Landwards

Agriculture • Horticulture • Forestry • Environment • Amenity

IAgrE Professional Journal www.iagre.org Volume 70, Number 2 Summer 2015

Water Management in a Changing Climate

2015 Annual Conference

In this issue...

Student presentation evening

IAgrE AGM and Awards

Young Engineers Competition

Anti-lock brakes for fast tractors

Biosystems Engineering

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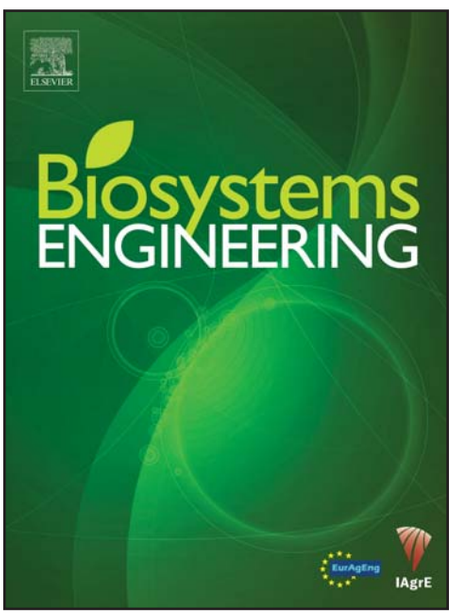

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The Managing Editor of ***Biosystems Engineering***, ***Dr Steve Parkin***, has kindly summarised some of the papers published in the last three issues which he thinks may be of interest to IAgrE members

Biosystems Engineering
Volume 130, February 2015, Pages 60-71

Challenges in the development of Precision Beekeeping - Review

Aleksejs Zacepins, Valters Brusbardis, Jurijs Meitalovs, Egils Stalidzans
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Precision Beekeeping (PB) is an apiary management strategy based on the monitoring of individual bee colonies to minimise resource consumption and maximise the productivity of bees. Although there are sufficient technical means and industrial products for the practical execution of PB, the process is slow due to the differing states of development of three implementation phases: data collection, data analysis and application. The technical execution, adequacy of earlier and current solutions and development perspectives are analysed to prioritise different challenges for PB. The development of decision support systems, which is usually a stumbling block in Precision Agriculture, is suggested to be a mid-term task. In the long term, specific DSS-controlled electronic devices should be developed to enable new functionalities for PB. Specific classes of actors are proposed to operate within future PB systems for the automatic execution of suggestions made by decision support systems, as well as for diagnostic purposes. PB systems should be optimised by searching for appropriate combinations of different sensors, and corresponding decision support systems must provide convenient, reliable and cost efficient solutions.

Volume 131, March 2015, Pages 1-14

Airflow characteristics and patterns in screenhouses covered with fine-mesh screens with either roof or roof and side ventilation

Meir Teitel, Monica Garcia-Teruel, Pablo F. Ibanez, Josef Tanny, SagiLaufer, Asher Levi, Aharon Antler
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In many countries fine mesh screens are used to protect agricultural crops. The low porosity of such screens impedes the exchange of mass, heat and momentum between the air around the crop and that occur in the atmosphere, modifying the crop microclimate. Experiments were carried out to determine the internal airflow characteristics and patterns of screenhouses. Results showed that screenhouses reduced air velocity compared to that in an open field. The internal air velocity increased with external windspeed but it increased to a greater extent near to the roof. Flow patterns and characteristics were affected by whether the screenhouse was ventilated only via the roof or via the roof and sidewalls. When the screenhouse was ventilated from the roof and side panels the air velocity was higher than under roof ventilation alone, and the airflow direction, both within the canopy and above it, was usually in a similar direction to that of the outside wind. However, under roof ventilation alone the internal airflow direction was generally opposite to that of the external wind.

Volume 132, April 2015, Pages 19-27

Multi-temporal imaging using an unmanned aerial vehicle for monitoring a sunflower crop

Francisco Agüera Vega, Fernando Carvajal Ramírez, Mónica Pérez Saiz, Francisco Orgaz Rosúa
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The objective was to determine the capability of an unmanned aerial vehicle system carrying a multispectral sensor to acquire multitemporal images during the growing season of a sunflower crop. Measurements were made at different times of the day and with different resolutions to estimate the normalised difference vegetation index (NDVI) and study its relationship with several indices related to crop status. NDVI was calculated from images acquired on four different dates during the cropping season. On two of these dates, two images were acquired to determine how the time of day when the images were taken influences NDVI value. The results showed that the linear regressions between NDVI and grain yield, aerial biomass and nitrogen content in the biomass were significant, except during very early growth stages, whereas the time of day when the images were acquired, the classification process, and image resolution had no effect on the results. This provides information that is related to crop yield from the very early stages of growth and its spatial variability within the crop field to be harvested, which can subsequently be used to prescribe the most appropriate management strategy on a site-specific basis.

The Professional Journal for Engineers, Scientists and Technologists in Agriculture, Horticulture, Forestry, Environment and Amenity

Landwards

EDITORIAL:

Hurricanes hardly happen . . .

CHRIS BIDDLE
Editor
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How apt, how relevant the choice of water management for the recent Annual Conference. It often takes true-life events to draw attention to some of the most basic requirements for day-to-day living. Elements, that are so obvious that they get overlooked or taken for granted in the chitter-chatter of news reporting.

Water is an obvious example. It was good to be reminded by LEAF's Caroline Drummond of Jacques Cousteau's saying "*We often forget that the water cycle and life cycle are as one*".

Members of the Government from the Prime Minister downwards would have been hard pressed to pin-point the Somerset Levels on the map until the winter before last. The media also had to dig out their Wellingtons and Sou-Westers whilst the story unfolded. And it is unlikely that funds would have been found for essential drainage work and water management schemes unless the media spotlight had not focussed on that part of the West Country.

That's the trouble with the UK. We have relatively benign weather, and are unprepared to cope with meteorological imbalances. As Professor Higgins said, "In Hertford, Herefordshire and Hampshire, hurricanes hardly happen".

Which is more than you say for the US. Coincidentally in the month of our conference titled Too Much, or Too Little Water, the state of Texas was experiencing the extremes. Like California, much of the State had endured almost four years of debilitating drought. Almost overnight, the heavens opened, submerging major towns and the countryside. Houston had 10 inches of rain in a 12-hour period. Over 30 people died in the floods on Memorial Day alone.

But, Texas has learned to cope and adapt. The state produces the greatest amount of wind-power energy in the US. Innovative methods are used to ensure that life can go on.

At the heart of water management are engineering solutions, which is why our President was spot-on with his choice of subject - and why the focus must remain on the elixir of life.

The views expressed in Landwards editorial are those of the Editor, and do not necessarily reflect those of the Institution

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IAgrE welcome budget boost for IoT

But warn it's not all about 'devices' for agricultural sector

Alastair Taylor, CEO of IAgrE says, "In the budget the chancellor pledged £40m for IoT, alongside a £600m investment in freeing up spectrum to be used for wireless broadband.

"It's great news but important to remember that the Internet of Things also embraces the wider agri-ecosystem including plants, animals and soils, as well as the agri-people, the farmers, machinery technicians and agronomists.

"IoT will enable the growth of small, inexpensive but sophisticated electronic devices and connect them via global mobile networks. Extreme weather, growing populations and the need to conserve natural resources and minimise environmental pollution are major drivers for exploring how IoT can help. More precise and accurate information can lead to improved opportunities for smart agriculture.

"We need to challenge perceptions of engineering to encourage young and budding engineers. They often think that a career in Formula 1 is an exciting choice. It is, but our job is to get them to consider the opportunities in agrifood instead.

"With these highly sophisticated new technologies, the role of agricultural engineering will need to reflect the levels of complexities and new skills involved in harnessing IoT opportunities.

"We might be wrestling with the new terminology and buzzwords such as 'big data', 'cloud hosting' and 'machine learning' but as an agricultural engineer, I've never been so excited about the future and the benefits IoT will bring.

"We now have technologies that previously didn't exist to bring autonomous, intelligent, useful and productive innovations to the field", added Alastair.

Cross cutting industrial strategy planned for mechanical engineering

EAMA announce plans for supply chain sector

In response to government's industrial strategy development, the Engineering and Machinery Alliance (EAMA) have announced plans for a complementary industrial strategy for the machinery and allied component (MAC) supply chain sector.

It will be based on the conclusions of a pilot study EAMA commissioned from the University of Cambridge Institute for Manufacturing (IfM) with assistance from the Department for Business, Innovation and Skills.

EAMA believes its initiative will greatly increase the ability of MAC SC companies, particularly SMEs, to benefit from the wide variety of schemes available to help build competitive performance.

Commenting on the cross-cutting initiative, Martin Walder, EAMA chairman said, "Having decided to proceed, EAMA are now inviting all interested associations and organisations representing companies operating in MAC supply chains to contact us so that we can share our plans in more detail.

"Associations don't have to be members to join in. That's the offer we made for the scoping study which enabled four non-members to participate and we are repeating the invitation this time.

"The pilot study has convinced us that there are significant opportunities to help member firms grow. The ultimate aim is, of course, to raise UK supply chain performance. We aim to achieve this by accessing and developing schemes that increase individual company competitiveness and productivity in a programme that reflects the fact that many firms serve more than one supply chain. Accordingly, the wider the participation, the greater the benefit to UK plc.

"From the out-set, we have made two major commitments to encourage engagement by as broad a cross section of interests as possible. First, we will be careful not to duplicate or inadvertently replace any schemes, but rather 'hook' into them and make it easier for MAC firms to participate in them.

"Second, participation fees have been set at a level that will enable organisations of all sizes to 'pitch-in' so that their firms benefit from the links that will open-up as the strategy develops. In some areas we expect to move on to implementation quite quickly, for example in automation/motion control.

"The government's approach to an integrated industrial strategy has encouraged EAMA, and many other associations like us, to re-evaluate how we can both help our members to access the myriad of opportunities that are available and at the same time ensure government designs policies that will deliver in-line with their requirements and those of the MAC sector as a whole.

"Developing an industrial strategy for an enabling sector such the machinery and allied component suppliers is a direct response to that challenge."

There is more contact information on the website *www.eama.org.uk*

SALLY WOOD has joined the IAgrE team as Business Development & Projects Assistant, responsible for updating and developing the website and expanding the Institution's corporate membership.

Sally joins IAgrE from Age UK Milton Keynes, where she was a fund raising coordinator. Working on a part-time basis she will also be responsible for Executive and the Publications Management Committee meetings.

"I am really enjoying my new role, especially developing the web site and in particular the new membership section that is at present under construction."

Alastair Taylor, IAgrE CEO added "Sally has been very quick to understand the Institution and is already developing new ideas which will be of benefit to members."

