AGRICULTURE ▪ HORTICULTURE ▪ FORESTRY ▪ ENVIRONMENT ▪ AMENITY

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Landwards

VISION 2038 *PART TWO*

FOOD

WHAT WILL WE BE EATING, AND HOW WILL IT BE PRODUCED?

In this issue

IAgrE

TECHNICIAN GRADE

NEW ROUTE INTO IAgrE FAMILY

DAIRY EQUIPMENT TECHNICIAN

The Technician grade of IAgrE Membership is for those who are qualified at a vocational or technical level. They may have completed an apprenticeship or extended diploma. Alternatively they may have gathered technical training at work or participation on an IAgrE approved training programme such as Parlour Safe.

To qualify, you will be working in industry and will have built up experience and career development in the workplace.

You will be keen to be part of the IAgrE family and seeking a cost effective way of getting involved and benefiting from being part of the community of professional engineers.

The IAgrE Technician Grade for Parlour Safe Technicians

If you are registered under the Parlour Safe scheme and have attended training courses at Reaseheath or Hartpury Colleges you are eligible to apply for IAgrE membership and use the letters TIAgrE after your name and on your business card as a way of demonstrating your high standards to your customers and colleagues.

If you have completed the training and assessment at Parlour Safe Category 3 and above you can also apply to become a professionally registered engineer.

This will permit you to use the title of Engineering Technician and join the growing number of engineers who use the letters EngTech as a demonstration of high standards and professionalism.

ACCREDITATION SCHEME

PARLOUR SAFE

To apply and find out more:

Go to the IAgrE website and complete the Application Form iagre.org/technician. With your completed application form, you will also need to provide a current full and detailed CV which describes in detail your working history and experience. We will need copies of academic certificates and details of education/training.

For further information contact Alison membership@iagre.org or 01234 750 876

EDITORIAL: DOWN THE HATCH

AT a wedding supper in Devon recently, I sat next to John Keeling the recently retired head brewer at Fullers, the London-based brewery. A family business with a history that dates back to 1845, the company was sold earlier this year to Japanese drinks company Asahi.

It is surprising how, on such occasions, worlds collide. Fullers are best known for distinctive bitters such as London Pride which require a constant supply of good quality malting barley. And John had made it his business to fully understand grain production and had spent time on combines to appreciate the changing nature of crops. "It's those subtle differences in crops that can give beer its changing and evolving taste that beer drinkers love" he said. He wanted to know more about current developments in machinery, whilst I (naturally) was fascinated in the subtleties of the brewing process.

In this issue, we focus on the future of Food and IAgrE's role in production over the coming years. Whilst compiling the feature, I did think that we probably should have made it Food and Drink. The UK has a wonderful heritage in brewing which is growing through the rise of independent breweries springing up across the country to counter to mass-industrialisation of brewing by international corporations such as AB INBev, SAB Miller, Heineken and Carlsberg (Asahi, who make Peroni and Grolsch only acquired Fullers brewing operations, not the pubs, in order to join the 'big-boys').

Cider production featured in this years' IAgrE Awards. Viticulture is an expanding element at land-based colleges such as Plumpton and there are now more than 600 commercial vineyards in the UK.

Gin production is rocketing in this country – and it seems that most IAgrE branches cannot get through the year without fitting in a visit to a drinks producer!

It is not an entirely flippant observation, but I have a feeling that specialised equipment for the drinks production sector could well feature more heavily in IAgrE's 'portfolio' in the years ahead Cheers!

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IAgrE is a founder member of EurAgEng, a licensed body of the Engineering Council and a founder constituent of the Society for the Environment

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OTHER FEATURES

LANDWARDS PRODUCTION TEAM
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NEW STANDARDS PASSED BY AGCO APPRENTICES

First UK group to pass End Point Assessments

Agricultural engineers from the AGCO Apprenticeship Academy at Moreton Morrell College are celebrating being the first in the UK to pass through the tough new national apprenticeship standards for their industry sector.

Fourteen land-based service engineering apprentices, working at AGCO dealerships across the country passed through their End Point Assessment (EPA), taken with Lantra at Moreton Morrell's land-based college at the end of February.

An EPA is the final assessment apprentices undertake to make sure they are fully competent and can do the job that they have been training for. Government legislation states that a rigorous and robust EPA must be delivered by a separate body to the training provider giving employers the confidence that apprentices have achieved occupational competence. This is the first ever cohort within the agricultural engineering sector to undertake the assessment.

Apprentice Jacques Marshall, who works at Thurlow Nunn Standen Ltd in East Anglia as a trainee technician was delighted to learn he had passed all elements of his EPA. The 23-year-old from Norfolk said, "It feels great to achieve after all the hard work and effort put into the four-year programme. Agricultural technicians are highly sought after so it's really good to know that I now have the skills that will give me a good career for life. College has been great, and I've definitely made some friends for life."

Anthony Linfield, AGCO's training development manager, said, "I am delighted that AGCO's dealer apprentices have become the first ever within the agricultural engineering sector to undertake their End Point Assessments including exams. The EPA represents a key element of the AGCO land-based engineering apprenticeship scheme, and serves as demonstrable proof at pass, merit or distinction of their qualification to the employers who have invested in them."

The AGCO Academy Apprenticeship is now in its twentieth year, and in partnership with Moreton Morrell College, part of the multi-site college group WCG, has been the starting point for some of the most highly-respected and sought-after agricultural engineers in the sector.

It combines classroom and workshop training with practical, work-based development to lay the foundations of a successful career, working with brands including Massey Ferguson, Fendt and Valtra.

IAGRE APPOINT NEW CEO

The Institution of Agricultural Engineers (IAgrE) has announced the appointment of Edward Hansom, BEng CEng MIMechE, as its next CEO.

Edward was introduced to IAgrE members at the 2019 AGM and Awards held at the National Fluid Power Centre at Worksop, Notts yesterday (May 2nd) by IAgrE President, Professor Jane Rickson. He succeeds retiring CEO Alastair Taylor on 1st September 2019.

Edward is a Chartered Engineer, with a background in mechanical and production engineering and was a Marine Engineer Officer with the Royal Navy. He has over 20 years' experience of leading teams within Professional Engineering Institutions, including the Institution of Mechanical Engineers (IMechE), the Institute of Marine Engineering, Science and Technology (IMarEST) and the Royal Institution of Naval Architects (RINA).

IAgrE say Edward will bring an extensive knowledge of membership and professional matters to the Institution. He has led the development of Professional Standards (including Engineering Council registrations), Accreditation and Continuing Professional Development, with special focus on increasing Institution membership and membership benefits.

Edward has worked with national bodies, industry, academia, and international organisations; including representation at a strategic level with organisations such as UK Governmental departments, the Engineering Council, the Science Council and the International Maritime Organisation.

Commenting on his appointment Ed said, "I am honored to be taking up the appointment of Chief Executive of the IAgrE. I am very much looking forward to the opportunities and challenges that will come with the job and to build upon the excellent work Alastair has done during his tenure."

A full profile of Edward Hansom will appear in the Autumn issue of Landwards

ROYAL ACADEMY OF ENGINEERING UPDATE UPDATE

POLL SHOWS HIGH UK ENGINEERING AWARENESS

. . but little knowledge

An opinion poll commissioned by the Royal Academy of Engineering indicates that a high proportion (88%) of the British public are proud of the UK's engineering achievements and two thirds of those aware of these achievements believe that the UK will develop the next breakthrough technology. The vast majority (90%) also said they believe that engineering is important to the UK economy.

However, the poll also indicated that many people are unaware that some of the world's most significant engineering breakthroughs have been made by British engineers. Out of a list of ground-breaking innovations, only the steam engine was correctly identified by a large majority (82%) as having been developed in the UK.

Just 52% knew that the World Wide Web was created by a British engineer – Sir Tim Berners Lee OM KBE FREng FRS – while less than half (49%) were aware that the first jet engine was invented in the UK by Sir Frank Whittle OM KBE CB FREng FRS.

Even fewer (45%) knew that the colour television was a British invention, while just one fifth (19%) knew that the world's first bionic hand was developed in the UK.

The findings, based on a nationwide survey of 2,000 people, come as the Royal Academy of Engineering prepares to announce the finalists for its prestigious MacRobert Award, the pre-eminent prize for UK engineering innovation, which celebrates its 50th anniversary this year.

HEAD OF ENGINEERING POLICY

The Royal Academy of Engineering has announced the appointment of Dr Shabana Haque OBE as Head of Engineering Policy to help enhance government's access to expert engineering policy advice.

Dr Haque will be collaborating closely with the Academy's Fellows and the wider engineering profession through the newly established National Engineering Policy Centre, an ambitious partnership between the 38 professional engineering organisations in the UK, to raise the visibility and impact of engineering on public policy.

Dr Haque will join the Academy in June 2019 from the Government Office for Science, where she has been working with the Government Chief Scientific Adviser and departments across the public sector to establish, drive and deliver an ambitious transformation programme for the Government Science and Engineering Profession. In 2018, she received an OBE in recognition of her strategic leadership and services to civil service science and engineering.

Dr Nick Starkey, Director of Policy at the Royal Academy of Engineering, said: "I am thrilled with Shabana's appointment. Shabana's connections, skills, dynamism and collegiate approach will be a huge asset to the profession as it works through the Policy Centre to bring its immense expertise and insight to bear on critical policy issues for public benefit."

KUBOTA LAUNCH NEW INNOVATION CENTRES

Partnerships with external partners Kubota has announced the launch of new Innovation Centres across Japan and Europe.

The facilities are intended to encourage the creation of new business ventures, products, and services in the manufacturer›s fields of business including agriculture and construction.

In a statement Kubota said they plan to work with external partners to «*advance open innovation for proactive engagement with ICT, AI, and other advanced technologies, and accelerate the creation of new business, products, and services*".

To date, the manufacturer says they have developed products by responding to the needs of customers mainly through specialised development departments for each of its product lines, such as agricultural machinery and construction machinery.

At the same time, Kubota says, in order to respond to changing customer needs, they need to utilise new technologies such as ICT and AI. These technologies are evolving at an increasingly rapid pace, and in order to engage with them in a timely manner it is essential for Kubota to pursue partnerships (open innovation) with venture businesses, companies in other industries, universities, research institutes, and other external partners. It is for this purpose that the manufacturer is establishing its new Innovation Centres, which will take the lead in planning and proposing new business activities, products, and services that transcend existing boundaries between different product lines.

In order to respond to regional needs, these Innovation Centres will be established in both Japan and Europe. The company say they will also consider establishing centres in other regions in the future.

ECONOMIC ANALYSIS OF HANDS FREE HECTARE PROJECT

Swarm robots can 'reduce cost of wheat production.'

An economic analysis based on the Hands Free Hectare (HFH) experience provides the first concrete evidence that crop robots will help make UK farmers more competitive and improve environmental management.

That was the core message of a paper presented to the Agricultural Economics Society (AES) Annual Conference in April at Warwick by Professor Karl Behrendt, who holds the Elizabeth Creak Chair in Agri-Tech Economic Modeling at Harper Adams University.

"Robotics will radically change the economies of scale in arable farming," Behrendt said. "Once human drivers are removed from farm equipment, the motivation for large farm machines almost disappears. Evidence shows that swarms of smaller farm machines can be cost-effective on modest size farms, even when fields are small and irregularly shaped."

The lead author of the AES paper is Professor James Lowenberg-DeBoer, with other co-authors Professor Richard Godwin and Kit Franklin (leader of the Hands Free Hectare project), all from Harper Adams University. Many robotics researchers and entrepreneurs have argued that robots would be both profitable and good for the environment, but this is the first whole farm economic analysis supporting that argument.

The research was based on experience with the Hands Free Hectare at Harper Adams University in 2017 and 2018 producing grain entirely with small scale farm equipment retrofitted for autonomous operation.

"Swarm robotics will help small and medium sized British farms compete after BREXIT," Behrendt said. "For example, this analysis shows that with robotics the cost of wheat production in the UK can be competitive with countries that now export wheat to Britain. With robotics, the economic forces driving hedge removal, cutting field trees and other changes to the British landscape will be mitigated."

AGRI-FOOD SECTOR WORTH £122 billion
Employs more than 4 million people

The strategic importance and economic value of the British food and farming industry must not be overlooked in the Brexit discussions to come, the NFU has said today after it published new Defra figures as part of its State of the Farming Economy report.

The data has shown that the contribution of the agri-food sector to the national economy increased from £113 billion to nearly £122 billion in 2017, and that UK food and drink exports increased by 2.5% to £22.6 billion in 2018.

There are also even more people now employed in the UK agri-food sector, with the number surpassing 4 million.

NFU President Minette Batters said: "Defra's latest figures reinforce the importance of the British food and farming industry both nationally and globally, and its value must not be forgotten as we head back into Brexit discussions.

"Farming is the bedrock of the UK's largest manufacturing sector, food and drink, which provides the nation and wider world with safe, traceable and affordable food produced to world-leading animal welfare, environmental and food safety standards.

"Given farming's value to the UK economy and the huge number of people it employs, we must ensure that food and farming in Britain is at the forefront of Brexit negotiations."

BOOST IN TRACTOR SALES

Highest April figures since 2012. According to figures released by the AEA, UK registrations of agricultural tractors (over 50hp) in April were up sharply, reversing the trend of the first three months of the year.

At 1,606 machines, the total was up by 35.1% on April 2018 and was the highest April figure since 2012.

Stephen Howarth, agricultural economist at the AEA, explained the figures saying, "Timing differences due to system changes implemented during the month, may have exaggerated the rise. However, even allowing for that, there would still have been a noticeable year-on-year increase in April.

"In part, this may be due to manufacturers bringing machines into the country ahead of the original Brexit date, rather than risk delays at ports or extra costs which might have resulted if the UK had left the EU without a deal. Any machines involved would likely have been registered during April."

The rise in April brings the total number of machines registered in the year to date to 4,273, 4% more than in the first four months of last year. Stephen Howarth said "it remains to be seen whether the temporary factors mentioned above will balance out in the coming months."

CEO

Reflections on a changing world

MAKING OUR VOICE HEARD

Promoting the agri-tech 'agenda' through the Royal Academy

Alastair Taylor *IEng CEnv MIAgrE*

People sometimes ask me what are the benefits of joining a professional engineering institution such as IAgrE?

I always answer by suggesting that it all depends upon your motives and the benefits are both tangible such as Landwards, events, CPD and the like; and intangible such as personal commitment, individual status, being recognised as a professional, etc. I make the point that you should never compare it to the National Trust where if you make three visits to a stately home, you get your money back. We just aren't like that.

The concept of benefit will often depend where you are in your career. I can understand why someone at the start of their career and starting out might want to see more tangible benefits and a return on their investment. At the same time there is much more return on investment than you might first imagine.

I have been a member of IAgrE for as long as I can remember (33 years) and the way in which it has benefited me cannot be measured. I don't plan to drop my membership any time soon.

I am saying all of this as it seems to me that a new benefit has emerged over the last year or so.

RAE Policy Centre

At IAgrE we have a good relationship with the Royal Academy for Engineering (RAEng) and I have made it my job to get involved where I can. One interesting development has been the RAEng Policy Centre which seeks to contribute to government thinking across a whole range of matters such as the next comprehensive spending review and how engineering should be represented through to more specific matters such as energy and manufacturing.

When invited, we have always done our best to be represented and one area of policy work which is of current interest is the subject of robots and automation. I was certainly keen to extend the opportunity to the Agricultural Engineering community to get involved. We wouldn't want future legislation and investment to be controlled only by the automotive sectors - would we?

I view this opportunity to get involved with the RAEng Policy Centre and to fly the Agricultural Engineering flag on subjects of relevance to our sector as a great membership benefit. You wouldn't get the opportunity to influence policy and offer your expert knowledge if you weren't an IAgrE member - would you?

New opportunities for members to contribute their expertise are coming along all the time so do keep a look out for these. We are considering a web page where we will flag up all these great opportunities for IAgrE members to contribute to the debate.

This goes a little further in that some members have a passionate interest in emerging aspects of engineering and through IAgrE can bring these to the attention of the RAEng Policy Centre. If there is something you feel should be highlighted, do bring it to our attention. It might not go anywhere but who knows, it might just hit a chord with the policy makers.

Thanks

I have just worked out that this is probably my final contribution to Landwards in my capacity as CEO, even though it will another three months before I finish. I may well continue to contribute to Landwards as a member as I plan to do some technical writing when I stand down at the end of August. I am not going to be too far away!

Once an Agricultural Engineer, always an Agricultural Engineer!

It would be remis of me not to thank all IAgrE members and particularly those who have run local branches, joined committees and helped to make my job easier. I have enjoyed working with four different Presidents over my six year term.

The camaraderie and support has been wonderful.

I wish you all well and hope that you give my successor Edward Hansom the same support, wise council and encouragement that you have given me.

Best wishes to all of you.

A.J. Taylor.

AWARD FOR LEAF'S CAROLINE DRUMMOND

'Women of the Decade' recognition at New Delhi forum

Caroline Drummond, Chief Executive of LEAF (Linking Environment and Agriculture) was announced as a recipient of Women of the Decade award at the Annual Women Economic Forum (WEF) held in New Dehli, India in April.

The WEF Awards 2019 celebrate achievers from all walks of life and Caroline joins numerous other women (and men) who have been recognised by the WEF.

The annual WEF forum, which is now in its 25th year, is a global platform that brings together pioneers and practitioners in circular economy, agriculture, sustainable development, public policy, smart cities, conscious enterprises, data and tech, cybersecurity, and all aspects of engagement and empowerment. The overall theme of this year's event is "Reimagining Societies: Reclaiming Humanity with Gender Equality".

LEAF Chairman, Philip Wynn said: "We are delighted to announce that Caroline, who has led LEAF since 1991, has been selected as a deserving recipient of the WEF Women of the Decade award for her work to develop and promote more sustainable farming. The award is a testament to her passion, hard work and dedication to global sustainability issues."

Caroline Drummond added: "It is a great honour to receive this award. I am very humbled to be selected and grateful for the support of my colleagues over the years, with whom I would like to share this recognition. It signals LEAF's growing recognition on the global stage in driving more sustainable farming. As we strive to ensure the impact of our work is meaningful, such an award greatly raises LEAF's profile in demonstrating what we do and what our farmers achieve. The global environmental challenges are massive, and this award recognises that the part LEAF plays is making a meaningful difference."

Caroline has led LEAF since it was first set up in 1991. Her work focuses on encouraging more sustainable farming practices and building better public understanding of farming and the environment. She is actively involved in many industry partnerships and initiatives.

In 2009 Caroline was awarded the Member of the British Empire (MBE) by the Queen, and has an Honorary Doctorate from Harper Adams University, as well as a Nuffield Scholarship studying 'What can Farmers Learn from Science to Improve the Nutrition of our Food'.

