SEVERAL RESEARCHERS IN DIFFERENT INSTITUTIONS DO SIMILAR STUDIES WITHOUT HARNESSING THE ADDITIONAL STATISTICAL POWER OF COMBINING THE STUDIES TOGETHER"
Danny Schnitzler steps onto the fight for funding battlefield

If you get into a conversation with a researcher about their work, the word “funding” will be dropped—perhaps in an irreverent way, or maybe in irritation. Either way, science is expensive: imagine you are baking a cake, but the ingredients cost hundreds of pounds each, you need a special licence to use the eggs, and the use of an oven costs more than your car. The final product may cure cancer, but who will bear the financial burden of all these costs?

The term “public funded research” is often used in our society, tossed around by political parties wishing to advance their agendas, media outlets, and the public. A 2011 research report by Ipsos Mori, the leading market research company in the UK, concluded that there is a widespread lack of understanding among the public about who funds science and how funding priorities are set. Participants in an Ipsos Mori workshop also had concerns about the transparency of funding. Moreover, media coverage of particularly exciting findings might be deceitful, with 71% of the Ipsos Mori participants agreeing that there is too much misleading information about science “and that it is difficult to know what to believe”.

The report also highlights how important it is for people to feel well-informed, with a strong correlation between understanding and a positive attitude to science, with less than half of those surveyed agreeing that “the information they hear about science is generally true”. Charities make things seem simple: donate to charity X and research for disease Y will be done. But where do governmental research councils, EU funding and large research charities such as the Wellcome Trust come in?

The UK public sector funding for science is organised into two main channels: Research Councils, that provide grants for specific projects and programmes, and higher education funding bodies, such as the Higher Education Funding Council for England (HEFCE), that provide overall funding to universities. The seven UK Research Councils receive funding from the Government’s Department for Business, Innovation & Skills science and research budget. The UK Government has ring-fenced £4.7 billion for science and research per year, however, the annual capital budgets vary year on year. The science ring-fence will be maintained in 2016, and an additional £1.1 billion has been invested into science and research.

IMAGINE YOU ARE BAKING A CAKE, BUT THE INGREDIENTS COST HUNDREDS OF POUNDS EACH

There are many sources of public funding, including innovation spending, R&D tax relief schemes, and research in government departments. In addition, a great deal of UK science is supported by funding bodies in the European Union, meaning the impending referendum is causing discord and uncertainty among researchers on both sides of the Channel. Although the Brits only account for 1% of the world’s population, 16% of the world’s high impact science is generated in the UK. A large amount of our research is funded through the EU, such as the seven-year science programme Horizon 2020, which is the EU’s biggest R&D programme aimed at “securing Europe’s global competitiveness”. In 2014, the EU boosted science by 50% to develop Horizon 2020, a €80 million project, supporting research mobility, multinational collaboration and academia-business interaction. The UK is now ahead of the US in terms of impact of research output, mainly due to more international collaboration papers being published, thanks to EU funding (more than 50%, compared to 55% by the US).

On top of governmental and EU funding, a great portion of scientific research is largely funded by the Wellcome Trust, the UK’s largest provider of non-governmental funding for biomedical research, and one of the largest providers in the world, followed by the Bill & Melinda Gates Foundation. The Wellcome Trust has a private endowment of £18 billion, independent of governments, industry and donors. In 1936 the Wellcome Trust was created from Henry Wellcome’s will, and owned the drug company Wellcome Foundation Limited. In the following years, the company developed breakthrough drugs, gaining more recognition and capital. Today, the Trust funds research and mediates science communication to the public (for example, this issue!), investing £700 million every year in science, the humanities and social science, in total funding over 4000 scientists.

It is important to remember that political discussion should never stray too far from the needs of science, nor should science be blind to changes in the political landscape. No matter how uncertain times might seem, funding bodies like the Wellcome Trust and others allow research to continue and advances in science to be made.

DANNY SCHNITZLER IS AN UNDERGRADUATE IN BIOMEDICAL SCIENCE.
When an 18 year old William Henry Perkin accidentally synthesised the first aniline dye in the 19th century he didn’t realise he would revolutionise the colouring of cloth. In trying to produce quinine, an antimalarial, Perkin oxidised aniline with potassium dichromate from which small amounts of purple dye could be purified. They named this dye mauveine, and it was seen to be much more stable than the standard purple dye of the day, Tyrian purple, favoured by royalty. The aniline Perkin used was a mixture which raises the question: can the mauveine composition be determined and can the synthesis be repeated? Some of our studies in this field at University of Aberdeen over the last five years are discussed. But firstly we can explore some of the intriguing history and background behind this iconic substance.

Mauveine, so named because of the colour of the purple mallow flower, was the first coal-tar dye to be commercialised, and heralded the beginning of the coal-tar dye industry. The names coal-tar dye or aniline dye originate from aniline, originally isolated from coal-tar and because the key ingredients benzene and toluene are distilled from coal-tar. Prior to 1856, dyestuffs were usually prepared from plant, animal or mineral sources. For instance, the red dye, alizarin, came from the root of the madder plant, indigo came from the root of the madder plant, indigo came from the root of the madder plant, and Tyrian purple came from predatory sea snails. From 1856 many patents appeared on dyes made by chemical synthesis, for which mauveine was the first. Mauveine was popular for about 10-15 years, and its popularity rocketed when Queen Victoria and Empress Eugenie began wearing mauveine-dyed dresses to state functions. Many other dyes made from aniline soon followed, leading to reds, blues and even greens. Not only were the new colours for clothes available to Victorians, but they were more resistant to fading than previous dyes from natural sources. Empress Eugenie wore an aldehyde-dyed green dress, to an evening function and the guests noted that it retained its colour all evening. The coal-tar dye industry spread rapidly throughout Britain, France, Germany and Switzerland. Hundreds of tons of the red dye alizarin was manufactured per year in the 1870’s.