Sally has two children and lives in Cranfield.

LE-TEC launch Landbased Engineering website

Contains information on careers, education and training

IAgrE along with the AEA (Agricultural Engineers Association) and BAGMA (The British Agricultural and Garden Machinery Association), under the LE-TEC banner, have launched a new website packed with information and advice on careers in the landbased engineering sector.

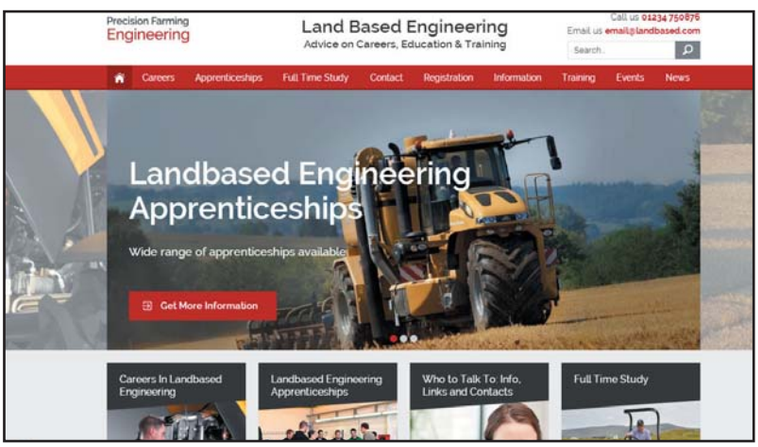
The site offers quick and easy access to essential information for students, careers advisors and parents about careers, apprenticeships, vocational and university courses in landbased engineering.

Alastair Taylor, CEO of IAgrE said, "It's like a one-stop shop, a place where anyone with an interest in a career in landbased engineering can access information from a central hub, because it's vital that all this information is in one place for easy access.

"I would call on all career advisers in schools, colleges and universities to use this single point of information to help people of all ages to embrace the exciting careers available in landbased engineering. It has been our concern for a number of years that young people are not being informed about careers in this industry and we have developed this site as the solution."

Keith Christian BAGMA Director said, "BAGMA is committed to providing industry specific training and supporting colleges and apprenticeships for the landbased sector. We believe the website will be a source of knowledge for students, educators and parents wanting to understand more about what careers in this sector can offer."

Ruth Bailey, Director General/CEO AEA added, "We anticipate the website will keep people up to speed with the latest information and advice for students, parents and careers advisors and will act as a point of contact for training and industry events."



The three Associations are members of LE-TEC (Landbased Engineering - Training and Education Committee), the joint Training and Education Committee that is the single voice for training and education within the landbased engineering sector. The group is an industry decision making body that represents all aspects of recruitment, education, careers and training that supports and promotes the LTA (Landbased Technician Accreditation Scheme) and liaises with colleges and awarding bodies to deliver the appropriate level of technical skills required by the landbased industry sector.

The site can be accessed at *http://landbasedengineering.com*

. . . and new 'World Of Opportunity' brochure

LE-TEC has also launched an updated *World Of Opportunity* brochure designed to encourage young people into the exciting field of Landbased Engineering.

Packed with useful information, the 16 page booklet contains sections on:

- **What is Landbased Engineering?**
- **Vocational training**
- **Higher Education**
- **Apprenticeships**
- **LTA technical accreditation**
- **FAQs**
- **Where to find more info**

CEO of IAgrE, Alastair Taylor said, "The new publication is designed to give an overview of the exciting world of Landbased Engineering. Although farming and food production is a major focus, our industry extends into a number of complementary areas. Everything concerned with the upkeep and control of the countryside, forestry, sports-grounds and open spaces comes under our scrutiny and influence.

"What is for certain is that if an individual is keen on science, engineering or computer studies - and they want to make a difference - then a career in Landbased Engineering is well worth a detailed look.

"We hope this brochure gives a sense of some of the opportunities offered into what is simply one of the best careers - on earth."

If you would like to request a copy of the brochure please email *secretary@iagre.org*

Alternatively it can be viewed online at *www.iagre.org/about/publications*

John Deere technicians graduate in style

A total of 28 young service technicians have graduated from the latest John Deere Ag Tech, Parts Tech and Turf Tech advanced apprenticeship programmes, run by national training provider Babcock.

Alistair Baillie from dealer Thomas Sherriff & Co Ltd in Alnwick, Northumberland was named ag & turf apprentice of the year for 2014, while parts apprentice of the year was Mike King of Ben Burgess Newmarket in Suffolk.

The group of third year students received their certificates at the John Deere Forum visitor centre in Mannheim, Germany during a specially arranged visit to the company's tractor and cab factories and European Parts Distribution Centre (EPDC). The presentations were made by Deere & Company's regional training delivery manager Dr Lutz Schueppenhauer, John Deere Limited training manager Richard Halsall and marketing manager Chris Wiltshire, and Babcock programme manager Guy Schornig-Moore.

Alistair Baillie received a crystal plaque, a certificate and vouchers for workshop tools worth £250, whilst Mike King received a certificate and shopping vouchers worth £250

The John Deere three-year apprenticeships lead to the BAGMA/City & Guilds of London Institute 4025 agricultural/groundcare service engineers NVQ Level 2 & 3 certificates and Level 3 IMI Diploma in vehicle parts competence. Apprentices can choose to complete their education for a fourth year to gain the John Deere Diploma and register at LTA2 level in the industry's Landbased Technician Accreditation scheme, while starting their adult training within the John Deere University.

Engineering awards ceremony success

JCB's Dan does the double

JCB apprentice Daniel Biggs is the toast of the company after scooping two top awards in a national competition.

The young engineer and fourth year apprentice, who works for JCB Transmissions in Abenbury Way, beat stiff competition to scoop the Outstanding Performance by a Final Year Apprentice Award at the EEF Future Manufacturing Awards held in London.

Judges said Daniel "demonstrated an immense knowledge and passion for engineering, allowing him to perform at the very highest level" and that he was an "exceptional apprentice role model".

Daniel, aged 21, of Wrexham, was also named Manufacturing Student of the Year at the same awards ceremony. Judges of that award said Daniel "demonstrated a tremendous level of professionalism and commitment to being an engineer, and the industry as a whole" and that his "absolute passion and dedication to engineering shone through" The award showcases the two major routes - an apprenticeship and a degree - available to people wishing to pursue engineering-based careers.

Daniel said, "To be named manufacturing student of the year and an outstanding apprentice is a real honour. I've learnt valuable skills that have set me on the path to an interesting and rewarding career and I would have no hesitation in urging other young people to pursue a career in manufacturing, either as an apprentice or university student."

JCB Transmissions MD Robert Owen said, "We are extremely proud of everything that Daniel has achieved. He deserves the recognition for his hard work and he is a great example of how engineering can be a fantastically exciting and rewarding career."

Daniel Biggs

> "...I've learnt valuable skills that have set me on a path to an interesting and rewarding career"

Harper student trains in France with Kuhn

International perspective with machinery manufacturer

Harper Adams third year student, Sam Green, is learning about agriculture from an international perspective during his placement year working in France for machinery manufacturer, KUHN.

The 20-year-old says he couldn't resist taking up the role at the company's headquarters in Saverne and now works alongside managers to complete marketing projects as well as hosting visitors and delivering technical training.

Through his job he has also been able to travel - working at SIMA in Paris, LAMMA in the UK and Denmark to provide product training.

Sam, who studies BSc (Hons) Agri-food Marketing with Business Studies, said, "Aside from learning a bit of French, my product knowledge is improving every day, you don't stop learning.

"I'm meeting people from all over the world, so learning how to communicate technical information to them can prove challenging and is a skill that takes time to develop.

"Being 1000km away from home isn't the easiest, but I'm experiencing a different culture and a completely different view on agriculture which I know will help me no end in the future."

With farming firmly embedded into both sides of his family, Sam found his interest in agriculture naturally led to him enrolling on a degree at Harper Adams.

But by choosing to study agri-food marketing with business studies, he has been able to apply his university knowledge to his placement job in a different way.

Sam, from Bilsborrow in Preston, said, "My course choice was perhaps a little different to some, but I've found that working for a machinery manufacturer isn't just about big kit.

"When meeting new clients and liaising with colleagues you need to know the current food markets, the economic situation and business terminology; my course has helped with this.

"Plus being at Harper Adams, I'm spending time with like-minded people and learning about the industry through both lectures and living with my housemates."

After being offered a new job role, Sam now works at the KUHN Blanchard factory in Chémeré on the West coast.

Considering his future career, the former Runshaw College student said, "Like most, my dream is to work on a farm.

"However, I want to try my luck elsewhere in the industry first as it's an opportunity to gain a vast amount of knowledge, experience and contacts that will be useful in the future.

"I'd ideally like a job in the agricultural machinery industry so that I can expand on my year in France and really get stuck in."

LSE 'inspiration' recognition for landbased analytics company

Cawood Scientific Ltd (under its holding company name) has been recognised in second edition of London Stock Exchange's 1000 Companies to Inspire Britain report 2015.

The Cawood Scientific Group is the UK's largest independent provider of analytical laboratory testing services for the land-based industries. Operating through three divisions, Sciantec Analytical Services (in Yorkshire), NRM Laboratories (in Berkshire and Norfolk) and Sci-Tech Laboratories (in Shropshire), together these provide a 'complete analytical solution' for the wide range of testing services that are required for businesses engaged in the land based industries.

The London Stock Exchange report identifies the fastest-growing and most dynamic small and medium sized businesses (SMEs) in UK with revenues between £6million and £250million, separating them into their Standard Classification (SIC) grouping and computed the average compound annual growth rate (CAGR) in percentage terms for each SIC sector over a four-year period and within each SIC sector, then ranked companies by their individual CAGR percentage. Then they identified the companies that have most outperformed their sector averages.

Xavier Rolet, Chief Executive, London Stock Exchange Group said, "This report is a significant part of London Stock Exchange's broader campaign to support UK high growth companies in their journeys from Start-up to Stardom and to create an entrepreneurship revolution. These businesses have a unique capacity to innovate and create new jobs, in turn spearheading the revival of the UK economy. This unique methodology reveals a community of UK businesses richer and more varied than we believe ever identified in any other exercise of this type."

CEO View

A busy Secretariat

Alastair Taylor

It doesn't seem like five minutes since I was writing my viewpoint for the Spring Edition of *Landwards*.

Since then a lot of water has passed under the bridge. The general election is behind us and my prediction that the electorate would show more common sense than the pundits outside Westminster certainly came true. Should we ever believe an opinion poll ever again? It will be interesting to see how the new administration progresses initiatives such as the Agri-tech agenda and whether there will be progress in establishing Innovation Centres. We remain hard at work on your behalf to help realise that aim.