She was also awarded Honorary Fellowship from the Society of the Environment, and in 2017, received the IAgrE Award for Outstanding Contribution to the Landbased Sector and the Farmers Guardian Outstanding Contribution to Agriculture. In 2018 she was awarded the RASE National Agriculture Award and an Honorary Fellowship from the Royal Agricultural University.

REPLACE SOIL WITH FOAM

Sheffield scientists say crops can grow up to 10 times faster.

Experts from the new Institute for Sustainable Food at the University of Sheffield have found that crops planted in polyurethane foams at an urban farm grow two to ten times faster than plants grown in soil.

Using a network of pipes, nutrient solutions, controlled growing environments and foams, scientists are growing everything from salad to tomatoes – demonstrating a potential solution to the global crisis of soil fertility.

Harry Wright, a PhD student at the University's Grantham Centre for Sustainable Futures, has developed specialist foams that chemically, physically and biologically resemble soil.

Jacob Nickles, a Knowledge Exchange Associate, has put Harry's foams to the test, transforming an abandoned school in Sheffield into an urban farm with the installation of pioneering hydroponics systems.

The potential of the low-cost system has already been demonstrated with an initiative to install hydroponics systems made from used mattresses at a refugee camp in Jordan, led by Grantham Centre Director Professor Tony Ryan, in collaboration with Professor Duncan Cameron at the Institute for Sustainable Food.

Professor Duncan Cameron, Director of the Institute for Sustainable Food at the University of Sheffield, said: "Urban farms that use foam instead of soil could take a lot of pressure off existing agricultural systems. And because this system is so efficient, it enables us to feed our growing population using fewer resources.

"In the future, I hope we can see farms like this all over the world, optimised for local conditions and producing cheap, healthy and sustainable food."

After opening, the farm will provide fruit and vegetables to the community in Tinsley, Sheffield, as well as training for local unemployed or low-skilled workers and an educational environment for schools.

The launch will be the first event hosted by the new Institute for Sustainable Food at the University of Sheffield – which brings together multidisciplinary expertise and world-class research facilities to help solve global problems like soil loss, achieve food security and protect the natural resources we all depend on.

Leading experts from the institute will offer hands-on demonstrations, food tasting, craft workshops and talks on nutrition and growing food in cities.

Professor Tony Ryan, said: "Our frontier research on synthetic soils meant we were primed to react to a waste disposal problem posed by UNHCR.

"The dirty and unusable second hand foam mattresses, considered a waste disposal problem in the Za'atari refugee camp, were identified as an alternative growth substrate and we found that potential urine contamination could actually aid growth.

CHANGING DIETARY HABITS

New production facilities off-farm?

IAgrE President
PROFESSOR JANE RICKSON CEnv, FIAgrE

President's Musings

You will have noticed that recent editions of Landwards have celebrated the Institution's 80th Anniversary, marking this impressive landmark with the question: "where will we be in IAgrE's centenary year?". The current edition focuses on food in 2038: what will we eat and how will it be produced?

This topic got me thinking of the past as well as the future and I came across the "Urban Working Class Household Diet (1940 – 49)" published by the National Food Survey Committee of the Ministry of Food "using records supplied voluntarily by selected samples of housewives".

For example in 1934-1935, adults consumed 3.7 pints of condensed milk per head per week! Clearly diets have changed significantly since then…but what are the challenges for future food production (and how can agricultural engineers tackle them?)

By the year 2050, the global population is expected to increase to 9.2 billion. How will they be fed? We only have finite land available, suggesting more intensive farming methods will be needed, but this can increase environmental degradation, which in turn reduces agricultural productivity.

Some studies have shown that total agricultural area has even decreased since 2000, with declining stocks of arable land per person. Use of fertilizers and pesticides has increased, while their efficiency has decreased, and available water sources are under intense competition.

Expansion of biofuel production, urban development, diets with a higher proportion of livestock-based products and climate change (causing more extreme weather events that threaten crop production and increase land degradation) will all intensify the risks of a global food crisis in the coming decades. As well as challenges to primary production, food safety, quality, authenticity, traceability and waste are also of concern.

> Adults consumed 3.7 pints of condensed milk per head per week

Clearly, we have to find ways to maximise food production with minimum damage to the environment. Some argue better crop breeding technology can boost agricultural production despite the challenges above, including the use of old varieties, GMOs or organic farming that are claimed to be more resilient to climate change.

Others advocate the use of urban vertical farming using rooftop gardens, greenhouses and indoor farms (defined as "ZFarming"), with much greater use of technology and automation to increase food productivity whilst reducing environmental footprint and food miles.

It is predicted that there will be increasing emphasis on foods with health promoting ingredients (e.g. natural antioxidants, concentrated vegetal extracts as phytochemicals, vitamins and fortification ingredients, prebiotics and probiotics).

> Increasing emphasis on foods with health promoting ingredients

These "functional foods" (e.g. "nutraceuticals" and ready-to-use-therapeutic foods) are claimed to reduce the incidence of chronic health disorders, so improving human health and wellbeing (and saving expenditure on health services). Future agricultural engineers will need to have the skills to develop these products, including nano-biotechnology, sensing technology, smart packaging, bio-based packaging materials, and non-destructive food testing.

Clearly, innovative farming systems and technological changes are needed to produce abundant, safe, and nutritious food; reduce harmful environmental inputs; and maintain the economic viability of farmers and rural communities.

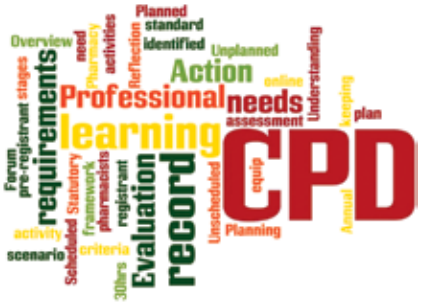
Agricultural engineering is uniquely placed to meet the food production and environmental challenges ahead.

Finally, I'm delighted to see that 'soil' is mentioned a number of times in the NFU report on the Future of Food 2040. According to the Food and Agriculture Organisation of the UN, 97% of our food comes from the soil, which is likely to continue well beyond 2038. So it is vital we maintain and improve this precious and finite resource for future generations.

IAgrE MEMBERS NEWS

CPD REQUESTS

Don't panic if you have received a request for your CPD Review for the past year. This is sent to selected members and is an obligation on IAgrE to provide an annual 'snapshot' of CPD. Activities which can be counted as CPD include conferences, courses and seminars, organised visits, writing articles or papers, IAgrE committee work, IAgrE technical meetings, professional updating by reading or private study, secondments and exchanges, further education, distance or open learning.



If you have any problems completing your CPD please give Sarah a call on 01234 750876 and she will be very happy to talk you through it.

Groundswell

IAgrE is partnering with the Society for the Environment to exhibit at Groundswell on 26th to 27th June 2019 at Lannock Manor Farm, Weston, Hertfordshire SG4 7EE

Entering its fourth year, The Groundswell event provides a forum for farmers and anyone interested in food production or the environment to learn about the theory and practical applications of Conservation Agriculture or regenerative systems, including no-till, cover crops and re-introducing livestock into the arable rotation, with a view to improving soil health.

Come and see us in Pasture Field A14 we are next to BioFarming and MicroMix, opposite Hutchinsons and behind Defra.

V & A EXHIBITION

FOOD: Bigger than the plate

The work of chefs, farmers, scientists and artists are all in **FOOD: Bigger than the Plate**, which is now open at the Victoria and Albert Museum in London.

Among the exhibits will be three cheeses created from bacteria gathered from an as yet un-named trio of celebrities, whilst Designer Carolien Niebling has teamed up with a butcher and a chef to create a range of more sustainable sausages including fruit salami and insect pâté.

Also on display will be dozens of objects from the V&A's own collection including early examples of advertising and ceramics, while artists from the Fallen Fruit collective have been commissioned to make a huge 12-metre squared wallpaper inspired by the museum's exhibits and the history of its Kensington site, once used as a nursery for fruit trees.

The curators say "In an era of major ecological challenges, fast-changing societies and technological re-invention, now is a crucial moment to ask not just what will we be eating tomorrow, but what kind of food future do we want? What could it look like? And taste like?"

MEMBERSHIP SURVEY 2019

We want to make sure our members are getting the best possible service from IAgrE. To help make this happen we are looking into the services we provide and how, moving forward, we can adapt and improve our membership offering.

We would be very grateful if you could take a moment to complete the questionnaire which can be accessed on the www.iagre.org

Everyone who takes part will be entered into a prize draw and the winner will receive a £50 Amazon voucher. To qualify you must have completed the questionnaire no later than Friday 28th June 2019.

LANDWARDS

IAgrE seeking new Editor

After 12 years of editing and producing IAgrE's professional journal, Landwards, Chris Biddle is to retire from the role. He will continue to produce the remaining (Autumn and Winter) issues for 2019. IAgrE has issued a tender document for the production of Landwards from 2020, with a closing date of 30 June 2019. Commenting Chris says "It has been an absolute privilege to have been entrusted with the production of the Institution's journal for the past 12 years. Not an issue has gone by without me adding to my knowledge and appreciation of the vast array of work undertaken by the IAgrE community. I would like to thank all the contributors and those who responded to the issues and views expressed through the pages of Landwards. Most particularly, a big thank you to the branches for the reports of their meetings and visits that took in so many different topics ranging from genetics to gin. And of course, real gratitude to the IAgrE head office team for their advice, thoughts and proof-reading skills -and to CEO's Chris Whetnall, Alastair Taylor and recently Ed Hansom with whom I look forward to collaborating during the rest of 2019.

It has been my pleasure to have worked closely with six IAgrE Presidents from Richard Robinson to Jane Rickson, all have stamped their influence on the content during their term.

Over the years, we have tried to keep Landwards fresh and relevant. Occasionally, we will have missed the mark, but I hope that overall Landwards has informed, influenced and entertained.

I shall miss the quarterly challenge of producing a 'window' on IAgrE's world. However, this is the right time for me personally - and it will provide an opportunity to take a fresh look at Landwards through new eyes."

BEHIND THE SCENES

PUBLICATIONS COMMITTEE

Publishing forms a very important part of the IAgrE function as well as a vital source of income. If you look at our Memorandum and Articles of Association it is very clear from the first two objectives how this is at the very heart of the IAgrE's reasons for existence, namely:

- To promote the consideration and discussion of all subjects affecting the profession of Agricultural Engineering and to facilitate the exchange of information and ideas.
- To disseminate information on all matters relating to Agricultural Engineering and to produce relevant publications in any form.

All of this easier said than done.

There are three broad themes to IAgrE publishing, firstly Landwards, the quarterly member's journal, secondly the learned journal Biosystems Engineering which operates as a joint venture with an international publisher, and thirdly the range of reports and responses which IAgrE produces from time to time.

LANDWARDS

Landwards starts with a broad plan for the year and readers will notice that each issue follows a theme. All of these are agreed in advance to ensure that Landwards is broadly balanced to meet the needs and interests of IAgrE members. We are such a diverse Institution and hitting all of the different specialisms can be a challenge.

A quarterly meeting between the Landwards editor and the IAgrE Secretariat takes place. Although a general theme will have been planned in advance, these meetings tend to be something of a "brainstorming" session in which topical news is discussed and if a member has done something particularly interesting, or there is a new theme emerging from the Royal Academy of Engineering, the Engineering Council, or the Society for the Environment, this is the place where these are raised and news worthy stories agreed.

As such, Landwards is an evolutionary publication and where needed very responsive to whatever is going on in the industry. One innovation has been the Perspectives section – eight pages which seeks to showcase subjects of a more technical nature. Some of these are articles from other engineering publications which are viewed to be of interest to IAgrE members, or technical papers written by IAgrE members.

We get a few letters to the Landwards editor, nothing ever too controversial, but these are always the subject of discussion to ensure that we meet the needs of our members as well as avoiding falling foul of our publishing objectives.

PUBLICATION MANAGEMENT COMMITTEE

This is an important committee with its terms of reference laid out in the IAgrE regulations. This committee is formed of the President and President Elect as well as colleagues from a range of backgrounds – academia to industry. There are always opportunities to get involved with this if this is something which interests you.

The Publications Management Committee (PMC) meets twice a year and in a nutshell, ensures that anything published under the IAgrE name is accurate, correct and above all will not bring IAgrE into disrepute.

Reports from the editors of Biosystems Engineering always form an important agenda item. This is always an interesting discussion and looks in detail at trends. For example the number of papers submitted to the journal has risen from around 800 to 1300 over the past six years. The number published has remained largely stable and the increase in papers submitted is indicative of a journal that is doing well and appealing to the research community as a good place to publish. Discussions also look at the countries where papers are coming from and as you might anticipate, China is a growing market.

Other discussions look at the topics for special editions of Biosystems Engineering with thought on emerging areas and the subjects that should be highlighted. I never cease to be amazed by the range and quality of papers submitted to the journal as well as the wisdom of the editors in sorting the good quality and relevant papers from those which might be better published elsewhere.

Another interesting subject for PMC discussion is the matter of plagiarism, which thankfully is an infrequent occurrence. It is the job of PMC to ensure that these have been handled fairly and that the journal has not been compromised. Every other year, there is a meeting with the publisher where the discussion is broader, looking at the markets where the journal is sold together with emerging challenges such as the move from a subscriptions model towards one of more open access where there is a payment for publication with free ongoing access.

PMC touches on Landwards and particularly where a technical article has been submitted by a member or an article is being re-published. There are occasions where PMC might be critical of an article in terms of its accuracy or relevance – but not often. As such, they act as an editorial board.

The final area of work for PMC relates to special publications produced by IAgrE. In the past two years, we have been commissioned by government departments to prepare research and technical reports and as such, these have become a useful source of income for IAgrE as well as showcasing our capability as a Professional Engineering Institution.

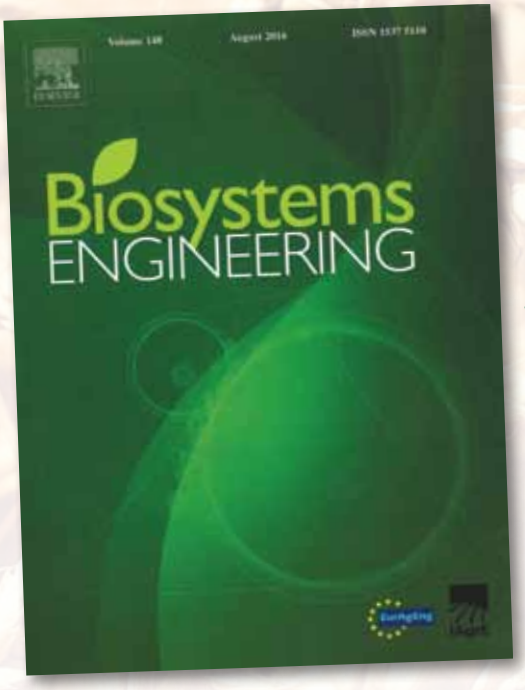
Nothing is put into the public domain until PMC has checked it over.

So there you have it – an insight into another aspect of your Institution. Perhaps you weren't aware of the rigour that goes on behind the scenes but it is in your interest that IAgrE set a high bar and maintains a good standard in its outward facing publications.

By following this approach, we maintain our reputation and continue to be a well-regarded institution that deals in high quality and relevant publishing. If you want to get involved, do please get in touch.

Landwards meeting at Cranfield: (l-r) Marion King, Alastair Taylor, Sarah McLeod, Chris Biddle, Alison Chapman

Biosystems Engineering



Biosystems Engineering, owned by IAgrE, and the Official Scientific Journal of EurAgEng, is published monthly with occasional special issues.

Reduced subscriptions are available to members of IAgrE. To view the full article list of the current edition, visit:
www.sciencedirect.com/science/journal/15375110

For further details of the depth and breadth of articles accepted for publication in Biosystems Engineering, visit:
www.journals.elsevier.com/biosystems-engineering

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www.iagre.org/biosystemsinformation

The Managing Editor of Biosystems Engineering, Dr Steve Parkin, has kindly summarised a selection of papers published in the last three issues which he believes will be of interest to IAgrE members

Biosystems Engineering

Volume 179, March 2019, Pages 35-48

Human–robot interaction in agriculture: A survey and current challenges

Juan P. Vasconez, George A. Kantor, Fernando A. Auat Cheein
Universidad Técnica Federico Santa María, Valparaíso, Chile
Carnegie Mellon University, Pittsburgh, PA, USA

Human–robot interaction (HRI) is an extensive and diverse research topic that has been gaining importance in last years. Different fields of study have used HRI approaches for solving complicated problems, where humans and robots interact in some way to obtain advantages from their collaboration. Many industrial areas benefit by applying HRI strategies in their applications, and agriculture is one of the most challenging of them. Currently, field crops can reach highly autonomous levels whereas speciality crops do not. In particular, crops such as fruits and vegetables are still harvested manually, and also some tasks such as pruning and thinning have long been considered to be too complex to automate completely. In addition, several countries face the problem of farm labour shortages. As a consequence, the production process is affected. In this context, we survey HRI approaches and ap-plications focused on improving the working conditions, agility, efficiency, safety, productivity and profitability of agricultural processes, in cases where manual labour cannot be replaced by but can be complemented with robots.

Biosystems Engineering

Volume 180, April 2019, Pages 146-160

Optimisation tool for logistics operations in silage production

Patrizia Busato, AlessandroSopegno, Niccolò Pampuro, Luigi Sartori, RemigioBerruto
University of Turin, Torino, Italy
Italian National Research Council (CNR), Torino (TO), Italy
Department of Land, Environment, Agriculture and Forestry, Legnaro , Italy

A critical task within the logistics operations in silage production, i.e. harvesting, transporting, and compacting, is the management of the biomass flow, in connection with the biomass storage system and the required conditions of the stored product depending on its further purpose of use. A key issue in large-scale silage production operations is the matching of the material processing capacity of forage harvester with the material removal capacity of transport units and the material processing capacity of the compactor, in order to maintain a steady material flow. This allows for the optimisation of the working chain. A decision support system was developed that for a given silage production system determines the configuration of the optimal number of transport units in each field of an area to be harvested that minimises the total operational cost of the production system under time constraints for the completion of the operation. The tool provides performance evaluation measures that consider the interaction of the various parts of the working chain and can be easily tuned for other silage operations with different crops.