William Henry Perkin’s patent on alizarin was dated 26 June 1869 but he was pipped to the post by Heinrich Caro whose patent was dated a day before. Luckily for Perkin, an arrangement was made allowing Perkin & Sons to supply alizarin to the British market only, whereas Heinrich Caro supplied much larger quantities to Germany and Europe.

Perkin was lucky to be in the right place at the right time. The production of illuminating gas from coal, for lighting, was a huge industry, which produced coal-tar as a by-product, on which Perkin’s commercial venture depended upon.

Bottles of original 19th century mauveine, as well as early samples, are on display in museums across the U.K. and in the States. However, the mauveine composition of these dyes differs from that which can be made by Perkin’s original patented method. Repeating Perkin’s early method gives a composition rich in four chromophores known as mauveine A, B2, B and C, while the archived mauveine housed in museums is rich in mauveine A and B only. These chromophores are similar but differ in the number and position of the methyl group substituents. Mauveine A has two methyl groups, mauveine B has three and mauveine C has four. At the University of Aberdeen, the use of high performance liquid chromatography (HPLC), a separation technique, has confirmed that archived mauveine is different to Perkin’s. This suggests the archived mauveine was produced via a different method. We discovered a novel method for producing a mixture of mauveine A and B which is very similar in composition to archived mauveine and we proposed that Perkin might have used this as a second commercial method in the 19th century for making mauveine rich in mauveine A and B. Until now, this method had not been uncovered and is a mystery unveiled from the 19th century. It requires a new modified building block, which is used in a protection-deprotection sequence, and is not just a variation of the conditions. Discerning how historical compounds were produced is an important step in synthetic chemistry. It allows us to track how chemicals are changed throughout history, in order for us to test the efficacy and safety of compounds in common use today.

MEET THE RESEARCHER: DR JOHN PLATER

Image: John Plater

Dr John Plater is a Senior Lecturer in Synthetic Chemistry at the University of Aberdeen.
A word from Cara

VISIT AUSM.ORG.UK TO CHECK OUT OUR SCIENCE BLOG!

m a y
F E S T I V A L
27–29 May 2016

TOURS
LITERATURE
FILM
TALKS
WORKSHOPS
MUSIC
ENVIRONMENT
SPORT
SCIENCE
HANDS ON ACTIVITIES
FOOD AND DRINK
ARTS & CRAFTS
DEBATES
GAELIC

BE INSPIRED

YOUR JOURNEY OF EXPLORATION

Tickets released Monday 18 April

Tel 01224 641122 www.abdn.ac.uk/mayfestival

VISIT AUSM.ORG.UK TO CHECK OUT OUR SCIENCE BLOG!
Payne’s Chain Reaction

This is a quiz with a difference; each answer links to the next forming a chain which can provide clues to any questions you get stuck on. The links range from as obvious as a shared word to more obscure facts and play-on-words. Finally, in the spirit of scientific research, collaboration is encouraged!

1. What car did Ferdinand Porsche design at Adolf Hitler's behest?
2. Which 1968 Disney film was rebooted in 1997?
3. What mental disorder, with a name rooted in Greek mythology, is the female equivalent of satyriasis?
4. What is considered Robert Palmer's signature song?
5. What Shania Twain song has two exclamation marks in its title?
6. Which American Olympic gold medal-winning decathlete had a surprising appearance on the 2015 cover of Vanity Fair magazine?
7. Whose ex-wife and daughters have we been keeping up with since 2007?
8. In 1973, who became the first NFL player to rush for more than 2,000 yards in a season?
9. In sport, the illegal use of what is often referred to as “doping”?
10. With which athlete did Nike develop the Livestrong wristband in 2004?
11. Who were the first two people to walk on the Moon?
12. What are the names and professions of the two main characters in the Toy Story franchise?
13. What cover song was Eric Clapton's only US number-one single?
14. What word is given to a mass departure of people?
15. What can only be divided by themselves and 1?
16. Who is the leader of the Autobots?
17. What AC electrical device is used to transfer energy between circuits using electromagnetic induction?
18. Channing Tatum and Jenna Dewan started dating (and later married) after appearing together in which film?
19. What phrase, alluding to batting in baseball, is used to mean initiating action and assuming responsibility?
20. What structures make up the Earth's lithosphere?
The Kingdom of Fungi

An interactive exhibition for all ages
A fascinating insight into the world of fungi

Aberdeen Science Centre, opening end of May
For more information: aberdeensciencecentre.org

Discover how these intriguing organisms can be both saviours and killers and how researchers at the University of Aberdeen are leading the fight against fatal fungal infections.

www.abdn.ac.uk/research/afg

179 Constitution Street, Aberdeen AB24 5TU