L-R: Dr Steve Parkin, Chair of the Membership Committee; Alison Chapman, Membership Secretary; and Alastair Taylor, CEO

The IAgrE secretariat has been as busy as ever. We have successfully survived our five yearly licensing reviews from both Engineering Council and the Society for Environment. In both cases the outcome was positive. I have to add that the experience of going through what is quite a robust audit exercise is challenging. I would like to express my thanks to our membership secretary Alison Chapman and chair of membership Steve Parkin for their hard work and support through the process. The only worry is that the next review in five years' time will be with us sooner that you think.

We have experienced two significant IAgrE events - both reported elsewhere in this edition. Our decision to hold the AGM and awards ceremony separate from the conference was a great move and we are very grateful to colleagues at AGCO for being so supportive and of course for sponsoring the event through their kind hosting and excellent lunch. I was delighted to be able to give the award winners enough time to truly celebrate their achievements. There was an excellent discussion on the

importance of CPD and I walked away with a keen bunch of volunteers to help me raise our game in that respect.

The annual conference up in Newcastle was also a success and it was great to see a few of our members from the north participating - it was good to meet you all. For those who headed north, the trip was well worthwhile although I have to admit that as I trekked up the A1, there was a point (in a thunderstorm at Wetherby Services to be precise which definitely bought home the 'too much water' theme of the conference) where I did wonder what I was doing. The conference speakers were excellent and inspiring. Thanks again to our President, Mark Kibblewhite, for convening such an interesting event, and also the secretariat staff for dealing with the detail with such efficiency. I think the team enjoyed their trip to Newcastle although the coincidence of a 'Take That' concert in Newcastle was not lost on me . .

We welcome Sally Wood to the secretariat. Sally is an additional staff member and is busy looking at making improvements to our website, and the information we provide to new and potential members. Sally is taking over some other important functions such as acting as secretary to our Executive and Publications Management Committee. A major project for all of us is to develop the offer to young and middle career engineers and that will keep us all busy over the summer. We strive to make IAgrE irresistible to members.

Inspired Ideas . . .

From time to time an exciting e-mail arrives and when I read about the Agri-Innovation Den (see below) my first thought was 'why didn't I think of that?'

This is a wonderful opportunity. Budding IAgrE innovators need to think about bidding for the £100k prize - and pretty quickly! The idea is along the lines of the BBC programme *Dragons Den* and I suspect the judges will be every bit as challenging as those on the TV. This brings an additional opportunity for IAgrE in that we can offer support and mentoring to the winner (or winners) should our expertise add value to their idea. I do hope so.

All of this has spurned me on to think of a new TV inspired publicity initiative. I think we did *The Apprentice*, or should I say *The Trailblazer Apprentice* last year so that one is out. It goes without saying that *IAgrE's Got Talent* and many of our members deliver the *X Factor* day in and day out. With the *Dragons Den* taken that only leaves us with the obvious *Strictly Come Agricultural Engineering* - which I must say runs off the tongue rather well. Watch this space . . .

> **"We have successfully survived our five yearly licensing reviews from both Engineering Council and the Society for Environment"**

Writtle College launch careers campaign

#WrittleFutures to raise awareness of land-based employment opportunities

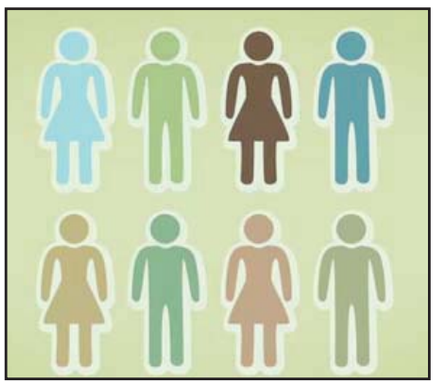
Writtle College has teamed up with a number of industry bodies to launch a new campaign which aims to raise awareness of careers within agriculture.

The campaign, which is targeted at secondary school students, aims to tackle stereotypes of the sector, as well as explaining the impact agriculture has on the world around us. Organisations such as Lantra, Bright Crop, Essex Young Farmers and Essex Agricultural Society, have all given their backing to the campaign as the College aims to improve the appeal of agriculture to a younger audience.

Craig Emery, Marketing Manager, said: "Agriculture is such an important industry for the long-term future of the planet and it's vital that the younger generation understand the impact agriculture has on all our lives.

"It was essential to get the support of organisations such as Bright Crop and Lantra, as we are all positively promoting careers within the food and farming sector, and are all passionate about the sustainability of the world.

"The purpose of this campaign is to try and explain agriculture in a way that the younger generation will listen to and encourage them to consider a career within this field. There are many different pathways for people from many different backgrounds and that's the message we are trying to get across. People may assume that you need to be from a farming background to do well at agriculture, and I think these are the types of barriers we are trying to overcome."



Watch the animated campaign video at:
tinyurl.com/m8m23h4

Dan Corlett of Farming and Countryside Education (FACE), the charity behind Bright Crop, said, "Bright Crop's research showed how 96% of young people wouldn't consider a career in agriculture. The main reason being that they simply aren't aware of the diversity of roles, the scale of the industry, or the career potential. This video presents farming as it is - dynamic, highly professional, and above all - vital to our world."

The launch of this campaign is the start of an online *#WrittleFutures* campaign by Writtle College which aims to raise awareness of careers within the land-based sector.

Bishop blesses Tanzania-bound tractor

Refurbished by students at Moreton Morrell College in Warwickshire

A Massey Ferguson tractor refurbished by students attending the AGCO Agricultural Engineering Apprenticeship Scheme at Moreton Morrell College in Warwickshire is set for work in the village of Tunguli, Morogoro in Tanzania.

The tractor gift project is being spearheaded by the Diocese of Worcester which has a friendship link with the Diocese of Morogoro. Also going to Africa will be a trailer and plough funded by the Mission Morogoro, which has supported the project.

Prior to being shipped to Tanzania, the MF 265 tractor was blessed at a special ceremony at Moreton Morrell College performed by The Right Reverend Dr John Inge, Bishop of Worcester. Also in attendance at the ceremony was Steve Wood, Chairman of the College Board of Governors.

"The fully-reconditioned tractor will make an enormous difference to the lives of people in Tunguli," said Bishop John. "We would like to thank AGCO, its student apprentices and the College for their help with this great project."

AGCO has been operating its Dealer Apprenticeship training scheme in partnership with Moreton Morrell College since 1999.

The MF 265 tractor with the students and The Right Reverend Dr John Inge, Bishop of Worcester

The Diocese of Worcester purchased the used MF 265 tractor in 2013. Over the last 18 months, AGCO student apprentices have been rebuilding the machine as part of their course work, transforming the 30-year-old model into a good-as-new tractor, ready for use.

"We were delighted to donate the major parts for the refurbishment and for our apprentices to test out their skills and knowledge in overhauling the tractor for this very worthy cause," commented Tony Linfield, AGCO Training Development Manager.

SEM Branch Student presentation evening

ALAN PLOM reports

At our traditional evening of presentations by students - which always coincides with our AGM in February - we were again treated to a series of excellent short talks on projects being carried out at Harper Adams and Cranfield Universities.

Some of the projects were in their early stages and further work is proposed, so it was hard to select a winner.

The winning students with Branch Chair Tim Chaman (on left)

AND THE WINNER IS . . .

YARA BOUBOU (Harper Adams) - The Judging Panel decided that Yara had earned the £75 prize for the standard of her visual and verbal presentation on the night, clearly explaining her findings and commercial potential of the work carried out so far.

Yara's project aims to improve precision inputs through understanding the variability in soil and lettuce growth in-field. She has been working with a large grower and has used commercially-generated soil electrical conductivity maps and aerial photography, identifying variable soil zones.

Up to 20% difference was found in yield between zones, associated with differences in organic matter and nutrients.

Her research continues and we (and the industry) look forward to hearing her final recommendations.

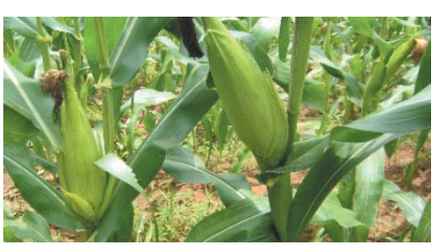
There were four other presentations:

MICHAIL GIANNITSOPOULOS (Cranfield) spoke about optimising drilling methods in conservation tillage systems for wheat and oilseed rape production.

He is investigating the agronomic, environmental and economic performance of different systems, assessing whether cultivation and seed placement method has significant effects on crop growth and yield, soil condition and economic profitability in a rotation of wheat and oilseed rape in UK.

BENEDICT UNAGWU (Cranfield) is looking at restoring the health of a degraded soil.

He is evaluating the effects of application of organic waste to restore soil health and productivity of degraded soil. He is assessing improvements in soil health by measuring selected soil quality indicators (physical, chemical and biological soil properties) and the resultant performance (in growth and yield) of maize.



JOSEPH MARTLEW (Harper Adams) reported on his interesting work comparing traffic and tillage systems for row crops in Sub Saharan Africa.

At a key time when the international community is looking to increase agricultural mechanisation and production for global food security, his study aims to assess the interaction between traffic and tillage management strategies specifically for this environment, to minimise degradation of soil structure and the negative impacts upon soil hydraulic characteristics, crop growth and yield.

Finally, **MICHELE FARALLI** (Harper Adams) is using thermal imaging to assess the effectiveness of applying film-forming anti-transpirant treatments to reduce the drought susceptibility of oilseed rape.

Water deficit at reproductive stages is considered the most detrimental factor affecting yield and oil quality and Michele described the physiological techniques used to explore stress in plants.

SEM Branch Committee congratulate them all and wish them well in their future endeavours.

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Secretary: **Paul Miller** Administrator: **Elizabeth Stephens**

Activities of the DOUGLAS BOMFORD TRUST

An update

General Management Board meeting held in November

A meeting of the Board of Trustees was hosted by Harper Adams University in early April and was attended by all trustees together with Nick August, a farmer from Oxfordshire as an observer pending his potential appointment as a trustee later this year.

At this meeting the Trustees:

- Reviewed the administration and financial position relevant to The Trust;
- Reviewed the progress of research projects and other activities that are funded by The Trust;
- Examined new proposals for funding and made recommendations as to which of the submitted proposals should be funded: The Trust agreed to support activities relating to:
  - The design and control of a hybrid ventilation system for UK pig buildings at Harper Adams University;
  - Wind turbine blades made of functional materials at Northumbria University; and
  - Resource recovery from waste water treatment in Malawi at the University of Edinburgh.