Biosystems Engineering

Volume 181, May 2019, Pages 140-156

Robotic kiwifruit harvesting using machine vision, convolutional neural networks, and robotic arms

Henry A. M. Williams, Mark H. Jones, Mahla Nejati, Matthew J. Seabright, Jamie Bell, Nicky D. Penhall, Josh J. Barnett, Mike D. Duke, Alistair J. Scarfe, Ho Seok Ahn, Jong Yoon Lim, Bruce A. MacDonald
University of Auckland, Auckland, New Zealand
University of Waikato, Hamilton, New Zealand
Robotics Plus Ltd, Tauranga, New Zealand

As labour requirements in horticultural become more challenging, automated solutions are becoming an effective approach to maintain productivity and quality. The design and performance evaluation of a novel multi-arm kiwifruit harvesting robot designed to operate autonomously in pergola style orchards is reported. The harvester consists of four robotic arms that have been designed specifically for kiwifruit harvesting, each with a novel end-effector developed to enable safe harvesting of the kiwifruit. The vision system uses deep neural networks and stereo matching for reliably detecting and locating kiwifruit in real-world lighting conditions. A novel dynamic fruit scheduling system is presented that has been developed to coordinate the four arms throughout the harvesting process. The performance of the harvester has been measured through a comprehensive and realistic field-trial in a commercial orchard environment.

COVER FEATURE: **LANDWARDS 2019**

Vision 2038: *Part Two*

FOOD

What will we be eating, and how will it be produced?

DIET AND HEALTH

The food British farmers produce will be dictated by what people want to eat. Shifts in eating habits have the potential to have a profound impact on farm businesses. The way the retail sector evolves and adapts will also change the way farmers work with their customers.

Today, we know that healthy eating is important to keep our bodies in tip-top condition.

A link between diet and health was first 'proved' in the mid-1800s by Scottish naval surgeon Dr Joseph Lind, who is credited with running one of the earliest ever clinical controlled trials. His study demonstrated that citrus fruits could protect sailors from scurvy. The watershed finding set the stage for lemons and limes to be issued as standard in sailors' rations - and showed how healthy eating can save untold numbers of lives.

These days, science dissects almost every element of our diet. Even when sticking to official advice, healthy foods that seem to energise one person can cause another to feel fatigued and bloated. Why can some people eat what they want, and never put on weight, whilst for others the 'battle of the bulge' is an ongoing challenge?

In 2015, a team of scientists from Israel tracked blood sugar levels in the blood of 800 people over several days, making the surprising discovery that individuals' biological response to identical foods varied wildly. Some people had a blood glucose 'spike' after eating sugary ice cream, while

NEW CHALLENGES

IT is forecast that over the next two decades, the UK farming industry will undergo significant changes in policy, markets and consumer demand, the likes of which haven't been seen since the introduction of the 1947 Agriculture Act.

The 2011 Foresight report on the Future of Food and Farming outlined the huge challenges to the global food system between now and 2050 – notably water scarcity and the impacts of climate change. The global population will also become older and more urbanised, both of which will impact on food consumption patterns and agriculture. The unstoppable pace of technology continues to revolutionise our world, but it is a world that is becoming more volatile, not just climatically, but also economically and politically.

With all these factors at play, it is timely that those at the forefront of agri-technology, such as the Institution of Agricultural Engineers, should be fully prepared to meet new challenges.

2038, now less than 20 years from now, may seem a long way away, but planning for that future must start now. Business as usual will not be an option.

others' glucose levels only increased with starchy rice – a finding at odds with conventional wisdom.

In the next 10 years, the emerging field of 'personalised nutrition' will offer healthy eating guidance tailored to the individual.

Our bodies' idiosyncratic handling of nutrients seems to be down to our genetics, the microbes in our gut, and variations in our organs' internal physiology. Clinical trials like those pioneered by Lind have given us general dietary guidelines, but nutrition research tends to assume all humans are the same, and so can miss the nuances and specific needs of the individual.

It is likely that by 2038, we will understand much more about our genetics. Dr Jeffrey Blumberg, a professor of nutrition science and policy at Tufts University in Massachusetts insists that DNA testing will unlock personalised nutrition. "I'll be able to tell you what kinds of fruits, what kinds of vegetables and what kinds of wholegrains you should be choosing, or exactly how often," he says.

SLOW CHANGE

Diets are notoriously difficult to predict, but there is unlikely to be dramatic changes in our diet in Britain over the next 20 years according to the recent ***Future of Food 2040*** report by the National Farmers Union (NFU).

They predict that whilst fad diets will come and go, and consumers will continue to seek out new and novel taste experiences, change is often very slow due to ingrained social and cultural influences. There is likely to be a simple and more gradual continuation of existing long-term established trends rather than a revolution. According to the Office of National Statistics by 2038 24% of the population is expected to be over 65 (in 2018 it was 18%).

The shift to dish-based meals and away from meals where a primary protein has been the focal point is likely to continue, along with the drive for convenience. The average time spent preparing a meal has dropped from 60 minutes in 1980 to around 30 minutes in 2016.

Convenience will be the key, the UK's 'food-to-go' sector is set to grow at twice the rate of overall grocery retail.

With the UK on course to be the most obese nation in Europe by 2030 according to the OECD, it's not surprising that diet-related health concerns, and the pressure this will put on our health services in the years ahead, will dominate the future food agenda.

While the UK's food-to-go sector is predicted to grow, it is possible we could see a renaissance in "cooking from scratch" which could slow the trend.

Moves towards "fresh" and "natural" driven by the health agenda are already starting to emerge, according to the Agriculture and Horticulture Development Board (AHDB) and it is possible this will encourage a return to more cooking at home.

BRITISH FOOD

The NFU report predicts that British shoppers will continue to want to feel good about the food they buy and eat rather than necessarily understand and know the detail. Just because people will be able to access more information in the future, this will not necessarily mean they will have any greater engagement.

Research from AHDB shows continuing strong support for British food and food producers and a strong association with higher quality.

While future support for, and trust in, British farming will endure, consumer reports from AHDB suggest that ultimately it will be high quality, safe, affordable and, importantly, inspiring food that will drive people to buy British, and not sentiment.

Research by the Institute of Grocery Distribution (IGD) into the Millennial shoppers of tomorrow (currently aged 18 to 25) backs up this point and suggests these future consumers will expect "better products, prices, more product diversity and improved services, along with wanting meaningful experiences and inspiration."

People will continue to value British standards and will expect high environmental, safety and welfare standards as the norm, and there has been a growing interest from British consumers over recent years in how their food is produced.

This is likely to increase over the next two decades, particularly with regard to environmental impact. However, this doesn't always translate into how people make individual product buying choices. Cost is still the driving force for many consumers.

The Sustainable Development Goals set by the United Nations' 2030 Agenda will further focus political and stakeholder attention on the

sustainability of our food system. A Food Sustainability Index has already been developed to attempt to rank performance as a nation and guide policy making. But, despite all this, we should not expect people to want to pay more for their food. Information from IGD shows price, quality and convenience will remain significant drivers of consumer choice - and farm businesses will have to work even harder to market their 'Unique Selling Points' and access premium prices in an increasingly crowded market. Provenance and marketing will be extremely important and fiercely competitive and so value-added products will need to stand up to, and stand out from, global competition.

MEAT AND POULTRY

'Flexitarian' trend

People will continue to enjoy eating meat and it will still be seen as a good source of protein and vitamins, as well as continually delivering on one of the key drivers of purchasing behaviour – taste. Increasing resource and energy costs, and pressures from climate change, may drive up the cost of meat, but it may also create some opportunities in terms of differentiating on quality and premium. In-vitro meat (see panel) and insect protein may well grow in popularity depending on advances making these protein sources more palatable, and the ability for them to be produced cost-effectively at scale.

There has been considerable research into the potential contribution that insect protein could make to food systems of the future including by the Food and Agriculture Organisation of the United Nations (FAO), and cricket flour is already being used as a way of integrating protein into bakery goods.

While these products and other replacements, such as dairy alternatives, may be freely available, "normalised" and integrated into our diets, it is unlikely they will dominate the shopping basket and be a direct replacement for the vast majority of British people.

The increasing popularity of more flexitarian diets (diets that are predominantly vegetarian with occasional meat and fish consumption) is likely to continue, with 41% of meat eaters currently classified as "flexitarian" and the percentage of 'meat-free' evening meals on the rise in Britain, according to research from Kantar Worldpanel.

But this increase in "flexitarianism" does not necessarily signify a shift towards alternative protein sources, such as pulses, and might provide some opportunities for product development, according to the AHDB.

However, the FAO reports that beyond the UK, based on current levels, global meat consumption is set to double by 2050, mostly in developing countries, due to rising incomes and urbanisation.

POULTRY

According to the EU Agricultural Outlook 2018-2030, poultry is the only meat that will see a strong increase in production across the EU, along with an increasing global demand.

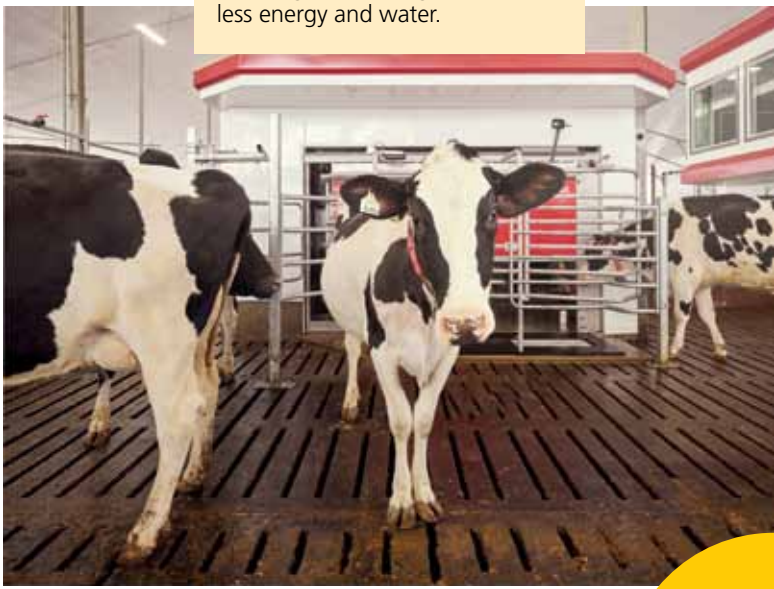
The average person in the UK eats an incredible 33 kilograms of poultry

LAB-GROWN MEAT

Scientists in Holland successfully produced in-vitro meat, also known as cultured meat. They grew strips of muscle tissue using stem cells taken from cows, which were said to resemble calamari in appearance. The first scientific paper on lab-grown meat was funded by NASA, says social scientist Dr Neil Stephens, based at Cardiff University's ESRC Cesagen research centre. It investigated in-vitro meat to see if it was a food that astronauts could eat in space.

Ten years on and scientists in the field are now promoting it as a more efficient and environmentally friendly way of putting meat on our plates.

A recent study by Oxford University found growing meat in a lab rather than slaughtering animals would significantly reduce greenhouse gases and use less energy and water.



BELOW: Farmer run milk dispenser in pub car park

meat per year according to Defra. That's 10kg more than beef and lamb put together. Chicken production and consumption is expected to increase by seven percent in the next 10 years.

There is a big opportunity for British poultry farmers to continue to produce a product that is affordable, versatile, low in fat and growing in popularity.

Estimates by industry experts show that there is a weekly UK demand for 24 million chickens. At the moment we are falling short of this by around six million.

DAIRY

The UK is the third largest dairy producer in the EU and tenth in the world. There are approximately 13,000 dairy farmers producing 14.0 billion litres of milk per year, which makes the UK approximately 80% self-sufficient in dairy products. 99% of all dairy imports currently come from Europe.

Whilst Brexit remains a challenge to the dairy industry, it is the current uncertainty that is perhaps most unnerving and makes planning difficult.

The overarching priority for the industry to address is how to produce a commodity (milk) profitably, in an economic climate where supply and demand is finely balanced. There have been huge milk price variations over short economic cycles (35.0 pence per litre in November 2013 to 19.0 pence per litre in June 2016).

Support is likely to change and reduce. The justification for £3.0 billion of direct support to a farming industry that contributes less than 1.0% to the country's GVA will be difficult to justify, particularly given ongoing competition for funds from other sectors of the economy such as the NHS.

Forty years of income support appears to have done little to improve productivity and efficiency, and so a change to the support system should not necessarily be seen as a negative. Any change in support will almost certainly impact on the supply and retail elements of the dairy food chain.

The industry's greatest virtue, which is so underplayed, is the standards achieved in terms of animal welfare and food hygiene across the dairy food chain in the UK. Whilst there is always room for improvement, the consumer should be reassured that the bar is constantly being raised; driven by the retailer pools, with Marks & Spencer and Waitrose leading the way.

GENERATION GAP

In a report for the Sustainable Food Trust, dairy farmer Alex Heffron, says that younger adult 'millenials' are choosing to consume less dairy than their parents and grandparents, and more 'mylk' alternatives like almond, oat and soya milk. In 2016, head of Dairy UK, David Dobbin, said that, "It's a demographic time bomb. If we don't address the problem now, then we are facing a fall-off in demand for dairy."

According to market research carried out on behalf of The Grocer magazine in 2017, millennials have three concerns about milk: how healthy it is, animal welfare and its environmental impact. In recent years, the dairy industry has largely responded by trying to convince people that there's nothing to worry about – that dairy is indeed healthy and that the British dairy industry has world-leading animal welfare standards.

"I think the dairy industry needs to look at what is underlying consumer concerns. Why is it, for example, that older generations say dairy is good for them, and younger generations say that it is bad for them?" he says.

"There are three key aspects in changing Millennials attitudes to dairy: connection, identity and trust. People get excited about knowing where their food comes from; that might mean opening your farm up to customers or sharing videos on social media. People increasingly want their food to come with a face and a name on it.

Identity can lead to trust – or lack of it. If milk is packaged in a bland, plastic bottle and you don't know what farm, region or even country that it's produced in and there's no information about how it's produced, then it's hard to trust its provenance. The general public are wanting to know more about their milk, as well as other foods. The dairy industry's mass marketing campaigns for a nebulous product are missing the point.

More and more, people are getting the sense that dairy is moving in a direction they dislike. Most people want to see cows in fields not barns.

Concerns about nutrition, welfare and the environment must be addressed, but dairy must address its lack of value in the eyes of consumers, and this begins with the most basic value of all: taste.

People buy our milk for all sorts of reasons, but the number one thing that excites them is that it has flavour. It's rich, creamy, sweet, and has a unique texture in the mouth unlike any milk that can be bought from a supermarket. There are two basic issues that face farmers and they're both intertwined. They're paid too poorly, and they're undervalued and underappreciated. There is a revolution in dairy waiting to happen and some innovative farmers are already starting to reap the rewards. Those who are investing in bottling their own milk, producing their own cheese, yoghurt or kefir, and connecting with their customers are getting a head start in a completely uncontested marketplace."

HOW WILL FOOD BE PRODUCED – AND WHERE?

CEREALS

The UK is a relatively major player on the global cereal market as a top 15 wheat producer. It arguably punches above its weight because of its large population and its long history of developing new varieties and growing techniques. The UK is also very good at producing grain efficiently. It is a British farmer who currently holds the world wheat yield record and only a few other countries in the world can consistently deliver such high-yielding cropss.

It is important that the UK grain industry makes the most of its natural advantages both before and after Brexit. Consumption of grain-based products may be static at best in the UK but a rising population does still mean there are plenty of opportunities. However, the buoyancy of the UK market will attract the attention of other countries, especially those in Europe where populations are declining such as Germany and even Russia.

Cereals are one of the few commodities where the UK has an exportable surplus. There are already signs that UK shipments are shifting away from the EU to outside it, although the union is still the biggest market. In the 2015/16 season 17.5% of wheat exports were outside the EU and in 2014/15 it was 36.5% which compares to 11.4% over the last 11 seasons. Barley exports outside the EU account for around a third of shipments every year with the proportion rising.

The immediate effects of Brexit were largely positive for the UK grain industry, with a plunging pound making the UK more competitive. But then the reality of the global market kicked in and even a poor European harvest did little to reduce the world's stockpiles of grain and prices remained subdued.

In many ways Brexit is a sideshow for the cereal sector with the future of support perhaps the most pressing issue. Currently only a very few British growers will be making money without support and there will be concerns as to the future of payments after 2020.

But Brexit will have little impact on the fundamentals of the grain market - notably the weather, demand and production in other parts of the world. Although still niche, there is an ongoing move to bring food production closer to large population centres, but the main agricultural growing areas will still be traditional farmland, which will witness a hastening of new technology, particularly robotics.

With the global food chain under pressure from population growth, Robotics and Autonomous Systems (RAS) are now seen as enablers of this critical food chain transformation *according to the UK-RAS report on The Future of Robotic Agriculture*.

The opportunities for RAS range include the development of field robots that can assist workers by carrying payloads and conduct agricultural operations such as crop and animal sensing, weeding and drilling. The integration of autonomous systems technologies into existing farm operational equipment such as tractors. Robotic systems to harvest crops and conduct complex dextrous operations. The use of collaborative and "human in the loop" robotic applications to augment worker productivity and advanced robotic applications.

In short, RAS technology has the potential to transform food production and the UK has an opportunity to establish global leadership within the domain.

To deliver this vision, says the UK-RAS report, research and innovation requirements include the development of robust robotic platforms suited to agricultural environments, and improved capabilities for sensing and perception, planning and coordination, interoperability between robots and existing machinery, and human-robot collaboration - including the key issues of safety and user acceptance.

However, technology adoption is likely to occur in measured steps.

Most farmers and food producers will need technologies that can be introduced gradually, alongside their existing production systems. There will be a transition period in which humans and robots work together as first simple and then more complex parts of work are conducted by robots, driving productivity and enabling human jobs to move up the value chain.

DRONES

There is huge untapped potential for the use of Unmanned Aerial Vehicles (UAVs), or drones, for sensing and mapping. Solar powered drones capable of staying airborne for days and capturing real-time information on pests and weather are being developed. Used in combination with hyperspectral imaging sensors (i.e. sensors capable of looking at multiple spectra of light in closely spaced bandwidths), they could be used to detect the early onset of disease and stress.

They could even be used for the remote collection of ecosystem information – potentially helping with the monitoring and evaluation of future environmental schemes.

The adoption of new technology will also help agriculture reduce its environmental burden through the ability to carry out operations more precisely and with less resources, further reducing its impact on the natural environment.

VERTICAL FARMING:

Stewart Brand, author of Whole Earth Discipline says "We will see industrial districts of cities turning into semi-agricultural districts with year-round vegetables and fruits grown in dense indoor farms."

Hydroponics, aquaponics and other controlled environment systems will not just be a niche market or a novel urban enterprise. While growing crops undercover and the use of hydroponics is not new, the introduction of vertical stacking and recent advances in LED technology will have expanded the range of crops it is possible to grow in this way. Worldwide predictions indicate the vertical farming industry will have a multi-billion-pound value over the next few years. Supermarkets are already taking an active interest in how this might fit their business model of the future, specifically because of the potential for saving energy and inputs like fertilisers, reducing waste, while also guaranteeing consistency of quality and supply, and the potential for nutritional enhancement. Leafy salads, some vegetables and fruit will all be widely grown in this way.

However, its current high energy consumption limitations will need to have been overcome and certain crops will remain difficult to grow – in particular soft fruit.

BERRY PRODUCTION

Speaking to the Global Berry Congress in Rotterdam recently, Rob Hancock of the James Hutton Institute told delegates emphatically that berry production is not feasible in a vertical farm.

"If you want to lose money, start growing your fruit in an indoor farm," he said.

Following vertical farming trials by the institute, Hancock said that, crucially, growing soft fruit hydroponically using LEDs does not provide enough light intensity, with a negative impact on yields, quality and sugars in the fruit.

Furthermore, the architecture of soft fruit plants is unsuited to vertical growing, and crucially the high cost of installing and running a vertical farm makes it extremely difficult to generate a profit.

"The one thing you can control in an indoor farm that you absolutely cannot in an external farm is the light. By messing around with the light spectrum, you can have impacts on the colour and quality of the strawberry. By manipulating the light spectrum, you can massively enhance the concentration of anthocyanins present in the crop.

"The disadvantage is the light intensity. In an indoor farm you're lucky if you're getting 200 micromoles of light, so with a product like strawberries or raspberries you're operating at nowhere near maximal photosynthetic rate – that's going to impact yields, quality and sugars.

Another disadvantage is clearly that the architecture of something like a blueberry or raspberry cane is not very well suited to vertical growing."

Currently, the James Hutton Institute is trialling some of these technologies at its Advanced Plant Growth Centre in Invergowrie near Dundee – a £27 million project funded by the Scottish and UK governments to enable research, development and innovation in crops grown under cover.

SUMMARY

What role for IAgrE?

Whatever shifts consumer behaviour takes place over the next 20 years, there is no doubt the engineers and engineering, science and technology, innovation and yes, inspiration will play a major role in enabling the expected transitions in food production to be met.

Not just because of the rise in popular dissent evidenced over recent times, whether they be Extinction Rebellion or animal rights and vegan activists, agriculture will need to adapt and respond over the coming years - but not as rapidly as the protesters think should be the case.

Global economies are fragile and finely balanced and to act on a whim or with draconian haste could destroy the current and future prospects for many less developed nations.

But it is clear from the views represented in this review, that we are in the midst of considerable shifts in consumer demand which will only escalate and change further in the coming years.

Within its ranks, IAgrE has the wealth of talent, expertise, skills and original thinking to meet new challenges. The Institution should hasten and consolidate its relationship with other bodies working in the same 'arena'.

To set out the exact parameters and pace of future change is fraught with danger. But as the saying goes "The only constant IS change".

Next issue (Autumn) this special Landwards series Vision 2038, will consider in more detail the changes and evolution in machinery and equipment required for food production over the next 20 years.

PERSPECTIVES

IAgrE

Selected features from latest professional engineering and related journals.

In this special supplement we reproduce, by permission, articles and features from professional and business journals that we believe are relevant and of interest to IAgrE members.

FARMING FOR FUTURE GROWTH

Agriculture faces mounting challenges in the 21st century. More of us live in cities than ever before and the global population is estimated to reach 11.2 billion by 2100. Science writer Sarah Griffiths spoke to Intelligent Growth Solutions' Niall Skinner, Senior Mechanical Engineer, and Douglas Elder, Product Manager, to understand how produce grown inside under lights in trays arranged in vertically stacked towers could help meet growing demand for food.

Current farming methods are often wasteful in terms of space, water and money. However, vertical farms, which grow crops in trays stacked in tall towers, could help to reduce food waste by up to 90%. They would help to grow produce locally and on demand, and the growing process could allow farmers to control the environment whatever the season, changing the intensity and length of exposure to light, temperature, humidity, water irrigation, nutrients and carbon dioxide levels to create optimum conditions in which crops including lettuces, are grown in a few operational vertical farms.

But the UK does have Europe's largest vertical farm owned by Jones Food Company, which is 17 storeys high. Scotland's first vertical farm, operated by Intelligent Growth Solutions (IGS) at the James Hutton Institute in Dundee, uses new technologies to overcome challenges presented by power and labour costs, which have inhibited the sector's expansion so far. IGS claims its growth tower is the most advanced vertical farm design developed to date because it allows experts to monitor and control growing conditions, learning from mistakes and improving the environment using artificial intelligence (AI).

A key breakthrough for the system has been in the way that it manages power consumption, particularly through the development of LED lighting, which has reduced energy costs dramatically. The demonstration facility opened in August 2018 and the company expects 95% of its technology to be exported, with the first installations already being deployed in the US.

The current farm has space for four growth towers, each with a growing area of approximately 310 square metres, but only occupies a footprint of 41 square metres. The towers are individually housed in a standard steel frame warehouse building with insulated cladding walls to provide isolation from the external

THE BENEFITS OF VERTICAL FARMING

- Good for the UK: the UK's population is growing at about 0.6% a year and the country is expected to face a shortfall of two million hectares of farmable land by 2030, making vertical farms a practical, space-saving solution.
- Crops are grown locally: this produces near-to the demand for food, so reduces food miles, cutting costs. Salad crops and ground fruit would be grown in vertical farms in the short term. The method of farming also increases food security, by reducing dependency on imports.
- Food is better quality: proponents of vertical farming say the method improves the appearance of food, as well as its nutritional qualities and taste, which remain consistent year round because of growing conditions. Crops are disease-free, eliminating the need for pesticides, while semi-hydroponic techniques eliminate the need for washing, reducing contamination.
- Natural resources are saved: vertical farms have a much smaller footprint than fields, freeing up farmland for alternative use, such as energy crops or for conservation. Furthermore, the ability to recycle water reduces its consumption by 90% compared to field growing and makes it around 10% more water efficient than greenhouse growing.
- Saving money: the reducing cost and improving electrical efficiency of LEDs, compression of the value chain, production matched to consumer demand, reducing wastage and integrated automation reduced labour costs mean vertical farming can cut costs.

environment.

Each tower, which is currently growing a range of fast-growing herb and leaf crops, has standalone ventilation and irrigation closed-loop systems that automatically sterilise and recycle air and water so that the only regular inputs that the system needs are power, seed, nutrients, carbon dioxide and harvested rainwater.

Within each tower, all important parameters – light, heat, humidity, water, nutrients, and crop movement – are controlled by industrial programmable logic controllers (PLCs), which are computers that run on an architecture that does not need unpredictable updates. The Omron SYSMAC PLCs use feedback from sensors distributed throughout the tower and systems that is transferred to a cloud-based control system can thrive. In the future, these vertical towers could replace greenhouses at about half the cost, and with increases in savings and a reduction in space used. This agricultural revolution is not a new concept; in 1909, Life magazine published one of the earliest drawings of a vertical farm. In the 1950s and 60s, prototypes were first produced.

In 1999, the idea was reintroduced by Dickson Despommier, a professor of environmental health sciences and microbiology at Columbia University, who speculated that a 30-floor farm could provide food for 50,000 city-dwellers. While many of his ideas have been challenged, vertical farms are now a reality in the US, Europe and Asia, where they are popular in cities where space is at a premium. In 2016, there were 2.3 million square feet of indoor farms across the globe, and this is expected to grow to between 8.5 million square feet and 16.55 million square feet by 2021.

However, the UK's vertical farm industry has previously been described as 'underdeveloped' as only a few crops, including in real time, allowing experts to constantly monitor and adjust the growth environment to optimise production. This system uses AI algorithms that analyse the growth results, learn from production and calculate the best way to boost output by suggesting tweaks to the growing environment.

The idea is that a commercial farm could be controlled via an app and the system managed by engineers instead of farmers having to get to grips with extra cables and computers.

MANAGING POWER CONSUMPTION

To overcome the challenge of energy consumption, IGS designed a power-management system that flexes with the grid in real time, so that it responds to external influences such as grid stability and power availability, importing power when cheap or exporting it when costly.

This means that the facility effectively acts similarly to a large battery where the energy is converted into food. The use of industrial Omron SYSMAC PLCs within the facility allows automatic recovery from power loss events and means that individual towers and sites get the power they need, meaning that none of the systems need to be reset, reprogrammed or manually repositioned. Each tower has a baseline power consumption of 60 kilowatts (kW), which can be rapidly increased to 105 kW or reduced to 30 kW for short periods to optimise grid stability, while the impact on growing is managed by the control system's AI elements.

Heating and air conditioning can be a drain on power resources. However, the watering, heating, ventilation and air conditioning systems are also closed loop, which minimises their impact. The design also reduces the need for HEPA (high efficiency particulate air) filtration to clean large volumes of incoming air, and the potential heating and/or cooling of this air depending on location and season.

The air is sterilised by UV filtration technology, similar to clean rooms, and heated by the waste heat from LEDs that are used to mimic the sun. Standard industrial chillers and cooling coils cool and dehumidify the air, before it is passed back over the LEDs for preheating and then returned to the crop. Carbon dioxide can be added to this loop when required too. Lighting uses approximately 70% of the system's power, which is not surprising as there are 1,140 LEDs per tray. To improve the efficiency of power transmission to the lights, IGS developed a power distribution system for driving the LEDs, which takes an industrial three-phase power supply, transforms it to a safe voltage level and transmits it to each individual tray within the tower using tubes rather than cables.

The use of tubes rather than cables improves transmission efficiency

because of the skin effect in cables. When electrical AC power is transmitted through a cable, magnetic effects cause the current to be forced to the outside 'skin' of the conductor. This reduces the useful cross-sectional area of the cable. The presence of conductive material in the centre of the cable gives rise to these magnetic effects, so the use of tube rather than cable actually reduces the cause of skin effect, allowing better distribution of current through the remaining conductor material and improving transmission efficiency.

This effect is driven by the AC frequency and conductor diameter, with a 9 millimetre cable diameter being the key threshold parameter for efficiency with 50 hertz supplies. Due to the safe low voltage used to transmit power to the trays the current and cable diameter is large, leading to significant advantage in the use of tubes over cables. A side effect of this is that aluminium tubes are also much cheaper and lighter than suitable copper cables. The retention of three-phase AC power to a tray level further reduces losses and provides inherent phase balancing, eliminating the need for costly and inefficient filtering and power factor correction, as well as the use of capacitors for single phase conversion. These measures contribute to a 5% to 10% increase in driver efficiency.

LIGHTING UP THE FARM

Many indoor growing facilities use red and blue lights to nurture plants, after scientists demonstrated that not all wavelengths of light contained in sunlight are needed for effective growth. More recent research has shown that varying the spectrum used at different stages of growth can also offer a significant improvement in the crop yield. This system uses four different wavelengths of red, blue and green LEDs and has experimented with others including far red and white.

The LEDs are fitted in clusters, with each cluster containing all types of LED. The team then varies the light intensity and/ or dimming for each individual colour to control the spectrum. This dimming is controlled by its LED driver boards, which are wirelessly connected to the PLC controller.

The ability to vary the spectrum used has been a key focus for IGS and the company says that the ability to control the spectrum or pulse width modulation (PWM) and intensity to simulate solar radiation is unique among vertical farms. Each wavelength can be turned on or off or dimmed via PWM, linear dimming or a combination of both. However, while the facility has this ability, the precise optimal mix of light for each crop and stage of growth is not well understood, so the team is using AI to measure and understand the crops' progress, in order to accelerate learning in this area. Its observations within a controlled environment are challenging some of the current thinking in terms of important wavelengths and data will be used at the farm to further boost plant production. For example, while research has shown that green light does not directly contribute to photosynthesis to any great degree, IGS has shown that adding green light, particularly at certain stages of growth, increases both crop yield and quality. Its scientists believe the green light is acting as a trigger to improve photosynthetic processes, rather than the dominant effect being a contribution to photosynthesis. Similarly, the company uses far red light because it stimulates stem growth, rather than directly contributing to photosynthesis.

This means that doses of far red light at certain phases of growth can be used to alter the plant's shape or structure by promoting stem growth in a controlled manner. The challenge is not allowing the plants to grow excessively tall and leggy, so using AI to learn the effects of far red light at different stages of growth allows IGS to produce crops suitable for market with the minimum energy input, by only using far red light where it has most effect.

Alongside the spectrum of light used, the method of how it is delivered to crops could affect how well they grow, and the facility can vary both intensity, through linear dimming or PWM, and PWM infinitely in 0.01% increments over all wavelengths simultaneously and maintain 90% electrical efficiency from grid to LEDs. As biological systems, plants have response times to stimuli in the same way as we do.

One such response is the time taken to activate photoreceptors within the plant to perform photosynthesis, as well as the time to shut down again

once it has gone dark. This means that plants are not as efficient as they could be in performing photosynthesis and that a pulsing light regime could be used with a pulse duration long enough to keep the plant photosynthetically active. Not only would this boost the plants' efficiency at converting water, carbon dioxide and light energy into glucose and oxygen, but it could mean that less light is needed overall for the same growth result, potentially benefiting the farmer and saving money.

Currently, this is not a proven field and scientists are not sure what the mechanism is that manages the photosynthesis response, but IGS's initial work shows that similar yields can be produced by pulsing the same intensity of light as when it is on continuously, which means the crop is producing the same yield for less light photon input. IGS has reported promising initial results with the system and it is a further reason for the AI control to enable optimisation.

MONEY MATTERS

The UK's agri-food supply chain accounts for an annual turnover of £96 billion with revenues of £10 billion, accounting for 6.4% of the UK's gross value added according to a Defra report published in 2018. The agri-tech industry, supporting farmers and growers with machinery and other kinds of technology, is a multi-billion pound sector in which the UK has a 4% to 5% share of the world market. Vertical farming technology could potentially make the UK a leader in this area. Farmers worldwide face a common set of challenges: population growth, dwindling land, water and energy resources, climate change, and the need to increase efficiency and lower costs.

It is hoped that vertical farming will play an important role in tackling these problems. Niall Skinner, Senior Mechanical Engineer at IGS, said that economic benefits include improved yield and reduced wastage for each crop produced. For example, a typical glass house growing basil produces about 30 kilograms per square metre a year, but the vertical farm produces almost double. The technology allows a year round growing season, which could mean eating strawberries in winter is less environmentally damaging than flying them in from abroad.

However, it is difficult to calculate energy and carbon savings, because there are so many factors that determine the cost of production. Douglas Elder, Product Manager at IGS, said the cost of power is the biggest factor because it is determined by scale, location and power generation technique. However, the company produces two to three times the amount of greenhouse-grown crops that require supplemental lighting, heating and cooling, putting its production costs per kilogram in the same range. It is anticipated that vertical farms would be built near cities and/or distribution hubs, so there would be fewer transport costs and a reliable supply because farmers would be less dependent on the weather, potentially saving large amounts of money by avoiding crops spoiled by drought or frost.

While the amount farmers save on buying pesticides is unlikely to cover the cost of power for lighting, it will help. Elder said that critics should also consider a massive reduction in wastage through improved regularity of supply and predictability for the retailer, meaning fewer losses. Smart vertical farms could also cut farmers' utility bills, thanks to the ability to minimise power costs through grid balancing or flexing (especially at larger scale) and use water more sparingly and effectively.

Farmers could also save money when buying or renting land because vertical farms have a much smaller footprint. However, much like other agri-tech equipment, a vertical farm would be a huge investment. One way to overcome this might be to rent them, much as farmers tend to lease tractors and combine harvesters. IGS has not ruled this out and says its software and support services will be offered on a subscription basis to allow customers to access the latest developments. However, it envisages farmers spending on a vertical farm upfront could recoup their investment in two to four years, thanks to better efficiency and higher crop yields.

IGS says this estimate is dependent on a grower's ability to successfully establish the necessary supply chain. However, if the investment was readily available, farmers could grow their vertical farms as the system is designed to be scaled, with all elements being modular to allow additions at any time. The towers and control system are fully automatic, and the design allows for as much or little automation outside of this as desired by the farmer or local economics.

It is anticipated that most commercial facilities consist of 20 growth towers or more, but vertical farms could be as small as two towers. The growth trays are all returned to the base of the towers for planting, watering, fertigation, harvesting and monitoring, which is designed to work with existing automated harvesting equipment or can simply be removed by hand. Its system has also been designed to self-monitor and provide predictive maintenance capabilities to cut both maintenance costs and labour, providing work schedules for maintenance staff to verify that tasks have been completed. The systems engineering approach adopted in design means that there is a large degree of spares commonality and so the spares inventory for even a large facility can be small.

THE FUTURE IS VERTICAL

While vertical faming is not expected to replace conventional farming, it is expected to form part of the solution for feeding growing cities and meeting the challenge of food security. We could be eating more fruit and veg grown in indoor farms here in the UK, as IGS aims to have the first commercial farms in operation by late 2019. According to Skinner, the technology will focus more on market expansion than replacing traditional farms, partly because not all crops can be grown in an indoor environment. While arable crops are not suited to these systems because they need broad acre production to reach the volumes required, vertical farms are perfect for produce such as salad vegetables and groundfruit crops such as strawberries. Elder states that the company's controllable lighting technology may also be suited to growing exotic crops such as vanilla, but this has yet to be tested. Whatever the case, vertical farms will probably replace glasshouses and polytunnels, seizing around 30% of the market, so it may soon become the norm to buy fruit and vegetables grown in vertical farms

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BIOGRAPHY

NIALL SKINNER is Senior Mechanical Engineer at Intelligent Growth Solutions, where he has been integral to mechanical and ventilation design. He has over 20 years' engineering experience.

DOUGLAS ELDER is Intelligent Growth Solutions' Product Manager, responsible for overseeing all product development from idea to launch. He has a master's degree in mining geology and began his career as a geologist in onshore oil and gas, focusing on unconventional resources in the UK and Poland for seven years.

The Ten Principals of Agronomics

Digitisation of agriculture is not only energising but reversing the generation and flows of knowledge, from top-down to bottom-up, so creating a new crowd-sourced, multi-scale science which we call agronomics. Benefits in enhanced productivity and sustainability should be large but mainly public and diffuse.