It was also agreed to extend The Trust's involvement with the Arkwright Scholarship Scheme that aims to promote engineering to those studying for A-levels at school.

CONGRATULATIONS- to Joanna Niziolomski who has successfully completed her PhD studies at Cranfield University involving her research project entitled '*Developing machinery designs for optimising soil disturbance and mulch attenuation options to reduce soil loss, increase water use efficiency and negate environmental impacts of high value UK row crops*'.

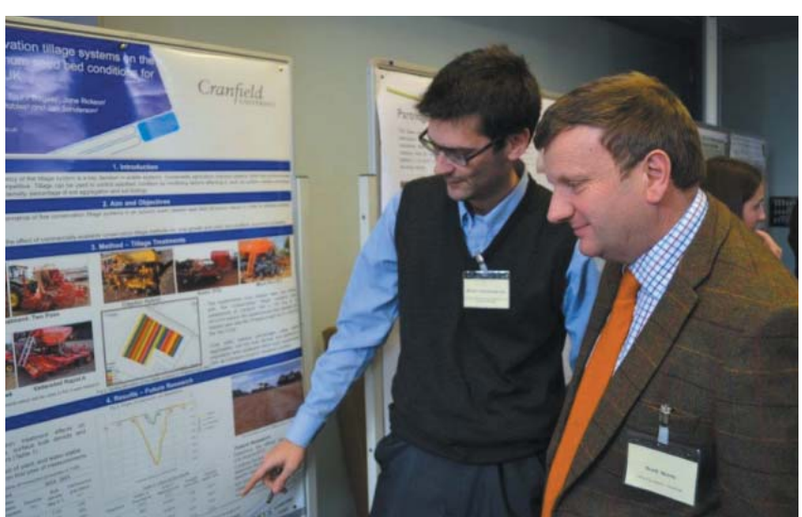
DBT Students at the AFCP Student Forum Event

DBT Sponsored Students played a key role in the 2015 AFCP (Agri Food Charities Partnership) Student Forum Event held at the Sutton Bonington campus of Nottingham University in early March.

A total of eleven presentations and sixteen posters were made at the meeting by students who are receiving some support from charities for their work and four of these involved students receiving support from The Douglas Bomford Trust.

These were:

- **Emily Smith** from Harper Adams University who presented a poster relating to her project work entitled '*Improving the sustainability of soils with low pressure and controlled traffic farming systems together with reduced tillage*'
- **Iain Dummett** from Cranfield University who presented a poster relating to his project work entitled '*Can strip tillage improve the economic profitability of oilseed rape cultivation, whilst reducing off farm environmental costs of agrochemical runoff and leachate?*'
- **Michail Giannitsopoulos** from Cranfield University who presented a poster relating to aspects of his project work entitled '*Optimising direct drilling methods in no tillage farming systems for wheat and oilseed rape production*'
- **Agnese Mancini** from Cranfield University whose poster reported parts of her project work entitled '*Optimising soil erosion control and runoff management in forage maize*'.



Michail Giannitsopoulos explains aspects of his poster to Scott Norris, Chairman of The Perry Foundation.

More details of these and other projects supported by The Trust are available from the Secretariat.

The event was well supported and provided a good opportunity for supported students, supervisors and trustees from different charities to exchange views and renew contacts.

President's Musings

Cheap Nitrogen - Reduce, Recover, Replace!

IAgrE President, MARK KIBBLEWHITE

Glorious May is my favourite month. You can almost see the fields growing minute by minute and certainly day by day. The greenness of the countryside is profound this year: a deep dark green in both cereal fields and grassland. Yet this greenness is not really natural but 'a hymn to industrial nitrogen'. This is an element that worries me and demands our closer attention.

Plentiful nitrogen underpins modern food production; we would definitely have a smaller and less well-fed global population without the invention of the Haber-Bosch process that ended dependence on natural sources of nitrogen. It has delivered cheap nitrogen and continues to do so, with current UK ammonium nitrate and urea prices now falling below £240 per tonne delivered on-farm. Lower prices encourage higher application rates boosting yields to support farm incomes and reduce food prices.

This is all good but we may be sleep walking in to trouble.

It takes prodigious amounts of energy to manufacture nitrogen fertilisers and this requirement is being met by cheap fossil fuels. This month even Shell pointed to the urgent need to reduce fossil fuel consumption and to the likelihood of a 4 degree global temperature rise this century.

In one way or another the supply of nitrogen is going to be affected by constraints on fossil fuel consumption. My guess is that this will soon lead to a steep rise in nitrogen prices. I think the question is not whether this will happen but when will it start to bite in to agricultural margins and drive up output prices. My guess is within a decade.

Meanwhile the environmental impact of agricultural nitrogen use remains because it is a tricky element to contain on-farm in its gaseous forms and once dissolved in water. About half the nitrogen applied to fields ends up in air and water and the economic case is persuasive for still stronger interventions to reduce pollution, perhaps via a fertiliser tax.

In short, our current reliance on cheap nitrogen for agriculture is under threat. So what is to be done? A good strategy may be to focus on the 3Rs of Reduce, Recover and Replace. In that case agricultural engineering is the key discipline, at least for the first 2Rs.

With only about half the applied nitrogen ending up in produce there would seem to be lots of scope to reduce usage without yield losses. Precision agriculture is already delivering more efficient nitrogen fertiliser use by arable crops and increasingly in grassland. How can we improve the current technology and get it more widely adopted? Is there scope for growing more than salad and fruit crops in controlled environments where nitrogen applications can be timed very precisely and efficiently?

Recovery and re-use of nitrogen in livestock-based agriculture is an ancient practice, but one that remains inefficient. As the price of nitrogen rises so should the incentive to manage slurries and manures better. Containment and speed of spreading are big factors.

How can slurry and manure storage be developed to further reduce losses? Have we fully developed spreading systems that optimally combine speed and efficient incorporation? And how can improved systems be made simpler and more economic so that they replace inefficient ones?

Recovering the nitrogen lost from field crops is a tall order. The losses are diffuse and concentrating them to recoverable levels difficult. One option that looks promising to me is to use reactive barriers to trap nitrogen in groundwater by incorporating it into organic material within an interceptor trench.

Replacing nitrogen in agriculture is of course impossible, it is an essential element, but replacing nitrogen from the Haber-Bosch process is not beyond possibility. It is what legumes do when they team up with those amazing nitrogen-fixing soil bacteria.We need to exploit these better.

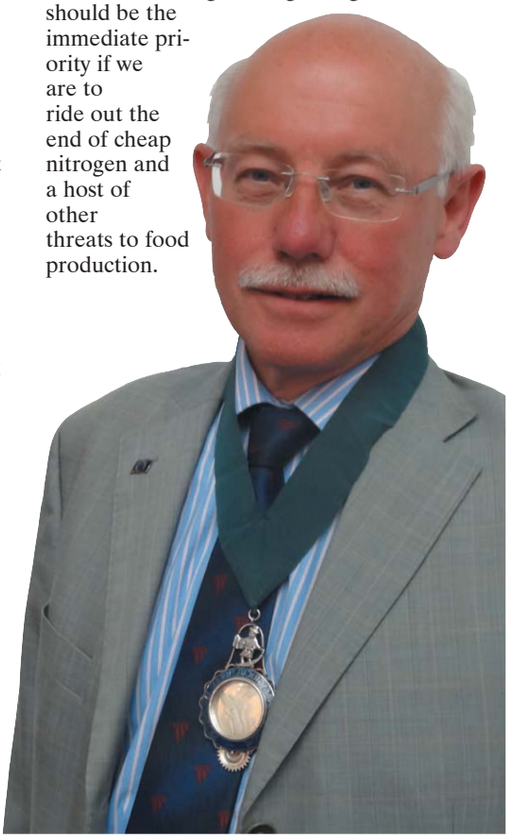
I heard promising reports at an American Society of Agronomy workshop last autumn about novel agro-ecosystems in the development pipeline that could help reduce industrial nitrogen inputs. It was exciting as well to realise that these will require innovative mechanisation, for example for mixed crop establishment and planting in to cover crops.

It is clear that managing nitrogen better is a top priority for farmers, advisors and the research community. I think agricultural engineers are best placed to deliver early on-farm progress. It is all about optimising systems and that means engineering.

This needs to be understood better by policy makers in industry and Government who focus investment on biochemistry and especially plant sciences.

Good luck to the biochemists in their search for the keys to industrial biological fixation as a replacement for the Haber-Bosch process and to splicing nitrogen-fixing genes in to cereal genomes, but the magic outcomes being promised are still far away, even after 50 years of serious funding.

Agricultural engineers have transformed on-farm nitrogen use over the same period by developing precision agriculture, advanced farm waste solutions and many other innovations. Private and public investment in engineering for agriculture should be the immediate priority if we are to ride out the end of cheap nitrogen and a host of other threats to food production.



With only about half the applied nitrogen ending up in produce there would seem to be lots of scope to reduce usage without yield losses

Conference

2015 IAgrE CONFERENCE

Too much or too little water?

Report by CHRIS BIDDLE

FOR the world's population, water is known as the elixir of life. Water is central to every citizen's wellbeing, whether for health, or for food and sustenance. But the availability of water is not an exact science. At various times, we have **Too Much, or Too Little Water**.

It was this challenge, and particularly this engineering challenge of maintaining a sustainable balance that prompted the theme of the 2015 IAgrE Conference, sponsored by Mastenbroek and in association with Newcastle University, which was held on 20 May at the splendid Great North Museum, Newcastle.

IAgrE PRESIDENT PROFESSOR MARK KIBBLEWHITE CEnv FIAgrE chose to examine the innovation that engineers could bring to water management for agriculture in a changing climate.

In his opening address he said, "For centuries, drainage and irrigation engineering have successfully increased the productivity of land in Britain, but sustaining this over the coming decades is going to be very challenging.


Professor Mark Kibblewhite

"Climate change will increase winter and reduce summer rainfall, simultaneously requiring more drainage and irrigation infrastructures. Water for irrigation is limited and urban demand for the same water is rising. National investment in field drainage has taken a back seat for decades and the state of ageing field drains is uncertain. So the current challenges are substantial. The good news, however, is that innovative engineering offers smarter ways to irrigate and drain fields."

The total use of water in food production is often wildly underestimated


Caroline Drummond MBE

CAROLINE DRUMMOND MBE, chief executive of LEAF (Linking Environment and Farming) started by reminding delegates of a quote from Jacques Cousteau - "*We forget that the water cycle and life cycle are as one*".

She said that today, 2.5 million people, almost 40% of the world's grain production and a quarter of the global economy were at risk because of non-sustainable water use.

"The total use of water in food production is often wildly underestimated. For instance it can take 200 litres to produce a glass of milk, 140 litres for a cup of coffee, 120 litres for a glass of wine - and 2400 litres for a hamburger!

"Efficient water management is central to LEAF's Integrated Farm Management scheme. And when it comes to it - smarter engineering is the key".


Professor Dick Godwin

PROFESSOR DICK GODWIN FREng, HonFIAgrE, covered the problems and penalties pertaining to the issues of inadequate field drainage in relation to the impact of water logging on crop yield and field operations.

He explained basic aspects of soil water relationships in relation to water storage and infiltration; and how soil pore size and soil compaction influence infiltration rates. Typical top and groundwater drainage problems were covered alongside the current failings in drainage infrastructure.


Dr Rob Simmons

The range of practical applied and adoptable options to control runoff and erosion were explored by **DR ROB SIMMONS**, MIAgrE, Cranfield University.

Examples were provided of runoff and erosion control options along with grassed waterways, mulching options, shallow soil disturbance and companion/cover cropping. He also covered recent developments in the field application of polyacrylamides to prevent structural sealing/capping in susceptible soils.

DR MARK ELSE, of East Malling Research spoke on Water Efficiency in Food Production.

He said, "We need to understand and manipulate crop and environmental interactions in order to deliver improved resource use efficiency, marketable yields and quality of fresh produce. One facet of our work at EMR is to develop precision irrigation and fertigation systems that match demand with supply to help improve resource use efficiency and consistency of fresh produce quality. In addition to delivering the anticipated 20% savings in water and fertiliser inputs, our experiments at EMR and on-farm have shown that marketable yields can be increased by 20% and consistency of produce quality is improved."


Dr Mark Else

Advances in drainage technology were discussed by **FRED CLARKE**, Technical Sales Director, Mastenbroek Ltd. He gave an overview of the use of GPS technology used in drainage installations, advances in software programming and use of drones in surveying.


Fred Clarke with Bruce Brockway


Dr John Gowing

DR JOHN GOWING, Newcastle University on Land Use and Hydrology in Semi-Arid Environments said, "Good water management is essential for high agricultural yields and farm environmental performance".

He reflected on 30 years personal involvement in research and training on 'tools for water management'. Future forecasts for the expansion of irrigation and increase in water use vary, he said, but there is no disagreement on the need to achieve greater water productivity (more crop per drop).


John Newstead

JOHN NEWSTEAD, Technical Sales Engineer of Delta-T Devices Ltd provided an overview of Precision Sensing and Control Systems for improved water efficiency.

Delta-T Devices has been designing innovative solutions for soil, plant and atmospheric measurement for over 40 years.

Q&A WITH PROFESSOR JANE RICKSON

Finally, **Professor Jane Rickson FIAgrE**, Cranfield University, concluded the event by chairing a lively discussion amongst delegates, focussing on the issues raised during the day.

Professor Jane Rickson (right) and some of the delegates during the Q & A session

Full details of speakers and their presentations can be found on the IAgrE website

www.iagre.org

Agricultural Engineers celebrate engineering awards

Delegates at the AGM

In a break from tradition, the annual IAgrE Awards were this year combined with the IAgrE Annual General Meeting held at AGCO's headquarters at Stoneleigh on 30 April

CHRIS BIDDLE reports

HONOURARY FELLOW

The award of Honourary Fellow was made to **Dr Steve Parkin** in recognition of the tremendous service he has given the Institution over a 25 year period of membership.

Presenting the award Alastair Taylor IAgrE CEO said, "Steve fully justifies the award of Honourary Fellow. He is an established agricultural engineer with a wide experience of research, development and training, particularly relating to agricultural chemical applications, a field in which he continues to be recognised as an international expert.

Steve's contribution is massive. As well as being a proven engineer his contribution to the Institution includes managing editor of our journal *Biosystems Engineering* and Chair of our Membership Committee."

L-R: Steve Parkin, Mark Kibblewhite & Alastair Taylor

IAgrE Awards

CONTRIBUTION TO THE LANDBASED INDUSTRIES

An award for Contribution to the Landbased Industries, made to a member who has made sustained contributions to the landbased sector throughout their career, went to **Richard Trevarthen**, a retired lecturer from Brooksby Melton College.

Presenting the award Alastair Taylor said, "Richard has contributed greatly to agricultural engineering education with endless enthusiasm. He instilled this enthusiasm into the many hundreds of young engineers and apprentices he supported during his working life."

Richard Trevarthen

MICHAEL DWYER MEMORIAL PRIZE

Jeremy Burgess, managing director of Sparex Group received the Michael Dwyer Memorial Prize. This prize is awarded to a mid-career engineer who has made outstanding progress in the agricultural engineering industry.

"Under Jeremy's leadership the Sparex Group now has 18 companies in 17 countries and an annual turnover of £120 million. And his interest in agricultural engineering doesn't stop when his work ends as in his spare time he can often be spotted working on or driving his vintage tractor collection," said Alastair.

AWARD OF MERIT

Roger Lane-Nott

An Award of Merit was presented to **Roger Lane-Nott**, IAgrE Fellow and recently retired CEO of the Agricultural Engineers Association (AEA).

Roger has been the machine equipment sector's global industry champion for the past eight years, which involved intense lobbying with the European manufacturers' organisations and the EU commission.

> "His interest in agricultural engineering doesn't stop when his work ends"

Jeremy Burgess

AWARD OF MERIT

A posthumous Award of Merit was made to the family of **Professor Brian Chambers**.

Brian passed away suddenly in September 2014 at the age of 53. He had joined ADAS in 1985 after completing a BSc in Soil Science at Newcastle University and PhD studies at Aberdeen University and latterly held the post of Head of Soils and Nutrients within ADAS.

He was internationally recognised for his research interests focused on the efficient use of organic manure and fertiliser nutrients, and the development of sustainable farming systems with a low environmental footprint.


The Chambers family

BRANCH MERITORIOUS AWARDS

This year's branch meritorious awards for members who have delivered outstanding service to an IAgrE branch went to **James Hunter** and **Bruce Hamilton**.

James has been a member of IAgrE since 1980 and Vice Chair since 2008. "His perspective as a farmer has been invaluable to the branch committee together with his practical knowledge and amusing observations and ability to create interesting and varied programme of meetings," said Alastair.

Bruce Hamilton is secretary to the Forestry Engineering Group and has proved to be invaluable in setting up the Group's autumn symposium.


James Hunter


Bruce Hamilton

AWARD OF MERIT

Lastly, an Award of Merit announced in 2011 was presented belatedly to **Professor Wynne Jones**, a respected figure in the farming world.

Wynne was Principal of Harper Adams University College from 1996 to 2009 and was previously, from 1988, the College's Vice Principal and Director of Academic Affairs.

His personal contributions have been recognised by the industry through, for example, his Fellowship of the Royal Agricultural Societies, by the RASE's National Agricultural Award in 2005 and the Farmers' Club Cup in 2007 for an outstanding contribution to British Agriculture.

In 2009 he was awarded the OBE for services to agricultural higher education.


Professor Wynne Jones

Competiton

Young Engineers Competition 2015

This year the annual Young Engineers' competition took place on March 17th and was held at GreenMech Ltd, Alcester, Warwickshire.

REPORT: Richard Trevarthen, IEng, MIAgrE

The Young Engineers Competition continues to be run on similar lines to those first envisaged by Richard Robinson (Autoguide Equipment).

It is open to all UK landbased colleges and teams of two students are given a set of wheels, a battery and maximum dimensions. Their task is to produce a remote or radio-controlled vehicle to power up a curved ramp, with the one going the highest declared the winner. This year eleven teams took part.

- **Eastern and Otley** entered four teams, with their vehicles named Jet T850 Mk.2, J.A.W.B., I.D.F.S and Deere Mk2.
- **Plumpton** entered five teams, with their vehicles named Ryans Irons, Plummet, Spare, The Old Bean, and Heavy Handed Farmers.
- **Babcock** entered one team with vehicle John Deere.
- **Warwickshire** also entered one team with GreenMech Ltd.

On arrival all signed in whilst enjoying light refreshments, and Spencer Southall of GreenMech extended a warm welcome to all and wished all the teams good luck.

Following this, the vehicles were scrutinised. All vehicles passed and were duly entered into Class 1.

So for the first time in some years, there were no vehicles in Class 2 (Class 2 normally has a vehicle or two that has failed scrutineering but has some unusual/interesting idea where a team has thought 'outside the box').

Richard Robinson then addressed the teams by saying, "The competition is intended to reward the team willing to invest time in building a vehicle that conforms to the rules, and an understanding of the strategy necessary to beat the opposition."

Teams then had one chance for a quick trial run, carry out some fine tuning, and then 'battle commenced'.

Round 1: most teams displayed a degree of caution, and used their three attempts to experiment with the best way forward. At this stage vehicle John Deere struggled, and Heavy Handed Farmers did not complete because of a burnt out motor.

Rounds 2 and 3 saw much excitement as teams assessed the competition, and strived

LEFT: Richard Robinson, Hon FIAgrE, explains the rules to the students

BELOW: Making some last minute repairs and adjustments

RIGHT: The Competition hots up

BELOW: The GreenMech entry

to push their vehicles to gain vital inches (sorry centimetres), up the ramp.

At the end of **Round 3** the leading four teams, (one from Easton & Otley, two from Plumpton, and one from Warkwickshire), were very closely matched, and were entered into the FINAL to determine the top places.

The results are as follows:

- **1st - Easton & Otley** - *Team Ike Neave & Harry Gillingwater with Jet T850 Mk2*
- **2nd - Warwickshire** - *Team William Baker with GreenMech Ltd*.
- **3rd - Plumpton** - *Team Ryan Haword & Tom Diplock with Ryans Irons*

Congratulations to the top three and to Easton & Otley for winning the competition two years in a row.

All received cash prizes and power tools courtesy of our sponsors, Bosch Rexroth.

Some teams had taken a lot of trouble to disguise and cover the bare chassis and at the judges' discretion four vehicles, namely The Old Bean (Plumpton), John Deere (Babcock), GreenMech (Warwickshire) and Jet T850 Mk.2 (Eastern and Otley) were awarded additional prizes of cash and power tools, again courtesy of our sponsors, for design finesse.

Following lunch, we then enjoyed a tour of the GreenMech Ltd works and were given a working demonstration of their wood chippers.

GreenMech Managing Director Jonathan Turner spent a lot of time helping the students and talking to them through the factory tour. "It was been a great day," he said. "The level of competition was very high and it was brilliant to see our own apprentice William coming a close second. Congratulations to all involved."