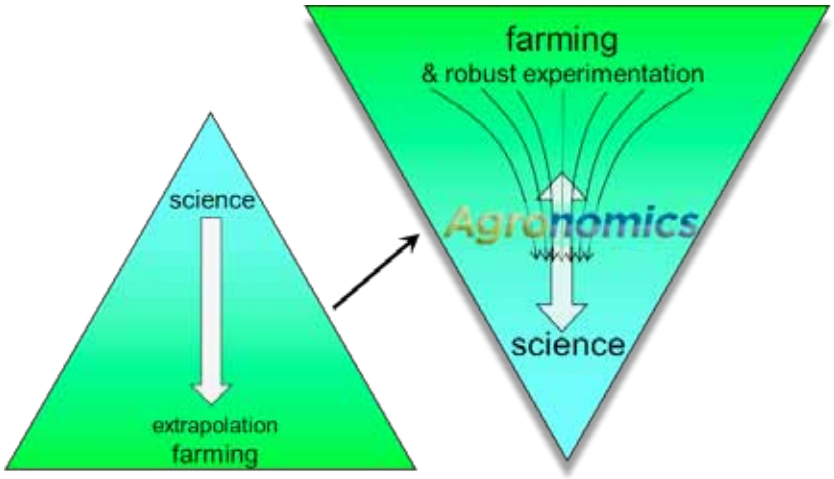
Paper by Roger Sylvester-Bradley & Daniel Kindred, ADAS, published in Food and Farming Futures

This review of our top ten tenets of agronomics suggests that essential innovations need to be conceptual and social more than physical, so difficult to justify commercially. Priorities for investment to maximise agricultural progress through agronomics are the creation of an open digital ecosystem for interoperable software services, and a structured network (or 'virtual institute') to lead thinking, research, education and training in agronomics.

We are excited by the emergence of a new technology which we call 'agronomics' – this is farming, but as revealed and facilitated by the burgeoning digital technologies. Of course agronomics incorporates conventional agricultural science, but it offers to provide far more intensive and extensive quantification, it applies across multiple scales of both time and space, and it has farmers and their supporters as central players, both as exponents and investigators, unravelling the variation that they, and everyone that depends on them (i.e. everyone!), seek to control. In particular, the new dynamics of measurement and communication enabled by digitisation are offering to supersede conventional rates of progress in agriculture.

The agronomic revolution, from top-down to bottom-up, being brought about by the digitisation of farming.

With hundreds of farmers already involved, and with these farmers having done hundreds of experiments, we are now beginning to see the key attributes of agronomics, hence the vital investments needed to enable agronomics to fulfil its obvious, urgent and huge potential. Here, briefly, we describe our top ten tenets that should enable agronomics to 'fly'. However, we must initially explain the fundamental contrast between agronomics and all that has gone



before – digitisation creates a new arena of knowledge generation and offers not only to energise but to reverse knowledge flows in agriculture. Agronomics challenges the widely held supposition that most agricultural innovations and progress largely originate in labs., rather than in fields and on farms. They seldom have done iii, iv and now, fields and farms are becoming 'where it's at'

1. OPTIMISING BETWEEN RIGOUR AND URGENCY:

The over-arching and major challenge that stands out from our experience of facilitating agronomics so far is the strong contrast between farmers and scientists in their attitudes to evidence, proof, expertise and scholarship. The immediacy, complexity, uncertainty and commercial nature of farming inevitably lead farmers to focus on incremental change, entertain hear-say, follow fashion, and be subject to ignorance or bias. On the other hand science progress is measured but slow; the discipline of science honours the written word and the history, evolution and provenance of ideas, it has created exacting standards of testing and proof, and it values professional qualifications; but this all takes time. Hence in combining farming with science, agronomics must achieve the tolerance and humility necessary to bridge between these two poles; appropriate understandings, relationships, protocols and standards must be developed.

Table of some contrasting knowledge building traits of farmers and scientists

Our experience so far in promoting and engaging in agronomics has highlighted the vital role of on-farm advisers, students and their parent organisations in providing essential mediation and two-way technical support, and the value of collaboration, both farmer to farmer and between industry and academia. New social structures are currently being tested to optimise between rigour and urgency including 'Thematic Networks' and 'Operational groups', 'Field Labs.', 'Science &

Farmer	Scientist
Optimism & trust	Rigour & scepticism
'Proof' = >50% certainty	'Proof' = 95% certainty
Holist & Generalist	Reductionist & Specialist
Synthesis & Design	Analysis
Lore & Experience	Laws & Mathematical models
Commercial metrics	Bio-physical metrics
Large scale	Small scale
Spatial	Dynamic

Technology Backyards' and 'Farmer Innovation Groups'; these show a mix of constitutions, protocols and communications.

2. ADMITTING & QUANTIFYING UNCERTAINTY:

It follows from Tenet 1 that farmers, their advisers and supporters, must find ways of knowing and sharing their uncertainties. That is, they must gauge accurately, and admit to their clients, the degree of confidence that they have in each aspect of their knowledge and advice. This will be a big change for many advisers and farmers. It has been natural hitherto for farmers to trust their advisers according to the 'confidence' that those advisers portray, and hence it has been natural for advisers, and advisory organisations, not only to find ways of expressing advice that transmit most certainty, but commonly to overplay the certainty that they have in their own advice and recommendations. Whole sets of procedures have evolved whereby intelligence for farmers is standardised before being communicated; these are common to most extension organisations which seek to inform farmers. For example in the UK, the AHDB committees considering 'Recommended Lists' of crop varieties or fertiliser guidance (RB209) have, in the last two decades, formalised the procedures that previously evolved in the hands of NIAB, NAAS and ADAS through the previous five decades. But as farmers seek to make urgent technical advances, and are enabled to make their own tests, they will need and want to identify, question and test those current practices and products that are most telling and least certain. So, in devising recommendations into the future, procedures must evolve to identify, manage and carefully communicate the most important uncertainties.

3. DISSEMINATING RESEARCH PROCESSES:

Given that the seat of knowledge generation in agriculture is moving more firmly onto the farm, and that farms are so numerous and busy, farm advisers and other supporters, including students, are coming to assume vital new roles. Supporters who in the past provided 'one-way' knowledge transfer, must come to provide a 'two-way' channel. Supporters must acquire sufficient expertise in research methods that good questions are formed on the farm, efficient tests are set up, and crucially, on-farm findings are fed-back, collated and added to the public knowledge-base.

To support these new skills, and avoid large extra costs, the newly acquired research capacity on farms needs to be automated as far as possible, with new systems to support searching and acquisition of current knowledge (e.g. through 'wikis'), networking and discussion to share ideas, data capture and benchmarking, data analysis and visualisation. Bespoke services will then be needed for data-sharing, social networking and distance learning.

4. FACILITATING PRE-COMPETITIVE KNOWLEDGE SHARING AND GENERATION:

Relationships between farming and food production businesses become competitive at some point. Scientists also compete for funding and career advancement. But the vast majority of farming businesses, and scientists seeking practical impacts, stand to gain far more than to lose by collaborating with each other in their learning and knowledge generation activities. Farmers, and those that most closely support and supply them, must realise the value of sharing and comparing ideas and data between farms and across landscapes. Farms are inherently dispersed (so to capture and photosynthesise as much global solar energy as possible), but their challenges and technologies are common globally, and the environmental effects that they seek to understand are best studied across big distances (so providing necessary big contrasts). Hence players in agronomics must be enabled and encouraged to engage with the vast knowledge mine that the global farm represents. We must develop means whereby farmers, advisers and scientists (and any other stakeholder) can control yet allow access to each other's ideas and data within a shared arena. As Kindredvi has recently pointed out, agronomic progress will be stifled if science and farming maintain their quite separate spheres of debate.

5. DEVELOPING SEMANTICS AND ONTOLOGIES:

An essential prerequisite for automating knowledge acquisition and searching is that terminologies and metrics become standardised and systematised. The development of so called 'ontologies', already being addressed in some sciences, must be expedited across agriculture so that all involved can access and exploit the efficiencies and global purview of the new 'semantic web'.

6. PROVIDING EDUCATION IN AGRONOMICS:

The novelty, potential universality, and breadth of agronomics require that it quickly becomes a subject for education and training. Any new science such as agronomics generates a highly dynamic 'noosphere' where ideas and evidence engender lively debate. We need teachers and academics to engage in this. Additionally, as the source of new data and ideas shifts from lab to farm, students will come to form an obvious and vital bridge between farms and colleges, farmers and professors, whilst benefiting their own education and employability e.g. the Science & Technology Backyards in China.

7. INCORPORATING SOCIAL SCIENCE & METRICS:

We must accept that behaviour, attitudes and social circumstances play large parts in explaining the success of farming strategies, decision making and performance; so understanding of social and cultural relationships must be recognised as equally crucial in explaining farm performance as understanding of the purely 'natural' sciences. Availability of and access to multiple performance metrics at field and whole-farm scales provides a huge new opportunity to bring together the social and bio-physical sciences in a way that builds new explanations and suggests new solutions to the enhancement of farm performance.

8. DEVELOPING AGRONOMICS AS A NEW SCIENCE:

Agronomics merits being recognised and developed as a new multi-scale, holistic science, evolving out of the

existing agricultural sciences. Through its new wealth of farm-centric, field- and farm-scale data, agronomics offers an exciting large-scale creative arena where novel farming systems and designs will be imagined, discoveries made, and rules and laws will be forged.

Whereas agricultural science has hitherto worked in disciplines, analytically – in genetics, chemistry, engineering, hydrology, physiology, animal health & welfare, nutrition and economics – agronomics offers to build these, by synthesis, into new holistic designs according to quantitative conceptual frameworks that describe, explain and predict farm performance at field and farm scales – something that agricultural science has largely shirked or shunned so far.

Whereas the agricultural sciences hitherto have sought to build understanding from testing, explaining and extrapolating from single agronomic factors – environments, genotypes and husbandry treatments – simple sums show these can never address the trillions of trillions of options that farmers face annually. New philosophies must be developed for observation, experimentation and data interpretation that provide farmers with more certain outcomes, and scientists with more certain insights.

9. DESIGNING BESPOKE SENSING SYSTEMS:

Whilst new technologies can create vast data-bases of new metrics, there are multiple deficiencies in the current data-sets available to properly explain farming outcomes according to current conceptual frameworks. We cannot re-write the agricultural sciences – nutrition requires that we measure nutrients, health requires that we measure pathogens. Whilst some vital metrics like the weather are now available cheaply and automatically worldwide, methods of measuring many equally essential metrics remain manual, laborious and unautomated. The UK government has recently invested in Centres for Agricultural Innovation; these now need to prioritise the most telling farming metrics, or their best surrogates, and to find funding for campaigns to automate their sensing.

10. EXPLOITING NEW ANALYTICAL OPPORTUNITIES

If this new science is to progress, the large datasets now routinely being created must be processed: captured, stored, referenced, cleaned, calibrated, analysed, modelled and easily visualised and shared. Exciting current advances in mathematics and computing must be applied to the torrent of new agricultural data.

However, experience in science shows the labour required to assemble the apposite data for each impending question, and the labour involved in making sense out of multi-dimensional datasets. The extent of and need for this labour, and its power in knowledge generation, are not widely appreciated outside science, so for decades applied agricultural research has accumulated multiple large, potentially valuable but unanalysed datasets – the AHDB's RL database being just one example.

Analytical tools and teams must be developed to undertake 'pump-priming' exercises which demonstrate to farmers and their support organisations the power of big-data analysis, and evolve efficient procedures for this. It must become inherent in new agronomic systems that data providers and analysts see mutual benefits in close engagement.

The current data explosion dictates that many new commercial services should emerge for data interpretation, but these can only do so when farmers and associated stakeholders come to value their full power (whilst trusting that their data can remain secure).

CONCLUSIONS:

These top ten tenets are offered to support current comment and debate about how R&D investments in the UK should be targeted to make fastest progress in agriculture. It is evident that the tenets are as much notional as physical, so any investments to exploit agronomics must address social relationships and skills, as much as software and sensors. Whilst recent government investments have created 'innovation centres' for Agrimetrics, Crop Health & Protection, Livestock, and Precision Engineering, these focus on important physical factors, whilst they largely eschew the more fundamental changes in socio-economic relationships in agriculture, driven by amplifying and reversing the flows of data and knowledge.

Whilst agricultural levy bodies continue to address agricultural productivity and sustainability issues through conventional top-down research and knowledge exchange mechanisms, they have recently been recognising the potential of bottom-up knowledge generation; agronomics now formalises this change and offers a major opportunity for crowd-sourcing and more intimate engagement with levy-payers and their advisers.

In conclusion we propose that our more conceptual tenets might

be addressed by a new structured network or 'Virtual Institute for Agronomics' (VIA) which would lead thinking, research, education and training in agronomics: in particular developing the new science and forging engagement with the knowledge generators – farmers and their advisers. But also it would seek to reconcile rigour with urgency, develop ways to quantify and report uncertainty, develop farming ontologies, and incorporate social understanding (with appropriate metrics) into more conventional (physical) explanations of agricultural performance.

The more procedural tenets above, involving the sharing of data, knowledge and ideas, could be best addressed by developing a new open digital ecosystem for interoperable software services. These would automate research processes, facilitate pre-competitive knowledge sharing, generation and recording using newly developed ontologies, design bespoke sensing systems for prioritised metrics, and provide new analytical tools to distil the multiple, new, big, agricultural datasets.

New investments on the scale of an institute and a digital ecosystem are justifiable because, even though the UK is only responsible for 1% of global agriculture, such infrastructures should form a leading global resource.

The UK is far from unique in its farmers, its farm variation and its agricultural challenges; if the UK can take a lead in developing the technologies and procedures for agronomics, these will be immediately applicable and relevant worldwide, even where levels of governance, education and technology don't match those of the UK. By creating the systems, software, sensors, and skills to enable mainstream agronomics in the UK, and by doing this in cognizance of other regions, agronomics investments could become exploited globally, and pay off handsomely, whatever the current challenges for global farming are seen to be.

Further information:
www.adas.uk/services/agronomics

2019 **IAgrE** Annual General Meeting and Awards

The 2019 IAgrE Annual General Meeting and Awards were hosted by the National Fluid Power Centre (NFPC) at its Worksop headquarters and attended by over 80 members and guests who were welcomed by John Savage NFPC director.

Following an excellent lunch, he and his colleague Nick Gower showed delegates around the impressive training and education centre.

The NFPC is a BFPA certified CETOP Education Centre and approved training provider for many 'blue chip' companies. The Centre employs Training Engineers who have many years of industry experience in the hydraulics and electro pneumatics sector. It has 3 fully equipped technical centres with over £3 million worth of equipment supplied by industry partners such as Eaton, Danfoss and Bosch Rexroth.

Photo captions

1 *Alastair Taylor reflects on his term as CEO*

2 *John Savage (Director NFPC) receives plaque from Prof Jane Rickson*

3 *Newly appointed CEO Edward Hansom*

4 *Students at NFPC*

5 *Prof Paul Miller with Parmjit Chima (Harper Adams)*

6 *Alastair Taylor with Ralph Alcock*

IAgrE AWARDS FOR **CONTRIBUTION TO THE LANDBASED SECTOR**

M Clare Butler Ellis

CEnv FIAgrE

Extract from citation by Professor Paul C H Miller FREng, CEng, CEnv, HonFIAgrE

Clare's contributions to the activities in the land-based sector have mainly related to her work concerned with agricultural spray applications. She currently manages the work of Silsoe Spray Applications Unit Ltd – a small company that has an international reputation for excellence concerning all aspects of agricultural chemical application.

While much of her current role requires strong technical leadership and direct involvement in research, development and testing that serves a diverse customer base and in which commercial companies are a major component, Clare is also responsible for all day-to-day activities within the unit including all finance functions. Her input has been a vital component in the successful establishment of the new commercial company and her work has resulted in the new organisation having a profile that is technically sound, financially sustainable and is continuing to build an excellent reputation.

Clare's work with spray application started in 1994 when she joined the Chemical Application Group at Silsoe Research Institute. She became leader of the team working on spray applications at Silsoe Research Institute in 2001 and, when the closure of Silsoe Research Institute was announced in 2005, she became UK and Europe Programme Coordinator for Pesticide Action Network UK - a charity focussing on tackling the problems caused by pesticides. Prior to working on spray applications, Clare was part of a research team examining the milking of dairy cows and she also worked briefly in the Energy Technology Support Unit of AEA Technology and with the Farm Buildings Research team with ADAS.

She has a First Class honours degree in Physics and a PhD in Theoretical Physics – providing early demonstrations of her ability.

James Wallace AIAgrE

James (Jimmy) Wallace has been a member of the Institution for very many years; joining on 31 August 1954. He has been a very loyal and enthusiastic member of the IAgrE and the West Midlands Branch for very many years.

Professionally he was a combine harvester design engineer, starting in a dealership in Ayrshire and then transferring to the Massey Harris combine factory in Kilmarnock.

When that factory was closed in 1980 he transferred with the combine engineering team to the Massey Ferguson Banner Lane works in Coventry.

After retiring he continued to support the profession by becoming a factory guide and as an ATB instructor in combine harvesting and workshop skills amongst many other ways.

James was nominated by the West Midlands Branch for this award.

IAgrE **AWARDS OF MERIT**

David Tinker

CEng CEnv FIAgrE

Dave Tinker has undertaken a broad range of tasks, all associated with agricultural engineering in one form or another.

His early career, from 1978 whilst at Silsoe Research Institute involved him in overseas work on tillage and traction in Latin America and the Middle East. On returning to the UK he developed his career in Bio-Engineering, working specifically in the livestock industry and the engineering involved in slaughterhouses.

In 2006 he set up David Tinker and Associates (DTA Ltd) with the remit of providing secretariat services for the European Society of Agricultural Engineers (EurAgEng) and EU funded agricultural engineering projects, including the highly successful AgEng conferences.

DTA Ltd also manages the European Network for Advanced Engineering in Agriculture and Environment (ENGAGE) and until recently, Dave was Secretary General of both EurAgEng and ENGAGE.

Also within the remit of DTA Ltd is applied R&D input to a range of projects from CTF to carcass hygiene and most recently to the SmartAKIS project. For the latter, DTA Ltd teamed up with Agri-Tech East (of which they are a member) to provide Smart Farming Technology workshops across the east of England.

Overall, Dave Tinker has had a significant impact on a wide range of agricultural disciplines, engaging with broad audiences across Europe to promote innovation in research and development.

David Tinker was not able to be present at the Awards, but will be presented with his award at the 2020 Awards. He is pictured (left) at the launch of SmartAKIS Long Service.

Richard Barrowman CEng FIAgrE

IAgrE CEO Alastair Taylor writes

I would like to propose that Richard Barrowman receives an award for his contribution to the work of the IAgrE Membership Committee. Richard is a real stalwart and has been a member of the committee as long as I remember. He sets a high standard but is reasonable and sensitive in his recommendations as regards potential members and registrations with the Engineering Council. Where needed he gets involved in PRI interviews and always follows the IAgrE systems to the letter.

More than this, he has a great eye for detail and when it comes to agreeing new policies and procedures, or amending existing ones, you can always rely upon Richard to have read the documentation and thought about all potential scenarios.

As CEO and overall owner of the IAgrE procedures as they relate to Membership and Registration, I truly value Richard's contribution. He will always spot those matters which have passed me by and I value his eye for detail.

For me, Richard is one of those unassuming unsung heroes who has IAgrE written through his veins but quietly gets on with the job of promoting membership and professional registration.

Both Malcolm Carr-West, Chairman of the Membership Committee and Alison Chapman, Membership Secretary endorse this award as Richard is always on hand for advice and is always happy to give his time.

IAgrE **BRANCH MERITORIOUS AWARD**

Lawrence Knox

IEng MIAgrE

Lawrence Knox joined ADAS after graduating from Newcastle University with a degree in Agricultural Engineering. He returned to Northern Ireland in 1978 when he joined the staff of the Engineering Department at Loughry College of Agriculture and Food Technology. He has been a member of the Northern Ireland Branch of the Institution since that time.

Following a period as a lecturer in the Engineering Departments of both Loughry and Greenmount Colleges – now The College of Agriculture and Rural Affairs (CAFRE) – Lawrence transferred to the Health and Safety Inspectorate of the Department of Economic Development and still works part-time as a Health and Safety Inspector in the Health and Safety Executive for Northern Ireland, where his agricultural engineering background is greatly valued.

Outside work, Lawrence is a part-time farmer and has been an active participant in various forms of motorsport over the years, although no longer actively engaged in Formula Ford competition where he once had considerable success. He is a Committee member of Cookstown Motor Club.

Lawrence has been a member of the Committee of the Northern Ireland Branch for over 20 years and has served as Chairman, Treasurer and Press Officer. He is a regular attender at committee and branch meetings, where he acts as unofficial photographer as well as administering the unique Branch Associate membership scheme initiated by the Branch. His willing, positive and valued contributions to all aspects of the Branch are greatly appreciated by our Members.

Lawrence was nominated by the Northern Irish Branch, and the Award was presented at a Branch Meeting by IAgrE Trustee Kit Franklin

IAgrE **PRESIDENT'S AWARD**

Richard Brindle

CEng MIAgrE

A native of Edinburgh, Richard graduated with a BEng (Hons) degree in Agricultural Engineering from the University of Newcastle in 1993. His first design experience was gained with Scot-Track working on all-terrain vehicles.

In 1997 he joined JCB Hydrapower, soon to become JCB Compact Products, the division of the JCB Group responsible for the design and manufacture of mini and midi tracked Excavators up to 8 tonnes in operating weight. He quickly advanced his career, being appointed Senior Design Engineer in 1999 and Principal Engineer a short time later, taking responsibility for updating and expanding the range of zero tail swing (ZTS) machines.

In 2007 Richard was appointed Product Manager responsible for all new product introductions and the introduction of Tier 3 Off-highway emission level engines.

In 2010 he moved to the Backhoe Loader division taking responsibility for Tier 4 engine introduction, the top of the range 5CX model series and a complete re-design of the Backhoe Loader cab interior.

He gained his Chartered Engineer status in February 2002.

2012 saw Richard take up an ex patriate assignment at the JCB India plant in New Delhi where he became General Manager – Backhoe Loader Projects. During the next 3 years Richard led the team which designed and developed a new series of backhoe loaders which were to be built both in India and the UK and exported to markets around the world. This was a complex programme involving close co-ordination between the UK and Indian design functions and resulted in machines being very well accepted in their respective markets.

In 2015 Richard returned to the UK as Backhoe Loader Programme Manager and in addition has recently been responsible for leading the design of a range of all new site dumpers which were launched to the market in 2018. He currently manages a significant team of design engineers based both in the UK and within the JCB India operation.

In summary, Richard's career has progressed on a trajectory of increasing responsibility over time and his achievements to date and current level of responsibility make him a worthy recipient of the IAgrE President's Award 2018.

IAgrE **TEAM AWARD**

Thatcher's Cider

The Western Branch enjoyed a visit to the cider making facilities of Thatcher's at Sandford in Somerset in the autumn of 2017.

John and Martin Thatcher rely on local farmers for approximately 20,000 tonnes of apples every year, and they guarantee payment five days after delivery. A commendable commitment when considering the viciously competitive market that Thatcher's Cider markets their products through. Keeping their roots very much in the agricultural arena, John Thatcher has been involved in research to optimise the planting of trees, developing deeper roots to maximise water uptake.

Significant recent capital investments of £7 million and a further £15 million have significantly increased their bottling, canning, warehouse and distribution facilities.

These projects also included redevelopment of their pub, The Railway Inn. A further £14 million planning application will provide them with a new Cider Mill, planned for commissioning in 2019.

Applying his apple tree agronomy skills and engineering ingenuity, John Thatcher approached a local engineering company SFM Technology to design and build a bespoke harvesting unit. The tri-modular straddle harvester carefully picks the fruit and also undertakes shaping and spraying operations. The machine prevents the apples from touching the floor and is also very efficient in operation.

With an ever expanding market place, this includes Australia; Thatcher's Cider ensures that its continuing development is undertaken with environmental considerations whilst applying the most up to date engineering technology.

Thatchers were not present but Western Branch's Mike Whiting accepted the Award on their behalf and is to visit Thatchers to present it during the coming months.

DOUGLAS BOMFORD PAPER AWARD

Paul Jackson

The winner of the Award this year, for his contribution to the paper ***"An innovative concept building design incorporating passive technology to improve resource efficiency and welfare of finishing pigs",*** **Paul Jackson**, Jonathan H. Guy, Barbara Sturm, Steve Bull, Sandra A. Edwards, Biosystems Engineering, Volume 174, 2018, Pages 190-203, ISSN 1537-5110

IAgrE **IVEL Award**

Nutri-Flow Slurry System Agri Industry Solutions

This award is made at the LAMMA Show to a new product that demonstrates the most positive contribution to the environment. Directors Tim Merrell and John Crooks were delighted to attend the Awards Presentation and collect the IVEL Award on behalf of Agri Industry Solutions.

STUDENT AWARDS

IAgrE CNH Industrial Awards

The Institution is extremely grateful to Rob Alker and CNH Industrial for their continued support of these Awards and for providing innovative trophies

Iain Dummett

Made on the basis of a dissertation or thesis undertaken by an undergraduate or postgraduate student as part of their studies demonstrating innovation and practical application in the landbased industry. The Post Graduate Award was made **to** Iain Dummett, Cranfield University for his thesis ***"Evaluating Strip Tillage Practices for sustainable UK arable agriculture"*** and presented *by* Rob Alker from CNH Industrial.

William Hitchcock The Undergraduate Award was made to William Hitchcock from Harper Adams University for his paper ***"Quantifying the effects of a pre-cleaning chaser system on Sugar Beet recovery"***

Student Project Award Alwyn Morgan

This award is given to the best final year project submitted as part of a course leading to ND, NVQ Level 3, or similar qualification in land-based engineering. Won this year by Alwyn Morgan, of Coleg Sirgar for his project ***"Disc Brake Wear Sensor" Alwyn was unable to attend so his tutor Colin Jones from Coleg Sirgar stepped in to receive the award on Alwyn's behalf.***

IAgrE Safety Award Kevin Shuttleworth

This award has been established to encourage and recognise innovation in safe design or operation of equipment or processes by students studying agricultural engineering or subjects related to the application of engineering and technology to the land based sector. This year's winner was Kevin Shuttleworth, University of Central Lancashire for his paper ***"An investigation regarding the effects of acceleration produced by cabin suspension systems fitted to agricultural tractors upon the operator and operator health"***

IAgrE Photography Award

Nick Barlow

Nick Barlow from Marlborough won the 80th Anniversary IAgrE Photography Award with his image of a Trimble RTK base station taken at a harvesting roadshow in Oxfordshire. The theme was Agritech in Action, and the winning photo was shown on page5 of the Winter 2018 issue of ***Landwards.***

Special Award

Rexroth Bosch

A special award was made to Rexroth Bosch for their support over the years for the IAgrE Young Engineers competition. John Killgallen from the company was unable to be present, so the Award was accept on his behalf by YE competition organisers Richard Trevarthen, Richard Robinson and Peter Leech

Long Service Awards

It has become a tradition that long serving members of the Institution (50 and 60 years) be invited to the Awards and we were delighted to welcome many this year. Those invited were:

60 Years Service
Mr KC Baxter MIAgrE
Mr MJ Hadley IEng MIAgrE
Mr M Jamieson FIAgrE
Mr PW Palmer CEng FIAgrE
Mr JW Roberts AIAgrE
Mr RJ Roberts IEng MIAgrE
Mr DA Telford MIAgrE
Mr JAC Weir IEng CEnv HonFIAgrE

50 years Service
Mr W Beattie MIAgrE
Mr DJ Cooper CEng CEnv MIAgrE
Mr HC Wickington AIAgrE
Dr R Alcock CEng CEnv FIAgrE
Mr GPC Henry CEng MIAgrE
Mr AR Key CEng MIAgrE
Prof PCH Miller FREng CEng CEnv HonFIAgrE
Prof PB Leeds-Harrison MIAgrE
Mr RR Morrison MIAgrE
Mr MJ Percy MIAgrE
Dr KA Pollock IEng MIAgrE

DOUGLAS BOMFORD TRUST

The Douglas Bomford Trust,
The Bullock Building, University Way, Cranfield,
Bedford MK43 0GH
Telephone: +44 (0)1234 750876
www.dbt.org.uk enquiries@dbt.org.uk
@BomfordTrust Secretary: Alan Plom
Administrator: Elizabeth Stephens

Alan Plom, Secretary to the Douglas Bomford Trust (DBT) reports on recent activities of the Trust, sponsored students and other recipients of the Trust's welcome financial support.

TRUSTEES MEETING

Our bi-annual Board Meeting on 10 April was kindly hosted by Nottingham University and Trustees toured the extensive research facilities incorporated in the new Dairy Centre at Sutton Bonington campus, to see how the linked projects (co-funded with EPSRC) on 'image-driven' animal monitoring of dairy cows will work in practice.

MEET A TRUSTEE

Richard Robinson became a DBT Trustee at our AGM in November 2018. He immediately took on the role of mentor for one of our Arkwright Scheme (A-level) Scholars, Barnabas Pickford, who impressed Richard on a visit to his company Autoguide Equipment Ltd, justifying Barnabas' selection for our sponsorship.

Richard joined IAgrE in 1970 and was President from 2008 to 2010. He was awarded the title of Honorary Fellow in 2011, in recognition of his outstanding contribution to the agricultural engineering industry ["for making interesting and unique products"!] and service to the Institution. He has also been involved with IAgrE's Young Engineer's Competition, as an organiser, sponsor and judge for many years.

AGRI-FOOD CHARITIES PARTNERSHIP STUDENT FORUM

The 'post-Brexit World' was the theme of Lord Curry's keynote speech at this important biennial event in DBT's calendar when he emphasised future career opportunities in agriculture. Held at the University of Reading's School of Agriculture, Policy & Development on 11 April, this provides an opportunity for students sponsored by AFCP's member charities to present their findings, meet and network with others.

Three of our successful PhD students gave presentations: Cranfield's Dr Alexandra Cooke (research on 'soil filter socks' and now working for Severn Trent Water) and Dr Iain Dummett ('strip tillage and soil ecology', now at Rothamsted), and Harper's Dr Anthony Millington ('using X-Ray tomography to investigate soil properties', phase one of HAU's ongoing 'Tillage and Traction' project). They were joined by Reading's Nikolaos Koukiasas (who is nearing the end of his research on 'plant-specific weed control using an autonomous robot for pesticide application').

I also enjoyed a tour of the School of Agriculture's interesting greenhouse-based projects, studying crops ranging from tomatoes to cocoa and the impact of climate change.

ABOVE: Nikolaos Koukiasas, Iain Dummett, Alex Cooke, Alex Ansell, John McDonagh, Dimitrios Mallis and Alan Plom

WOMAN IN AGRICULTURAL ENGINEERING

We are pleased to see further developments at HAU, with the launch of the 'Stellar Harper Engineers' (SHE) group in March. This group is the "brainchild" of Mech Eng student Anita Woolf, who was inspired by her research into women in engineering after receiving a DBT Scholarship in 2018. Further DBT funding enabled her to attend the Women's Engineering Society (WES) Centenary Conference (at the Hendon RAF Museum, 15 March), *"Celebrating the Past, Transforming the Future"*.

AGRI-TECH EAST 'POLLINATOR' EVENT

DBT-co-sponsored this event at Cambridge (25 April) on the theme of *"Swarm Robotics – The agri-workforce of the future?"* - or *"fleet robots"* as one speaker, 'Trustee-elect' Clive Blacker (CEO, Precision Decisions) prefers to call them as he prefers to avoid stigma associated with the word 'swarm'. This well-attended event generated useful discussion and contacts with leading researchers and businesses working on what was dubbed the 'Fourth Agricultural Revolution' and we look forward to supporting Agri-Tech East's forthcoming *'Young Innovator Forums'* relevant to agricultural engineering too.

And finally....

If any of these projects might be of interest for a Branch meeting, please contact me via enquiries@dbt.org. More information on some of them will appear on our website and the criteria and form to apply to the Trust for funding are available on our website http://www.dbt.org.uk/.

You can also keep informed of the latest news on DBT-funded projects and related topics via Twitter ***@BomfordTrust*** and Linked-In. [Please tag us into anything that would be of interest to our contacts too.]

MEMBERSHIP ENQUIRIES
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Telephone 44 (0) 1234 750876
e-mail: secretary@iagre.org www.iagre.org

Council Meeting

The Spring Council Meeting, chaired by IAgrE President Prof Jane Rickson, was held at the headquarters of the National Fluid Power Centre on 2 May 2019, preceding the Annual General Meeting and Awards.

In his address to Council, CEO Alastair Taylor formally welcomed Ed Hansom who had recently been appointed as his successor, and who would take up his post in September.

He also announced that Chris Biddle, the Editor of Landwards since 2008 had decided to retire from the post, and the procedure to appoint a new Editor was already underway.

Amongst developments within associated organisations, he noted that both the Society for the Environment (SocEnv) and the Engineering Council were reviewing and updating their standards and that IAgrE was engaged with the Royal Academy of Engineering in reviewing future policy.

There followed a lively and constructive debate on ways and means of IAgrE being able to engage with small businesses more effectively in order to grow awareness of the benefits of membership.

MEMORIES ARE MADE OF THIS . .

Whilst IAgrE, like every other institution has to be forward-looking, experiences of the past so often underpin and influence our future thinking. There can be few industry sectors that have such a rich heritage as farming and farm machinery. So we'd like to hear from our members of their recollections of past developments, events or emerging technologies that turned out to shape the machinery, equipment or practices of today. For examples see the Members Memories section under Our History on About Us tab on www.iagre.org. Please send your memories with any relevant pictures to Sarah secretary@iagre.org

Picture: Thomas Teagle, founder of Cornish farm machinery company on the family farm 1949

ALAM CONFERENCE

This year marks the 59th anniversary of the Association of Agricultural Machinery Lecturers (ALAM), with the annual Summer Conference taking place from Monday 22 to Thursday 25 July 2019 at Myerscough College in Lancashire.

The programme includes Trailblazer Apprenticeships and the End Point Assessment process, changes to the National Proficiency Test assessment procedures, slurry management solutions; electricity generation at Heysham power station, animal feed storage and conveying systems. It will also include visits to CSA Leyland Test Centre and the Highways England, North West Regional Operations Centre, Haydock.

Further information from Lance Butters lfbutterst20@gmail.com or John Gough gough.j@btinternet.com

MEMBERSHIP BENEFIT

Would your finances cover you if you were unable to work?

How would you cope if you couldn't work for an extended period? Nobody likes to think of the unexpected, of course. But a surprising amount of people in the UK would fall upon serious financial trouble in the event of a debilitating illness or injury.
In a recent study 30% of people admitted that they had no backup plan in place if they were unable to work. That wouldn't be a problem if we were a nation of avid savers. But let's face it, that's not the case. In fact the average Brit's savings would last 32 days before the pot ran dry.

The welfare state is great, but...

Why are we so unprepared? Research by Royal London found that 48% of working private renters would turn to state benefits to make ends meet if they were unable to work for three months or more. And while it's true that benefits would help, it's unlikely to be enough.
The actual sum you would receive from out-of-work benefits is just £92.05 per week for the employed or £73.10 for the self-employed. Compare that to an average household spend of £554.20 per week, and it's clear that the safety net is not without serious holes.

Low confidence in insurers

The same study found that only 4% mentioned income protection as a contingency plan for being off work. Why is that? Well, it could have something to do with the public's perception of dealing with insurance companies. Surveys have found that 59% of consumers feel that making a claim is 'daunting, complicated and time-consuming'. Not only that, but consumers estimate that insurance companies pay out only 47% of the time.
Thankfully, the reality beats the perception.
A cohort of those surveyed had actually claimed before, and of those, 71% actually rated the experience positively. Payout rates are almost double the perception, too. Insurance companies often have payout rates of over 90%.
And PG Mutual's payout rate is a pleasing 97% over the past three years, totalling £2.55 million. The top three claim categories being musculoskeletal (26%), infections and flu (22%) and gastrointestinal (14%).

Make the most of your IAgrE membership

If you want to be prepared for whatever life throws at you, income protection makes perfect sense. In return for a small proportion of your salary each month, PG Mutual will pay up to 70% of your income while illness or injury prevents you from working until you reach age 65.
And it gets better. PG Mutual share their profits with their policyholders. When you join they create a Profit Share account for you, depositing your cut of the company profits each year. You can claim this as a lump sum when you choose to leave the scheme or your policy matures.
Best of all? As an IAgrE member you are entitled to **20% off** your first two years of cover. Just mention the discount code '**IAgrE**'. To get started call PG Mutual on 0800 146 307 or visit find out more at pgmutual.co.uk.

Science and Silage: the forgotten feedstuff?
Speaker: Dr Conrad Ferris, AFBI dairy scientist
Wednesday 20 February 2019
Report by Terence Chambers

Grass silage is the mainstay of the Northern Ireland ruminant livestock industry, but relatively little new research had been carried out on it locally during the last 15 years. It was interesting to hear how practices have changed since Dr Ferris began his research career, at AFBI in 1988, when his PhD thesis examined the effects of using dry sugar-beet pulp ensiled with direct cut grass. This was to alleviate, in the era of direct cut systems, the release of effluent which was a significant environmental issue at that time.

AFBI Survey

Ruminant livestock enterprises occupy most of the agricultural land in NI. Stock are normally housed for at least 5-6 months of the year, during which silage is the main component of their diets. Feeding good quality silage reduces the need for bought-in concentrate feeding. Grassland management has always been at the centre of AFBI research and their latest major research project (co-funded by DAERA and AgriSearch) focuses again on grass silage quality.