The Winners - Team Jet850 Mk2, Ike Neave & Harry Gillingwater

In conclusion it was a really great day. Special thanks go to:

- Jonathan Turner (MD) and Spencer Southall (Technical Support Manager) and all the team at GreenMech for pulling out all the stops to make us so welcome and ensuring that all went well.
- Our sponsors - Autoguide Equipment, Bosch Rexroth, and their representative, Sean Kilgallen, the Douglas Bomford Trust and the IAgrE
- The Autoguide Equipment team, Richard and Rob Robinson and Cassie Butcher.
- Peter Leech, for keeping track of the scores.
- The IAgrE Secretariat, for all their hard work behind the scenes, ensuring all went smoothly.

PROVISIONAL DATE FOR THE 2016 COMPETITION, TUESDAY MARCH 8TH

Please make every effort to be involved with this great event. We really would like to see more colleges entering this important competition.

LEFT: IAgrE members touring GreenMech

RIGHT: The Winners - Team Jet850 Mk 2 receiving their prizes from Richard Robinson (Past President IAgrE & Sean Kilgallen from Bosch Rexroth

Anti-lock brakes for fast tractors

By TONY MOORE,
former Development Manager and Chief Engineer, JCB Landpower

This article is an account of the work undertaken to develop a braking system for a new vehicle type - a fast tractor - and subsequently pioneer automatic safety technology, anti-lock braking (ABS) technology for the product sector. The intention is to give an introduction for those unfamiliar with the subject.

Our fast tractor, code name Project 130, resulted from an idea in 1984 by JCB's Chairman Lord Bamford. By July 1986 the first Chief Engineer - Dave Brown - had been appointed and he worked in secret based at JCB Transmissions factory at Wrexham.

By our 9th October 1986 review meeting the design specification was well advanced. We had a plan for a new type of agricultural tractor; an equal wheel, fully suspended, 'Trac' concept machine capable of all field operations but also, for transport work with a deck & trailer towing capability, having a maximum speed of 72 km/hr (45mph). The latter would be a critical point as it would dictate the braking system, as well as the suspension, tyres & steering to be fitted.

BRAKE SYSTEM

The vehicle would be subject to National Type Approval (also called homologation) before marketing in each territory. This was a complex intermix of agricultural tractor and truck legislation. Much was country specific and took the best brains in the engineering office to unravel.

However it soon appeared that the ruling critical legislation would be European truck braking directive- 71/320 EEC calling for a demanding 5 metre/sec (nominal 0.5g) deceleration from both tractor & trailers; with the trailer brake lines pressure output being governed by trailer compatibility criteria, (the tractor and trailer are never tested together)

We would require twin circuit power braking with highest braking torque being generated from the front axle - not the rear as generally found on agricultural tractors. The solo unladen Fastrac had about 50/50 weight distribution; when deck laden and trailer towing it was more heavily biased on the rear but also with a very high weight transfer to the front axle under maximum braking.

We would utilise proven heavy goods vehicle air brake components which were packaged in a pannier sub-assembly bolted to the chassis - *see ghosted illustration of tractor above*.

Wheel hub mounted dry caliper disc brakes would be used instead of the more usual wet multidisc variety to eliminate oil drag losses and heat energy build up associated with 72 km/hr operation. The system would be dual circuit air over hydraulic with a two line air trailer brake - the hydraulic caliper brakes worked at a nominal 140 bar and the air system at 7 bar so two 20:1 air to hydraulic intensifiers / actuators would be required.

Market demands for 3.5 tonne deck carrying capacity soon resulted in German requests for 12 tonnes gross vehicle weight (GVW). German farms were populated with a matrix of hard surface tracks which typically allowed towing of tandem 16 tonne trailers and a legal gross train weight (GTW) of 40 tonnes. For Benelux 44 tonne GTW was allowed which represented a worse case situation.

You can imagine that the 12 tonne GVW braking load case was significant both on the stresses in the axle castings, suspension links and brackets, and also the welded joints of the chassis. Much effort was involved in finite element analysis of critical parts and we embarked on a series of vehicle strain gauge tests to measure braking loads under real life working conditions.

The park brake was also an item of considerable importance. To meet the regulations it had to hold a load of 44 tonnes on a 12% slope.Therefore the 4WD clutch was designed as spring engaged to ensure maximum tyre adhesion in a parked condition on slopes. Moreover a one case emergency dynamic application of the park brake with the vehicle at GVW was mandated for instance when the brake pedal had been blocked by a loose object in the cab. We elected for a fail-safe caliper disc park brake mounted onto the rear of the gearbox - spring engaged and air released.

BRAKE CERTIFICATION

Brake testing was a witnessed test by the VCA (Department of Transport) at a designated proving ground.

Testing commenced with a series of static measurements including brake application response times, air charging times solo & with a trailer supply connected.

Dynamic tests followed both unladen and at GVW with normal brake function, front circuit failed, then rear failed. Finally a GVW brake fade test after heating brakes by a standard procedure - typically apply brakes 20 cycles from initial speed 60 km/hr until speed drops to 30 km/hr then release; repeat at 60 second intervals then carry out hot stop. The maximum fully developed deceleration was measured and had to be within prescribed limits.

The first public exhibition of the machine was at the Smithfield show of 1991 and the product was named Fastrac.

BACKGROUND TO ABS

By 1999 when we started to investigate ABS compliant with new European National legislation we had two ranges of machines, 2000 & 3000 series, on the market and were firmly installed as JCB Landpower in a 100 year old mill in Cheadle, Staffordshire.

Cheadle is not well known but the area has an interesting history of inventors and engineers. In the late 1700s one of these was Erasmus Darwin at Lichfield. He was grandfather to Charles Darwin, was a polymath being a medical doctor,poet and also a mechanical genius. Erasmus travelled many miles on the rough turnpikes as he visited his patients and became interested in carriage suspensions and steering. In 1758, together with Richard Lovell Edgeworth, Erasmus invented a steering linkage now used on all vehicles worldwide, some 60 years before the Ackermann patent by which it is now known. His idea was to improve cornering stability and was prompted after his standard carriage rolled over in Rugeley while negotiating a tight bend.

Moving forward some 240 years, not far away from Rugeley, we were also considering steering control and stability as ABS is as much to do with the above factors as it has to do with braking.

Twin caliper brake installation with cable to ABS sensor

This is summarised well in the notes to the German National Braking Regulations, “the main benefit of ABS is not just a potentially shorter stopping distance but rather the fact that in emergency stops the vehicle's steering and ride stability is maintained such that obstacles can be negotiated and any gaps between them can be utilised to prevent collisions.”

ABS was pioneered on aircraft notably as Dunlop Maxaret in 1950s. Automotive applications appeared later as electronic control systems were developed. In Europe Mercedes Benz claim to be the pioneer working with Bosch and the German brake supplier Wabco and had a production system working on a car in 1978. This was followed by coach and truck variants.

Our goal was to pioneer the brake safety system into another new sector - an agricultural tractor.

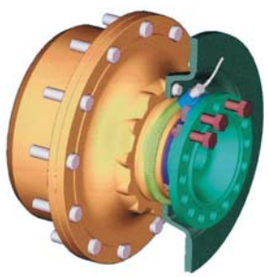
ABS FUNCTIONAL DESCRIPTION

A word or two about technicalities is necessary here covering the truck ABS concept we used.

The heart of the system is an Electronic control unit (ECU) which usually contains two microprocessors - one for running the main control program and the other as a safety system for monitoring and diagnostics. Control is closed loop with the inputs being wheel speed and the outputs being pressure reduction to the brakes through solenoid operated modulator valves. A vehicle reference speed is generated by using two speeds from diagonally opposite wheels. Using this and individual wheel speeds it is possible to calculate the ‘slip’ for each wheel. We adopted a location inside the drivers cab for the ECU to reduce concerns of environmental effects in a farming situation.

The four wheel speed sensors were inductive devices creating a sine wave output which was processed into a square wave by the ECU. The speed sensors acted against a multi tooth pulse ring which was pressed into the wheel hub.

The four speed sensors were located in spring sleeves - initially abutted to the ring but automatically pushed back to the correct gap in service. This idea gave us some concern for off-road operation but proved to work well in extended trials. Our axles were supplied by another division of JCB - JCB Transmissions - and they created an excellent new wheel hub layout to accommodate the new parts - *see illustrations*.



Wheel hub assembly with ABS speed sensor

You might now guess that we needed four output modulators to control the brake pressures. Actually we used three units. One modulator for each of the rear wheels and a shared modulator for the front wheels. A known issue when ABS operates on one wheel of a front axle while the other wheel retains full braking pressure in a split mu contrasting friction situation is the creation of a high yawing moment thus making the vehicle difficult to control. A way to avoid the

First prototype ABS development machine- view of brake components - showing for prototype purposes four switchable air to hydraulic actuators topped by oil reservoirs and to their right the ABS modulators

The four wheel speed sensors were inductive devices creating a sine wave output which was processed into a square wave by the ECU

> **“The main concern was ABS behaviour on transfer of the technology from truck to tractor”**

problem is to reduce the brake pressure on both front wheels if one wheel starts to lose traction. This is termed a ‘select low’ control system. Straight line stability on a split mu surface was a type approval sign-off criteria.

ABS controlled the air pressure supplied to the brake circuits and when operational cycled through three operating stages - increase pressure, maintain pressure constant, reduce pressure.

On board diagnostics were simple blink codes with a serial data link to download information for dealer service use.

ABS DEVELOPMENT PROCESS

On paper we now had a system. Our next task was to build a prototype for initial development trials, software calibration and performance pretests which would be carried out on special split mu test tracks.

We built the prototype with selectable two, three or four modulators - to evaluate performance under four loading conditions - *see photograph and test matrix*.

The main concern was ABS behaviour on transfer of the technology from truck to tractor. The most obvious change was the difference in wheel diameter and consequently much higher inertia not only of wheels but also rotating parts within the axles and back up the driveline to the engine. Suppliers were suggesting risk was significant as we were pushing the boundaries of the technology.

Concurrent with the ABS project our main focus was to upgrade the current product from 180HP to 220HP, including both our first electronically controlled engine and upgrading the spool valve external hydraulic services from mechanical to electronic control. I was also actively involved in developing a much bigger model that had the potential of 300 HP. For this we had already built a concept machine with 710/70R38 rear wheels - also requiring ABS - that we were keeping under wraps - *see illustration*.

The team were now working under our second Chief Engineer the highly popular and experienced Ray Clay. However we were rapidly running out of resource with all these activities. Our brake expert was both the engine and the homologation expert and much involved in the 220 HP project.

A development engineer was required to take on ABS as his main project. We had a steady stream of young engineers wanting to join our ranks and a recent recruit seemed an ideal candidate - a robust son of a farmer from Lancashire, educated in Shropshire with a good grasp of both mechanical and electronic engineering. He could work under the control of one of our senior development team who had an excellent eye for detail.

The target would be to finalise the initial prototype test work including field trials with different trailer configurations, tyre sizes, configure and field test prebuilds, carry out test work for company internal engineering sign-off and manage legal type approval tests. Final machines would be required for launch at Agritechnica 2001 and production to start ASAP following the show.

The timescale was short and the workload would be demanding.

ABS MODES OF OPERATION

MODE	A	B	C	D	FL	FR	RL	RR
4S4M	OFF	ON	OFF	ON	ON	ON	ON	ON
4S3M(F)	OFF	ON	ON	OFF	ON	ON	ON	OFF
4S3M(R)	ON	OFF	OFF	ON	OFF	ON	ON	ON
4S2M	ON	OFF	ON	OFF	OFF	ON	ON	OFF

LOAD CASES	REAR	TOTAL	FRONT
Unladen	2860	6350	3490
Front Plated	3988	0576	5808
Rear Plated	6628	9580	2954
Max Plated Even dist.	----	9800	----

First prototype test load cases with test valve positions to select either a shared modulator per axle or modulator for each wheel.

COLD WEATHER TESTING

Furthermore we had plans for winter testing 38 miles south of the Arctic circle where temperatures hovered at minus 20C. This would focus on further optimising of the ABS system on the icy conditions of a 500m diameter test track formed on a large frozen lake.

Finally, and most exacting, split mu hill descents were planned with one side of the tractor running on polished ice and the other on heated asphalt.

FASTRAC ABS PRODUCTION

Launch objectives were achieved and currently ABS production life has reached 13 years on Fastrac models including the high horsepower version that entered production in 2005.

Over the intervening years there have been many advances in ABS and today we supply a third generation safety system including additional features - hill hold control and traction control as we continue to explore the boundaries of technology with our British engineered and produced agricultural tractor.

High horsepower concept tractor

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MEMBERSHIP MATTERS

BRANCH REPORTS

NORTHERN IRELAND BRANCH

JCB - A STORY OF ENGINEERING INNOVATION

Recently the Northern Ireland branch members of IAgrE enjoyed a presentation by Mr. Stuart Henry (Area sales manager for JCB agriculture products) about the history of JCB and the development of its agriculture range of products.

He was accompanied by Mr. Ivan McKane, Agricultural Sales Manager for BC Plant, which is the dealership in Northern Ireland for JCB. The event took place at the CAFRE Greenmount Campus, Antrim.

JCB is one of the best known brands for a wide range of materials handling and construction equipment as used in many industries. It operates worldwide in 150 territories with 2,000 dealer depots over 300 products with an annual turnover of $4 billion. Its product business split is now approximately 80% for construction and 20% for agriculture.

The present Lord Anthony Bamford took over as company chairman (then aged 29) from 1974 and still runs JCB as a family business, from its Rocester, Staffordshire base. The family also run the Daleford Organics farming enterprise.

The extensive machine product range, produced in a wide range of model sizes, has broad application across construction, agriculture and other specialist areas. As a major world brand, JCB has an extensive manufacturing base in Staffordshire as well as plants in the US, India, Brazil, and China.

How it all began

Mr Joseph Cyril Bamford started in 1945 (in a small rented shed at Uttoxeter, Staffordshire) when he used recycled steel and an ex-army vehicle axle to build an agricultural trailer.

Others followed and he quickly applied his technical innovation skills to developing new products including an hydraulic tipping trailer in 1948 and the 'Major' fore-loader to fit the Fordson Major tractor by 1951. The 'Si-hydraulic' tractor mounted single-arm loader, with high lift and forward reach, was introduced in 1952. There was also limited production of a 'Loadover' wheeled loader on which the bucket passed above the driver's head to discharge at the rear.

The backhoe story

The first Mk 1 excavator was introduced in 1952 consisting of a rear mounted hydraulically operated backhoe and a Major fore-loader mounted on a Fordson Major tractor. The JCB logo and distinctive yellow livery was first adopted in 1953.


Getting a close look at the Loadall telehandler

By 1959 the design had progressed to a full chassis backhoe loader combination with an operator's cab. A significant innovation in 1961 was the sliding side-shift backhoe mounting which could be positioned anywhere across the working width and facilitated digging close to obstacles. This continued as a feature on the now world famous JCB 3C machine launched in 1963.

Today's JCB 3CX is the most recent version of the design and is complimented by the 4CX and 5CX models.

Telehandlers

The first JCB telescopic handler, the 520, was introduced in 1977 with its rear pivoted telescopic boom. By 1988 this design had progressed to 4 wheel drive and 4 wheel coordinated steering versions.

The first side mounted engine design came in 1997 and the current models have a low-profile boom design to maximise all round operator visibility. They are available in a range of sizes and the model numbering system across the range shows the maximum lift capacity in tonnes and the maximum lift height in metres.

For example, the 5 series 531-70 can lift 3.1 tonnes to 7.0 metres and the 560-80 can lift 6 tonnes to 8.1 metres.

1 in 4 of the construction telehandlers in the world is a JCB and 1 in 2 sold into agriculture is JCB. There is strong worldwide demand for both new and used machines.

Depending on the model, the transmission includes a torque converter and a manual or powershift gearbox. On some models, the torque converter can be locked up to give increased speed and fuel efficiency for 40 kph travel on the road.

'Automatic transmission disconnect', when selected to speed up loading and manoeuvring work, operates each time the brake pedal is pressed. Auto boom suspension for greater load stability and comfort can also be chosen.

Wheel loaders

JCB entered the wheel loader market in 1970 with the acquisition of Chaseside who already had a significant UK market share and design experience in this sector. Wheel loaders are popular as a robust machine for bulk handling across a range of industries.

The 400 series range is popular with agricultural contractors with the 'S' derivatives specifically designed for large farms where its climbing ability and high power-to-weight ratio make it especially suitable for work on silage clamps.

continues over

In-house manufacturing of engines and other components.

Because of the number of power units required for its wide range of products JCB developed its own eco-friendly 4 cylinder engines from 2006. These feature variable geometry turbos and so far, they meet the latest Tier 4 emission standards without the use of an exhaust gas after-treatment system.

To facilitate the worldwide demand for new and used JCB products the engines can be adapted to run on lower grade fuels depending on individual territory requirements.

Two of the engines were used to power the JCB Dieselmax car which broke the 350mph world land speed record ,for a diesel powered vehicle, at the Bonneville salt flats in 2006.

JCB now also manufactures its own hydraulic cylinders, axles, transmissions and cabs.

Fast tractors

JCB Landpower developed its Fastrac prototype in 1989 and production started in 1991 of a fast tractor designed to commercial vehicle standards with truck-type steering, a laminated windscreen and air braking for trailers.

In addition to fast safe towing on the road it can operate mounted, trailed and PTO driven implements in field work. The Fastrac design has 4 wheel drive, a full chassis, mid mounted cab, suspension on both axles and large external, easily serviced, twin caliper disc brakes with ABS.

The current range has models of up to 308 hp, max road speeds from 60 to 80kph and rear linkage lift capacities from 6 to 10 tonnes. There are also front PTO and linkage options.

Fastracs are popular in agriculture for a wide of duties such as trailer / tanker work, cultivation and crop spraying. All can be equipped with GPS steering. They have a rear deck load platform often used to carry a bulk seed / fertiliser hopper or a spray tank. The latest 4000 series version, the result of a £8.5 million development programme, was introduced recently.

The Teletruk

JCB manufacture a range of conventional masted fork trucks.

They have also used their telescopic handler experience in the unique Teletruk. Available in both yard and rough terrain versions, it can place a pallet load across a vehicle deck without needing access to both sides. This has time saving, space saving and safety advantages for confined loading areas.

Ivan McKane, Stuart Henry (guest speaker) and Ian Duff with the JCB Fastrac

Discussion period and display of JCB products

Following a technical discussion around the content of the presentation, branch members and guests went on to enjoy close examination of a 230hp Fastrac 3230 and an Agri Loadall telehandler.

The chairman thanked both Mr Henry and Mr McKane for providing such an informative, enjoyable presentation and display.


George Wallace, Ivan McKane, Stuart Henry (guest speaker) and Terence Chambers

Other product lines

Although this presentation concentrated on the agricultural products the extensive range of materials handling, earthmoving and other equipment, as listed below, also has a strong world market share.

The versatility of the designs widens their application to other related industries for which JCB have developed specific model specifications. It also has produced fast-travel specialist versions of some of its products for military applications.

JCB's other product lines include :-

- Articulated dump trucks
- Compaction equipment
- Compact tracked loaders
- Diesel generating sets
- Industrial and rough terrain forklift trucks
- Floodlighting towers and equipment
- Hydraulic excavators
- Site dumpers
- Skid steer loaders

More details of the JCB story and products can be viewed on *www.jcb.com*.

The local NI dealership's website is at *www.bcplantjcb.co.uk*

Terence Chambers

WEST MIDLANDS BRANCH

RURAL ELECTRIFICATION PROJECTS IN RURAL UGANDA

Speaker Colin Oram of Warwick University

"I'd like to do a water supply project in Mozambique," said the student. "Sorry we cannot support you there, but we can in Uganda." And so the story began . . .

Colin Oram who is one of the lecturers teaching engineering at Warwick University, with a special focus on the needs of appropriate technology to respond to the needs of developing countries was describing one of the student lead projects that he was involved in in rural Uganda.

Although student led, from his description he was taking quite a lead in sourcing and arranging finance for many of these small scale hydro projects.

The students would go out and work for several weeks on a project. The whole hydro scheme needed designing from selecting a suitable point in a stream for a dam where there was adequate continuous water flow, a robust enough geological situation and with an adequate head to the turbines. Plus of course the power lines to the village and installation.

These projects were several hours travel from the capital in a high rainfall areas where there were small rivers that could be harnessed for hydro power. He took us though many aspects of the various projects from the establishing of village power committees to arranging all the local support, on the ground site selection as well as the important funding. The villagers funded all the equipment and material costs with the students funding their own expenses and working on a volunteer basis.

For generating equipment Colin had located some small Chinese made turbine alternators but was finding they needed modifying to ensure that they were robust enough for service.

Supply of and range of materials was a problem with many items needing designing and making locally. For example there was 110mm drain pipe but all elbow joints had to be made. Dam framework and header tanks all needed designing.

Often finishing off work that had been left to the villagers was not done and we were shown a picture where the wall to the flume had collapsed because no earth had been put against it despite it having been completed two years earlier!