As part of its latest research initiative, AFBI carried out a survey among 174 dairy farmers, attending the 2018 CAFRE Dairy Open Days, about their silage making systems and their perceptions of the factors affecting silage quality. Some of the key results were:

Number of cuts

22% of the sample farms were taking 2 cuts, 65% 3 cuts, and 13% 4 or 5 cuts. More frequent cutting will result in higher quality silage, although costs will be higher. Early AFBI research has shown that digestibility drops by around 3 - 5% each week after ear emergence, and that livestock performance from early cut grass is superior.

62% of the farmers in the survey normally use a contractor, 9% do sometimes and 29% make their own silage. 89% of the contract customers were charged per acre, 7% per bale, 2.4% (2 farms) were charged per hour and 1 farm on the basis of the weight of herbage.

Yield and quality

The current average yield of grass in Northern Ireland is around 5 tonnes of DM/hectare but there is potential to grow and utilise up to 9.5 tonnes/hectare. To achieve this soil fertility and pH needs to be correct and reseeding may also be necessary.

Wilting

Wilting is now common practice and its advantages include less risk of pollution from effluent, improved silage fermentation, faster field clearance rates and improved animal performance. Previous AFBI research has confirmed the benefits of rapid wilting with a mean milk yield response across 8 harvests of approximately 3%, although the responses were extremely variable between harvests. Current advice is to aim for a herbage dry matter content of at least 30% with a maximum 24 hour wilt. During periods of broken weather, with risk of continued exposure to rainfall, achieving a herbage dry matter content of 25 -27% will minimise the risk of effluent being produced.

Additives

The benefits of using a proven silage innoculant has been demonstrated in many studies. Additives can improve the stability of silages, and improve animals performance, often when little fermentation benefits are observed. 47% of the AFBI survey respondents always used an additive, 18% did sometimes and 35% never did.

Harvesting systems

Most now pick-up wilted grass using a meter chop harvester , baler or self loading forage wagon (SLFW). According to the AFBI survey 63% use a contractor (most with high output self propelled forage harvester-based teams) producing shorter chopped material. The longer sliced-length grass from the SLFW requires more rolling when filling the silo and fermentation may be slower.

The traditional standard polythene cover sheeting is partially impermeable compared with the new oxygen barrier film type which is now available. It can be used to reduce storage losses in both bulk silage and wrapped bales.

Hands Free Hectare presentation
Speaker: Kit Franklin
26 March 2019
Report by Terence Chambers

The Northern Ireland Branch of IAgrE joined with the members of NIIAS (The Northern Ireland Institute of Agricultural Science) to hear a presentation, sponsored by First Trust Bank, given by Kit Franklin, Senior Lecturer in Agricultural Engineering, and team leader of the "Hands Free Hectare" project at Harper Adams University in Shropshire.

He described how it was set up with the objectives of drawing attention to the proven efficiency savings by using precision farming methods to explore how smaller lighter machines can reduce soil damage and how they could be used in an unmanned cropping operation.

The young team of four (Harper Adams staff Kit Franklin and Jonathan Gill, Precision Decisions mechatronics engineer Martin Abell and Huthinson's agronomist Kieran Walsh) worked together on-site. They liaised with other specialist interests to bring in and investigate how much automation could be applied, at reasonable cost, to simple cropping using suitable off-the-shelf technology and open source software.

The project gained financial support from Innovate UK, which is the UK Government funded body which encourages the development of innovative ideas, as well as other sponsors.

The 1 hectare minimum-tillage project uses much smaller equipment (around 30%) of the size currently used on UK arable farms. A 38hp Iseki tractor operates a crop sprayer and a Sim Tech Aitchison 1.3m seed drill. A small Sampo combine harvester, with 2 metre cutting width, is used for harvesting of the cereal crops. These machines are fitted with servo controls for autonomous operation and guided by an autopilot system designed for drone navigation. Control systems were chosen on the basis of cost and availability from other industries. There is a camera carrying drone for regular aerial monitoring and a small robotic vehicle to take soil and crop samples across the site. When the operational principles are proven the system could, if the industry wished to adopt it, be readily extended for wider commercial use.

A spring barley crop was grown the first year yielding 4.5 tonnes per hectare. The second year's harvest of winter wheat yielded 6 tonnes and the team are proud to have achieved improved vehicle guidance accuracy. This extended to simultaneous control of both the combine and the tractor to enable on-the-move unloading of the grain-tank.

Air sampling and weather stations on the site provide ongoing information to guide remote agronomy decisions and the timing of spray and liquid fertiliser applications.

Technology and the future

The presentation continued with an overall summary of the digital technology which is now available or under development for agriculture. This included:

The continued development and application of Global Navigation Satellite Systems (GNSS) satellite- based navigation / location systems and the use of Real Time Kinetics (RTK) to enhance the precision of position data for

The Fendt Story
Speaker: Sean Gorman, Area Sales Manager: Fendt-Ireland
Wednesday 19 March 2019
Report by Terence Chambers

Sean Gorman was the speaker on the subject of "Fendt – Our journey and vision for the future".
Fendt, based at Marktokerdorf in the picturesque area of Southern Germany, is well known for its prestige range of tractors. The family business built its first one (known as the Dieselross) back in 1930. Fendt invests a high proportion of its turnover on research and development and has often been first to develop advanced technology on its tractors. Its innovative developments have included front-axle tractor suspension, suspended cabs, the turbomatic clutch and the stepless, trend setting Vario transmission of which more than 250,000 units have been built since 1995.
As well as having a strong emphasis on engineering / research and development, Fendt also manufactures a very high proportion of its own components including axle components, transmissions and cabs. The company became part of AGCO Limited in 1997. This has facilitated sharing of expertise and manufacturing facilities with the other specialist AGCO group companies. In this process, Fendt now offers a full range of grassland harvesting, baling, cereals harvesting and crop protection equipment.

Tractors

The Fendt wheeled tractor ranges span 70 to 500hp. There are also 2 rubber-tracked models which are agricultural versions, with the Fendt Vario transmission and Variotronic management system, based on AGCO's Challenger range.
The current Fendt range also reflects the subsequent AGCO acquisition of well-established manufacturers in the grassland machinery sector including the Fella, Lely Forage Division and Welger brands. The range now includes mowers, tedders, windrowers, trailed forage harvesters, self-loading forage wagons, balers and wrappers as well as Fendt's own "Katana" self-propelled forage harvester.

Electronic guidance and management systems

The Vario transmission is designed for ease of control via the joystick and can be programmed to maximise work rate within pre-selected engine and travel speed settings. Reduced engine speed during travel on the road is a popular proven fuel economy feature. Others include ABS and Vario Active steering. The latter adjusts steering sensitivity between field and road travel uses.
Variotronic provides GPS steering guidance, variable rate control for spreaders / sprayers and automatic steering as well as recording of performance data.
Fendt tractors offer ISOBUS compatibility and control features such as the in-cab joystick controls for the transmission and implement control settings which are the same across the Fendt ranges. Approximately half of the 16,800 Fendt tractors built last year were supplied with Autosteer.

Future developments

It is anticipated, across the industry, that implement sourced automatic control of the tractor's transmission, hydraulics and pto will continue to develop. This will sense changing loads on field implements and adjust forward travel speed to suit. For a baler it can stop when the bale chamber is full, complete the wrap cycle and eject the bale without driver assistance.
The Fendt e100 Vario electric powered tractor, aimed at municipal & vineyard / orchard type work, now offers a power interface for electrically powered implements and an electrically powered heat pump for cab air conditioning. Fendt has built the X Concept tractor (based on the 700 series) which can supply up to 130kW 700v for electrically powered implements. Some future field operations may also involve using unmanned tractors.

field use.
Precision imaging, based on aerial observation by drones, is increasingly used to assess crop development and condition. Drones can be programmed for large area coverage of both arable and grassland areas. Further information on crop condition will involve the use of quantitative pictures based on the analysis of wavelengths not visible to the naked eye.
Crop sensing. A current proprietary example is the tractor cab mounted YARA "N" Sensor. It gives on-the-move nitrogen content analysis which is fed back to the fertiliser spreader's variable rate system. There is also potential for small robot sensor vehicles to travel along crop rows to observe, diagnose and treat problems around individual plants. Detection of plant odours may also become a means of identifying plant condition.
Crop protection product application. Auto-section control is now available for spray booms. Future development may include variable rate for individual nozzles. Spot spraying could be carried out using small robots or drones if the process can satisfy environmental legislation.
Local climate information. Stand-alone solar powered weather stations, air sample collectors and soil-temperature sensors will be available to support remote management decision making.
Data analysis software services will assist decision making. This may involve multiple sharing of data with both the benefits and potential misuse of information. Agriculture 4.0 is a worldwide initiative to integrate agriculture technical data and encourage sharing through the developing digitisation of information processes.

Hands Free Harvesting
Speaker: Kieran Walsh, Hands Free Hectare project
13 March 2019
Report by Mike Whiting

Manufacturers and farmers have dabbled in the concept of autonomous operation of agricultural machinery, even back in the 1950's and 1960's when labour was in abundance. However it takes a defined leap of faith to turn the vision into a working project, where autonomy is to become 100% operational practice.
The Western Branch welcomed Kieran Walsh, regional agronomist with Velcourt Advisory Services to the March AGM to give us an update of the Hands Free Hectare project and where next for this rapidly evolving technology.
The championing of the application for robotics in agriculture by Simon Blackmore, previously head of the Engineering Department at Harper Adams University was the catalyst for a small team of professional engineers to give the Hands Free Hectare (HFH) some legs. Kit Franklin, a research active Agricultural Engineering lecturer at Harper Adams University and Jonathan Gill, a qualified robotic engineer with 13 years of experience in specialising mechatronic systems provided the essential skill set. However good ideas require a cash investment and this is where Clive Blacker, the precision agriculture specialist for Precision Decisions Ltd confirmed his interest in the project. Clive considered his monetary contribution would be spent wisely given his awareness of the industries drive towards greater efficiency. Another key principal of the exercise was to offer knowledge and experiences on an "open source" basis to the agricultural and ancillary industries.
Getting the seed into the ground is only the start, and crop husbandry requires the input and knowledge of a keen and progressive agronomist, step into the HFH limelight, Kieran Walsh. Add the essential roles of media relations, research, and some high quality precision applications engineers, the HFH dream team was ready for action.
The "Keep It Simple, Stupid" ethos is alive and well with the HFH project, focusing the project on a flat field with no obstacles. After circulating the project within the industry, two manufacturers provided an Iseki tractor and a Simtech Aitchison orchard direct drill as loan equipment. A Sampo trial plot combine provided the harvesting machinery with the essential set of gang rollers and a mounted sprayer completing the stubble to stubble HFH profile. The straightforward "mechanical" principles of the Sampo combine with levers provided the ideal base for upscaling to autonomous control, providing the engineers with a definitive guide on how much movement would equate to adjustments of harvesting functions such as the cutterbar and reel positioning.
Kieran explained that innovative methods were required to enable him to undertake his "day job" of assessing the crop for the agrochemical input requirements. Drones were used extensively for mapping the HFH as this new technology becomes commonplace in the arable scene. In addition the base running gear from an electric wheelchair was used and adapted into a rover with a penetrometer attached to monitor ground compaction levels.
To maximise the ground scouts potential a soil sampling device was fitted at the rear which provided Kieran with the physical evidence of the crops progress, in addition to the cameras for capturing close up images to supplement the drones application.
The HFH team's ability of how to apply autonomous control to agricultural equipment has grown exponentially since the project's inception. With the original hectare of land now considered "closed", the HFH is moving towards a much bigger and integrated level of investigations, including how to get machinery from the farm buildings and into the field, safely, under autonomous control. However, for those of us mere mortals who yearn for the sanctuary of the tractor seat, fear not as Kieran reminded us it currently takes three people to operate one autonomous tractor.
The concept of autonomy in agriculture is certainly gaining momentum, and will continue to be exploited by all industry stakeholders as the demand for delivering a more efficient agricultural sector continues.

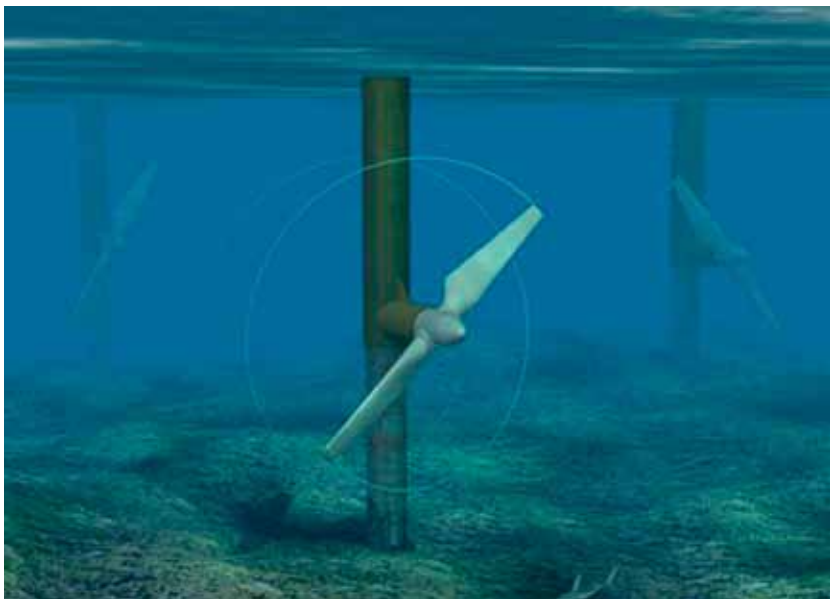
ABOVE: L-R: Kit Franklin, Martin Abell, Kieran Walsh and Jonathan Gill

Film Night
Speaker: Jim Wilkie
23 January 2019
Report by Mike Whiting

The Western Branch has found an ideal winter evening's entertainment for its annual schedule, with a film night courtesy of Jim Wilkie. Jim is a renowned source of archive material having pioneered the Old Sodbury Sort out where parts of many vehicles which were long thought to be extinct could be sourced. Its Jim's passion for agricultural merchandising material produced on reel that grabs our attention.
We started off with a film produced by the Fiat Corporation, circa 1987. It featured the familiar terracotta branded equipment covering the mid-range 110-90 tractors, a fleet of Laverda combines and the possibly unfamiliar part of the Italian stable, Braud, which included grape harvesting machines. The reference to a multimillion lira investment by Fiat into their manufacturing plants reminded us of the era before European domination took hold. This was a great film for us all to watch as even Jim hadn't seen it before.
We then moved onto a reel picked by Chris Brown which was the Massey Ferguson circa 1950's. Chris has recently returned to the UK after working on overseas irrigation and drainage projects, and we look forward to Chris becoming a regular attendee at Western Branch meetings. The film was taken at the time when Ferguson and Massey Harris merged, circa 1952. All the tractor drivers were wearing tweed jackets with the familiar farmer's caps.
We then had a couple of further films, the most relevant was a John Deere film pre the Second World War which previewed the tractor range of the 1930's in the US, with the Model A, B & G. What was interesting to note was the focus on row crop weeding.
Look where we are now in the year 2019 with Garford Farm Machinery and their camera operated inter-row weeder. We all sat there and commented that we're really just fine-tuning cultivation techniques which were common place just almost 80 years ago. In addition there was reference to machinery covering 60-70 acres a day with a tractor and cultivator no more than 2 ½ m wide, and when the tractor turned there was no slowing down, the driver simply hung on with all his might to get back on the next set of land. We estimated a number of machines wouldn't have completed the manoeuvre and ended up in the ditch.
The lack of guarding on multiple sections of the transmission drive systems and the operator filling up the fuel tank whilst smoking a pipe provided amusement for all.

Green Electricity from the Sea
Speaker: Mike Todman, Tidal Way
13 May 2018
Report by John Gough

Mr Mike Todman of Tidal Stream presented a thought-provoking overview of marine energy developments and challenges, which also included an insight into the effects that changes in national policy are having on the successful delivery of this technology.
The gravitational effects of the movement of the Moon and the Earth around the Sun have produced the phenomenon we recognise as high and low tides. These predictable events involve the movement of vast quantities of sea water in different directions, not only on our shoreline but further out at sea.
The technology which has so far been developed for marine sources can be divided into three categories: Coastal Inshore Tidal, Tidal Barrage and Tidal Current.
Coastal Inshore.
Development examples include a structure, currently being tested on the island of Islay off the west coast of Scotland, which uses the vertical change of wave height in a confined chamber to push and pull air through a fan-driven Wells turbine generator. However, the system apparently produces a wheezing sound which can be heard some distance away. The system on Islay, known as Limpit, has a 500KW capacity and was initially built and run by WaveGen.



Tidal Barrage.
This system ideally utilises a large tidal range, the difference in water-level between high and low tide, coupled with the advantageous shape of the coastline behind the barrage to entrap a large volume of water to produce electricity. Generators are installed in ducts in the retaining structure which requires the water to flow through the generators to equalise the water-level on both sides of the barrier. When high tide has been reached the water then flows back through the generators in the opposite direction.
Tidal Current.
This system is designed to harness the energy from large flows of water at strategically advantageous positions around the coastline. Around half of the potentially viable sites throughout Europe are around the coastline of the UK. The one offering the greatest potential is the Pentland Firth between Scotland and the Orkney Islands which carries water moving backwards and forwards between the North Sea, the Baltic and the Atlantic Ocean. Other sites around the UK include Anglesey, St Davids in South Wales, the Isle of Wight, Strangford Lough and the Antrim coast in Northern Ireland, and Skye, the Mull of Kintyre and the south-west corner of Scotland.
Tidal Stream has analysed the range of tidal-current structures already in existence and has developed a structure which can be floated out to site and partially submerged by ballasting it with water. It only requires one anchor point on the seabed, which allows the structure to pivot and follow the prevailing water current. The electricity produced can, after on-board conditioning to AC and transforming to grid frequency and voltage, be transferred to an undersea cable for transmission to the mainland electrical grid.

Visit: Veolia Waste Recycling Processing Centre,
19 July 2018
Report by John Gough

A group of 10 members were welcomed by Mr Nigel Price, the plant manager and our visit guide, and our tour started at 10am following a site-safety briefing and the issue of safety clothing.
This plant processes approximately 50,000 tons of recyclable household waste per year, about 50% from Birmingham, 20% from Telford & Wrekin and 30% from Shropshire.
The efficiency of the plant is largely influenced by the considered selection and sorting of the materials which the consumer presents for collection. We were also told that the demographic of an area can often be defined from the content of a load. The staff team have the opportunity to work on different tasks in the plant if they wish. Staff members who are new to sorting work can experience a sensation similar to motion sickness until they become accustomed to the continuous conveyor movement.
All waste material is transported to the plant by lorry and is unloaded onto the reception floor in the building where a load sample is taken for analysis. The remainder of the load is then gradually fed onto the input conveyor and through the initial sorting, carried out manually by 2 or 3 staff who pick out inappropriate material including large metal objects.
The garden green waste is taken to two sites about 10 miles away where it is stored in long heaps and turned every fortnight for 2 months to produce soil dressing or compost. The soil dressing is given free to local farmers; other material is sieved to remove larger lumps and then bagged for sale as "Pro Grow" compost, which is now being sold through some national outlets. The demand for this marketable product has grown from 3,000 to 60,000 bags / month.
Other sorted materials are sent for reprocessing: glass to St Helens to be used as skillet in the glassmaking process, steel goes to South Wales where it is turned into strip material for making tins. The aluminium goes to Warrington where it is smelted and formed into 22-ton ingots which are then rolled into sheets in Germany and returned to the UK to make more cans.

MEMBERSHIP CHANGES

ADMISSIONS
Member
Menon M (Yorkshire)
Jones K (West Midlands)
O'Donoghue C (Southern Ireland)
Foley N (Southern Ireland)
Elliott J H (Wrekin)

Associate Member
Dixon L (Yorkshire)

Affiliate
Turner B (South East Midlands)
Webb S (Kent)

Technician
Graham W (Northern Ireland)

Academic & Commercial Members
Hartpury College

STUDENTS
Cranfield University
Hasler R
Easton & Otley College
Askham L
Bostock J
Clark H
Clarke C R
Cross A
Ellis W
Hayward E
Ingham G
Mobbs D
Moore D
Parkinson J
Passmore E
Picard J
Seaman J
Shone C
Sharman L
Thorp G R
Touler W
Wallace C
Wyatt J

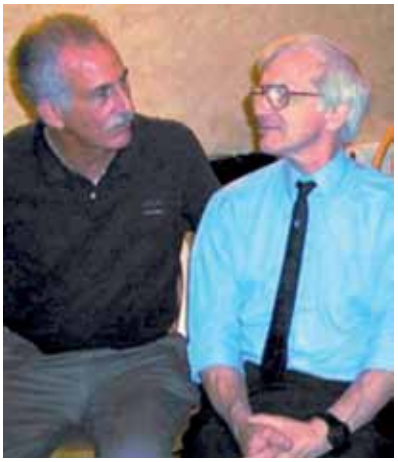
Riseholme College
Atkins Z
Chapman S
Collishaw A
Dench G
Doody E
Fawcett J
Foster J
Goodeve T
Hand A P
Mason H
Murphy J
Philips CD
Pinchin A
Porcogos D
Smalley M
Trewick O L
Walker J A L
Williams A H

South West College Omagh
Ewing A
Hargan M
Lucy R J
Johnston B W G
McGarvey D
McNally O
Mitchell R
Murray S
Wilson R
Woods N

Ulster University
Hopper E

READMISSION
Westwood M V CEng MIAgrE (Southern)

DEATHS
We have recently learned of the death of the following members and we send our condolences to their family and friends:
Mr D J Watson AMIAgrE (East Anglia) a member since 1959



TRANSFERS

Technician
McAdam JA (Wrekin)
Massey DJ (S E Midlands)

ENGINEERING COUNCIL REGISTRATIONS
EngTech
Thorpe H (Wrekin)

SOCIETY FOR THE ENVIRONMENT
CEnv
Smith A G (West Midlands)

LONG SERVICE CERTIFICATES (1 April to 30 June 2019)

IAgrE extends warm congratulations to the following members on reaching significant milestones

Name		*Date of Anniversary*
60 years		
John William Roberts	AIAgrE	9 Jun 2019
Dennis John Watson	AMIAgrE	9 Jun 2019
50 years		
Ralph Alcock	FIAgrE	17 Apr 2019
David John Cooper	MIAgrE	17 Apr 2019
Gino Paul Cameron Henry	MIAgrE	17 Apr 2019
Anthony Russell Key	MIAgrE	17 Apr 2019
Richard Roy Morrison	MIAgrE	17 Apr 2019
Hayden Colin Wickington	AIAgrE	17 Apr 2019
Kenneth Anthony Pollock	MIAgrE	9 Jun 2019

Name		*Date of Anniversary*
35 years		
Simon Winser Wilcox	MIAgrE	28 Apr 2019
Anthony James Hopkinson	MIAgrE	25 May 2019
25 years		
James Peter Middleton	MIAgrE	7 Apr 2019
Patrick Joyce	MIAgrE	27 Apr 2019
James Marcus Bellarby	AIAgrE	5 May 2019
Athanasios Tzivanopoulos	MIAgrE	2 Jun 2019
Edwin James Ratcliffe	MIAgrE	21 Jun 2019

ACADEMIC AND COMMERCIAL MEMBERS

ACADEMIC MEMBERS

Berkshire College of Agriculture
Hall Place
Burchetts Green
Maidenhead
Berks SL6 6QR

Bishop Burton College
York Road
Bishop Burton
Beverley HU17 8QG

Brooksby Melton College
Asfordby Road
Melton Mowbray
Leics LE13 0HJ

Coleg sir Gar
Gelli Aur Campus
Llandeilo
Carmarthenshire SA32 8NJ

Cranfield University
Cranfield
Bedfordshire MK43 0AL

Duchy College
Stoke Climsland, Callington
Cornwall
PL17 8PB

Easton & Otley College
Easton
Norwich, Norfolk, NR9 5DX

Greenmount College
CAFRE 22 Greenmount Road
Antrim, Northern Ireland BT41 4PU

Harper Adams University
Newport
Shropshire TF10 8NB

Hartpury College and University
Gloucester
GL19 3BE

Institute of Technology
Tralee Clash, Tralee
Co Kerry, Ireland

Lincoln Institute of Agri-Food Technology,
Lincoln University
Lincoln LN6 7TS

Manchester University
School of Electrical and Electronic Engineering
C39, Sackville Street Building
Sackville Street
Manchester M1 3WE

Myerscough College,
Bilsbarrow
Preston
Lancashire PR3 0RY

Newcastle University
King's Gate
Newcastle Upon Tyne NE1 7RU

Pallaskenry Agricultural College
Co Limerick
Ireland

Plumpton College
Ditchling Road
Lewes
East Sussex, BN7 3AE

Reaseheath College
Reaseheath,
Nantwich
Cheshire, CW5 6DF

Royal Agricultural University
Cirencester
Gloucester, GL7 6JS

Sparsholt College
Sparsholt,
Winchester SO21 2NF

SRUC – Auchincruive
Auchincruive Estate
Ayr, KA6 5HW

University of Manitoba
Winnipeg
Canada
MB R3T 2N2

Warwickshire College Group
Warwick New Road
Leamington Spa CV32 5JE

Wiltshire College Lackham
Lacock
Chippenham
Wiltshire SN15 2NY

COMMERCIAL MEMBERS

Ace Aquatec Ltd
16B City Quay
Camperdown Street
Dundee DD1 3JA

Agri-EPI Centre
1-4 Bush House Cottages
Edinburgh Technopole
EH26 0BA

Agricultural Engineers Association (AEA)
Samuelson House
62 Forder Way, Hampton
Peterborough PE7 8JB

AGCO Ltd
Stoneleigh, Abbey Park
Kenilworth, Warwickshire CV8 2TQ

Alvan Blanch Development Co
Chelworth, Malmesbury
Wiltshire SN16 9SG

Autoguide Equipment Ltd
Stockley Road, Hedington, Calne,
Wiltshire SN11 0PS

BAGMA
225 Bristol Road
Birmingham B5 7UB

Briggs Irrigation
Boyle Road
Corby, Northants NN17 5XU

City and Guilds
1 Giltsput Street, London EC1A 9DD

City Farm Systems Ltd
25 Hepplewhite Close
High Wycombe, Bucks HP13 6BZ

David Ritchie (Implements) Ltd
Carseview Road, Suttieside
Forfar, Angus DD8 3EE

Douglas Bomford Trust
The Bullock Building
University Way, Cranfield
Bedford MK34 0GH

DSL Systems
Adbolton Hall
Adbolton Lane, West Bridgford
Nottingham NG2 5AS

FEC Services
Stoneleigh Park
Kenilworth, Warwickshire CV8 2LS

Fullwood
Grange Road, Ellesmere
Cheshire SY12 9DF

Househam Sprayers
Roughton Moor
Woodhall Spa, Lincs LN10 6YQ

HSS Hire
25 Willow Lane, Mitcham
London CR4 4TS

JCB Rocester, Staffs ST14 5JR

John Deere Ltd
Harby Road, Langar
Nottinghamshire NG13 9HT

Marks & Clerk LLP
90 Long Acre, London WC2E 9RA

Mastenbroek Ltd
83 Swineshead Road
Boston, Lincs PE21 7JG

National Fluid Power Centre
Carlton Road
Worksop, Notts S81 7HP

Orby Engineering
Craigmore Road, Newry BT35 6JR

Reesink Turfcare UK
1-3 Station Road
St Neots, Huntingdon PE19 1QH

PlantTech Research Institute
Bay of Plenty, New Zealand

Shelbourne Reynolds
Sheperds Grove Ind Estate
Stanton, Bury St Edmunds
Suffolk IP31 2AR

SSAB Swedish Steel Ltd
Narrowboat Way
Hurst Business Park
Brierley Hill
West Midlands DY5 1UF

Teagle Ltd
Blackwater
Truro, Cornwall TR4 8HQ

TeeJet London Ltd
Headley House
Headley Road, Hindhead
Surrey GU26 6UK

Witham Oil and Paint Ltd
Outer Circle Road
Lincoln LN10 6YQ

ALASTAIR TAYLOR

SEVERN VALLEY RAILWAY

IAgrE CEO Alastair Taylor has long held a keen interest in railways - and signalling in particular. When not attending to the affairs of the Institution, he can be found as a qualified volunteer signalman in the signal boxes of the Severn Valley Railway. He describes the fascination and complexity of the role.

Summoned by Bells

I suspect that I am no different to many IAgrE members when it comes to an interest in industrial archaeology, steam engines and the like. My particular interest is in Railway Signalling, something which I have done for over thirty years.

I am a volunteer signal man at the Severn Valley Railway (SVR) and am qualified to operate the signal boxes at Kidderminster, Bewdley South and Bewdley North. There are four others which I do not work.

Quite why I got interested is a mystery although I do recall as a child that we knew someone who was a Signalman and we did have a railway line (now closed) running through the farm.

I was always intrigued by all those mechanical clunks and dings as the signalman operated the points and signals and communicated with the next signalman by special bell codes, 3-1 for a stopping passenger train, 2-2-1 for an empty train, 2-3 for an engine and so on.

So when in the eighties, the SVR advertised for volunteers, I got involved and have enjoyed it ever since. The SVR set an especially high standard in its signalling and on a busy day, the job can be every bit as intense as on the "big" railway – even though our speeds are limited to 25mph.

The other interesting point is that the signal boxes at Bewdley are original with little change from Edwardian times. It is rather good to think that I am keeping the skill alive and using the same equipment, rules and regulations as my signalling forefathers from one hundred years back. Railway preservation is much more than engines and carriages!

"Red for Danger"

Signal boxes are rather more complex than you might imagine. The development and improvement of systems and rules has often been driven by post-accident enquiries which recommend improvements to safety systems and rules. Human error is very often the cause of problems and for anyone interested I would recommend a book called "Red for Danger" by LTC Rolt.

It is an interesting read. IAgrE members might not know that there is a professional engineering institution for railway signal engineers (IRSE). They do rather an important job in my opinion!

The safety systems take many forms. For example, black levers operate points and these have to be locked by a blue lever called a Facing Point Lock (FPL).

Only when these have been set, and the lock proven (either electrically or by a mechanical system) and an indication given in the signal box can the relevant signal be operated. Signal levers are red. Sometimes points and signals some distance away from the signal box are worked by electric motors and under these circumstances the relevant lever is shortened as it is only an electrical switch and takes no effort to pull.

Behind the scenes, there are some fascinating systems which ensure safety. These involve mechanical and electrical systems which prove that points have been properly set or that a signal which can't be seen has properly operated. In addition there are clever locking systems which prevent the operation of one lever when another has been pulled.

All of this prevents the signalman from setting up a conflicting movement.

Single line tokens

When it comes to operating the whole railway, this is broken down into various short sections with there only being one train in the section at once. The SVR is around sixteen miles long and this is broken down into six sections of various lengths. Kidderminster to Bewdley is around 3 miles and it takes 10 minutes or so for a train to make its way through it.

Anyone who has visited a preserved railway will see that the engine driver is given a "single line token" which is their permission to travel that section. There is only one token allowed at a time and the train must have it!

On the SVR there is also a section of double line which operates according to a system called "Absolute Block" where trains only ever go in one direction and the first train has to arrive and be "out of section" before the next can be sent.

There is nothing amateur about any of this. I count myself as a professional signalman in that I have to operate to the same basic rules and regulations

Our feature looking at the hobbies and pastimes of IAgrE members when not engaged in their day-jobs. CHRIS BIDDLE reports

as my counterparts on Network Rail. My work is regulated by the same Railways Safety Inspectorate and I have to be reassessed every three years to make sure I am up to speed on the rules and regulations and especially what needs to be done if things go wrong such as a lineside fire or a broken-down train. (with very old steam engines, both of these are quite commonplace) I love doing it. Quite why a Lincolnshire farmer's son has developed this interest is a mystery to me. The camaraderie from fellow signalmen is great and the sense of teamwork when you end the day with everything on time and in the right location is very pleasing. Above all, it is great to think that I am keeping alive a tradition which is fast going on the national network is a wonderful thing. You have to search hard to find locations where the national network is operated in the old-fashioned way.

Also, it is a great place of observing steam engines with rather a special view from the lofty heights of the signal box. As you know, I will be having a little more time on my hands after September, so if ever you are in Kidderminster or Bewdley, do look out for me. It might be me who is pulling the levers and ringing the bells.

The modern railway might be fantastic in terms of its computerised control systems with a single person operating many, many miles of railway, but in my view, times were much better when the railway was broken down into many short sections, each controlled by a signalman looking out to make sure there was a red tail lamp and all the doors were properly closed, and all movements were *"summoned by bells"* to quote Betjeman.

The **Severn Valley Railway** is a heritage railway in Shropshire and Worcestershire. The 16-mile (26 km) heritage line runs along the Severn Valley from Bridgnorth to Kidderminster, crossing the county border, and following the course of the River Severn for much of its route. Train services are hauled predominantly by steam locomotives, plus one diesel hauled train, making two round trips a day most days. Diesel locomotives are also used for engineering trains, to replace failed steam locomotives at short notice, and during periods of high fire risk.

The railway line was built between 1858 and 1862, and originally linked Hartlebury near Droitwich with Shrewsbury, a distance of 40 miles (64 km).

www.svr.co.uk

FORTHCOMING EVENTS

IAGRE EVENTS

Wednesday 21 August 2019
9.30am-4.30pm
IAgrE Forestry Engineering (FEG) Symposium
Theme: New Developments in Timber Extraction
Newton Rigg

Wednesday 30 October 2019
9.30am-4.30pm
IAgrE Landwards Annual Conference
Can Big Data Lead to Smarter Farming?
Peterborough Suite
East of England Arena, Peterborough

INDUSTRY EVENTS

Sunday 23 June 2019
International Women in Engineering Day
There are several early sponsors on board for INWED 2019, including; Boeing, Cranfield University, GCHQ, Mercedes-AMG Petronas Motorsport, NSIRC, OPITO and Royal Academy of Engineering.

Monday 1 – Sunday 7 July 2019
Royal Society Summer Science Exhibition
The Royal Society
Carlton House Terrace, London

Thursday 18 July 2019
The Future of Farming: National Conference
Organised by Westminster Insight
Central London

Wednesday 4 September 2019
8.00am – 3.00pm
Tillage-Live 2019
Deenethorpe Airfield
Northamptonshire

Tuesday 10 – Friday 13 September 2019
CIGR and AfroAgEng Conference
Theme: 'Challenges of Water Mobilisation and Soil Conservation in Better Adapting to Climate Change'
Rabat, Morocco

Wednesday 11 September 2019
UK Dairy Day
International Centre
Telford, Shropshire

Tuesday 22 – Wednesday 23 October 2019
N8 AgriFood Annual Conference
Creating Solutions for a Sustainable Food System
The Principal Hotel
York

Tuesday 15 – Wednesday 16 October 2019
World Agri-Tech Innovation Summit
London

Dates and details are correct at time of going to press. Further information and updates from the events page at www.iagre.org

DATE FOR YOUR DIARY

LANDWARDS CONFERENCE 2019

BIG DATA

Will it lead to Smarter Farming?

WEDNESDAY 30TH OCTOBER 2019

VENUE: PETERBOROUGH SUITE,
EAST OF ENGLAND ARENA, PETERBOROUGH

BACKGROUND

The 21st century has seen a rapid increase in the amount of data being collected throughout the agricultural supply chain. Farmers use sensors for soil sampling and mobile apps, cameras and drones to monitor pests and diseases, mapping of fields – all generating huge amounts of data.

BUT how can farmers, agribusinesses and researchers gain real ***value*** from "big data"?

The challenges and opportunities for agricultural engineering include:

- Smart sensors and devices produce vast amounts of data that should provide unprecedented decision-making capabilities.
- Big Data is expected to have a large impact on Smart Farming and the Internet of AgriThings throughout the whole supply chain.
- Big Data is expected to cause major shifts in roles and power relations among traditional and non-traditional players.
- Governance (incl. data ownership, privacy, security) and business models are key issues to be addressed in future research.

The UK agricultural industry should harness the power of data to support decision-making and ensure future success. However, data experts say 90 per cent of the data collected is wasted.

This conference will explore how 'big data' is being used to improve agricultural practices, and how farmers and technologists should work together to extract the value of 'big data' and identify future development opportunities.

PROGRAMME AND SPEAKERS

The Big Data Challenge:
Professor Jane Rickson, President IAgrE

Unlocking Solutions though Big Data:
Benjamin Turner, COO Agrimetrics

Practical Lessons from the Farm:
Oliver Wood
Omnia Precision Agronomy

Machine optimisation through Big Data:
Dr Joachim Stiegemann, CLAAS

IOT for Agriculture:
IT Industry speaker (tbc)

PANEL DISCUSSIONS AND WORKSHOPS

Featuring

Andy Newbold:
IAgrE Past President

Dr Rob Simmonds:
Cranfield University

Professor Ron Corstanje:
Cranfield University

Professor Mark Rutter:
Harper Adams University

Professor Simon Pearson:
Lincoln University

PLEASE NOTE: The above details reflect the provisional conference and speaker arrangements.
Further information will be updated regularly on the Conference website www.iagre.org/conference-2019.

SPONSORSHIP PACKAGES for this prestigious event are available.
Please contact Sarah McLeod at IAGRE Head Office for details