Although the systems were very impressive and were providing electricity for phone charging and lighting there was the enthusiasm for TVs and video players with the problems of unregulated system overload. Most high technical items needed carrying in by hand which limited their weight and size.

But the projects bringing electricity had brought some big and important changes to the villages and an example was that in these rural areas they had problems getting teachers because of the primitive living conditions and the pupils having to walk often for over four hours a day.

With electricity some of the problems of recruiting teachers diminished because of having accommodation with light when dark. Also dormitories could be set up with lights and including toilet blocks so the numbers of children educated increased and especially the number of girls who did not have to go outside in the dark.

The frustrations were many and included members of the committee disappearing with finance raised by the villagers, villagers having problems not understanding electricity and loadings so that too much equipment switched on and that voltage dropped and equipment ceased to operate correctly. Also the local economy was not used to working to fixed budgets.

Routine maintenance such as the need for regular lubrication causing bearing failures and items disappearing during failures such as copper wiring and also the unexpected such as when a villager felled a tree across the main power supply and then the main supply to the village was stolen before it could be repaired.

The talk was very impressive and demonstrated how small scale electricity projects were appropriate technology approaches to bringing power to remote areas - whilst at the same time using local involvement to the maximum, with the great benefit to all.

William Waddilove

WEST MIDLANDS BRANCH

MEETING AND AGM

You will be pleased to learn that the 65th branch AGM was held and our committee was re-elected for another year.

We are not too sure just who exactly was within the third of the committee members that stood down and yet were eligible to be re-elected but we made it. We are still looking for new committee members and the chairman and secretary have asked if someone else could take over their roles. There were no challenges for any officer posts and so among the other appointments I remain the branch information officer but with Alastair Taylor present we are sure that the meeting was held in right ordering!

In the second part of the meeting we were informed and motivated by the President's Address and we received the invitation to come to Council meetings. There was discussions around how to keep the branch active and vibrant - a challenge for all branches and Alastair Taylor, representing the President was able to share some intelligence from other branches at the same time as celebrating some of the activities which are working well in the West Midlands (we like to think we are one of the more active branches in the country). We also discussed how we could publicise the Institution and recruit more members.

Our guest speaker at the AGM was Mike Woollacott of Greenwatt Technology who presented a technical talk related to sustainable energy usage in agriculture. We know the objective of farming is to produce energy in the form of food but in producing food we use energy. And with the developments in renewable energy technologies - coupled with Government incentives such as the Feed-in Tariff - farmers now have the chance to move towards self-sufficiency.

UK agriculture produces about 8% of UK Greenhouse Gas (GHG) emissions mainly in the form of carbon dioxide and methane - it is an area therefore requiring attention. With transport fuel representing an increasing farm cost as well as producing CO^2 emissions, the industry is starting to look at less environmentally damaging alternatives e.g. biomethane, hydrogen and electricity produced on the farm from renewable sources.

Mike raised the question 'If we were to set a target of reducing if not eliminating fossil-derived transport fuel supplies, what would be the advantages - and the problems?' He outlined a recent study that Greenwatt completed for the Royal Agricultural Society - '*Refuelling the Countryside*' - which examined a number of alternatives. The report established the need for energy and fuel monitoring on farms to establish the energy demand baseline and identify where changes to low carbon sources would be most beneficial. The Report examined the prospects for alternative, renewable transport fuels.

For example, electric vehicles powered by solar or wind energy technologies e.g. electric ATVs will have an increasing role on farms. However where greater power and torque is required, farmers will look towards biomethane (from anaerobic digestion) and hydrogen (from electrolysis) for those farm and field operations with high power needs.

Whereas most arable farms have high transport fuel costs, many livestock enterprises have other high energy demands e.g. dairy, poultry and pigs. In these cases, the 'farm of the future' as illustrated in the Report will utilise renewable electricity and heat technologies (wind, solar power, heat pumps and AD) to reduce the costs and environmental impacts of fossil fuels.

Members can access a copy of the Report at *www.greenwatt.co.uk/RefuellingtheCountryside-opportunitiesforsustainableruraltransport.htm*.

William Waddilove

WESTERN BRANCH

'FROM CLOUD TO RIVER' - A PRESENTATION ON MASTENBROEK LTD

Speaker Fred Clarke, Technical Sales Engineer, Royal Agricultural University

The final Western Branch lecture of the 2014-15 season held at Cirencester was attended by around 13 members and guests.

The lecture had been organised by Richard Robinson as a follow up to a Western Branch visit to Mastenbroek in 2011. It followed the branch AGM and presidential address given by Paul Miller HonF CEnv.

The company was founded in 1965 by John Mastenbroek and remains a family owned business to this day. John came over from his native Holland and started the business by importing Dutch drainage machinery. It soon became apparent that the machinery designed for soft Dutch alluvial soils was unsuitable for many areas of the UK so he had to make some modifications to suit.

The company is based near Boston in Lincolnshire and today employs 35 people and produces around 25 machines per year. These are designed to be used in not just agricultural drainage applications but also offshore (sub-sea), environmental, horticultural and civil engineering applications - anywhere a trench is required. The company also are the UK importers for both Conver and Herder watercourse management machinery.

Before 1984 the majority of equipment the company produced was for Agricultural drainage as up until then a grant was available to help farmers drain land to improve productivity. In that year the grant was withdrawn and the orders for agricultural trenchers disappeared almost overnight. It's at times like this when a company needs to diversify so it designed new machinery for use in amenity and sportsturf drainage which kept the company afloat.

Fred continued by covering the range of trencher types from V-ploughs used on light Dutch soils to trenchless machines, trenchers and the ancillary support machinery such as self-propelled or trailed stone carts. V-plough machines in the right conditions can lay up to 10km of pipe a day.

Like all manufacturers of off-highway machinery Mastenbroek have to conform to the latest diesel emissions legislation and a common engine they use now is a Volvo D8 320hp Tier4Final/Stage 4 unit. Volvo engines have been preferred by Mastenbroek for a number of years.

Deep trenching is mainly used in environmental, mining and civil engineering projects as a way of de-watering land and for soil stabilisation. For depths of 15-20m a trencher of between 40 & 50 tonnes is required with around 700hp.

Examples were shown of deep trenching operations in France & Germany for installing concrete walls, stabilising haul routes in mines, providing flood defences and for preventing landfill leachates entering water courses.

Utility services also require trenchers to install cabling for solar and wind farms and also pipelines. Often these will be a rock trencher machine with a continuous chain fitted with rock picks rather than a bladed type chain. In the same vein offshore wind farms require cabling to be laid back to shore in sea bed trenches. This requires a sub-sea trencher which is lowered to the sea bed with an umbilical attaching it to the surface ship's power supply and control system.

One machine was designed and built in 12 weeks and tested in The Wash. It was then sent to Holland to lay a pipe to Texel Island off the Dutch coast. Operation of sub-sea trenchers has occurred down to 1850m below surface using technologies used in other oil & gas ROV systems.

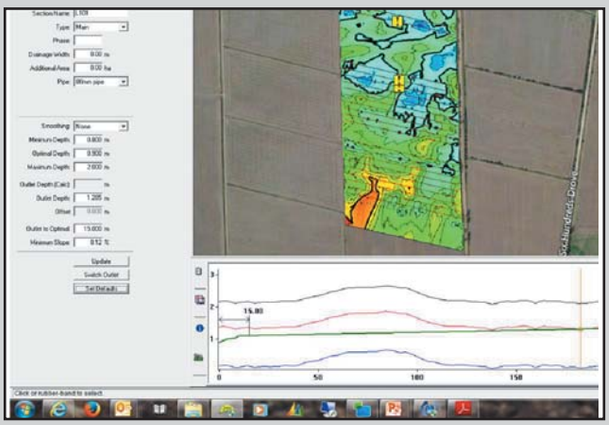
Examples of the Conver and Herder machinery were also presented. This includes drain jetting equipment to maintain previously installed drainage systems, dyke cleaning equipment, tractor mounted flail/cutter arms and amphibious vehicles with weed handling attachments. Recently this type of machinery was used in the Somerset Levels after the floods.

Fred then moved on to the ways that trencher control had moved on over the last 40 years.

From the 1970s trench depth control was provided by rotating gyroscopic lasers with a transmitter based in the field and a receiver fitted to the trencher. The plane of the laser was set at the plane that the trench bottom was required to be and the system controlled trencher dig depth of the machine travelled over undulating ground. From the late 2000s though this system is being replaced by a GPS based control which gives various advantages over laser such as no weather issues, faster surveying, earth flat (not laser flat), controls both trencher level AND direction, and is directly compatible with farm maps and precision farming methods.

The GPS system also gives many advantages in terms of reduced gravel usage due to optimum dig depth. It also provides the map of the installed system for invoicing and accurately pricing up pipe and gravel used. The land owner then has an accurate record of where his drains are for maintenance reasons. A possible development of this when legislation allows is to have remote trencher operation without an operator aboard.

ABOVE: Trencher BELOW: Drainage plan



The lecture was rounded off with a review of future developments. As above the machinery could become more autonomous without the need for operators. Also the surveying side of the operation is being enhanced by the use of Unmanned Aerial Vehicles (UAVs) which can put together an accurate 3D survey by overlaying many hi-res photos of the surface.

Drainage practices are also being developed with regards to reducing nitrate run-off which has environmental impacts in some areas. In these cases the water is filtered through wood chip pits which convert the nitrates to nitrogen gas before it enters the watercourse. Also controllable drainage to reduce or stop the drainage in dry periods where the soil requires a certain moisture content.

Rupert Caplat, Branch Chairman, summed up the meeting and gave thanks to Fred for his lecture.

Rupert Caplet

SOUTH EAST MIDLANDS BRANCH

THE EVOLUTION OF JCB'S UNIQUE FASTRAC

April 2015's joint meeting of the SEM Branch was organised by the IAgrE and the IMechE's Automobile Division -Eastern Centre and was '*The Evolution of JCB's Unique Fastrac*'.

It included a brief history of JCB and then followed the development of the latest model of the Fastrac tractor. Charles Nicklin, Fastrac's chief engineer for the past ten years, gave an excellent overview of JCB and a detailed description of the development processes involved in the highly sophisticated and innovative vehicle that is today's Fastrac.

JCB started its life in 1945, when its founder J.C. Bamford designed and built a hydraulic tipping trailer.

This was followed in 1949 by the single arm Major loader, in 1953 by the Backhoe loader and in 1977, by the telescopic handler. Anthony Bamford took over from his father as MD in 1975 and has been largely responsible for developing the company to its present £3 billion annual turnover.

Anthony Bamford was knighted in 1990 and made Baron Bamford in 2013. JCB is now the third largest manufacturer of construction equipment in the world and the first in Europe and India in terms of excavation equipment. It is the world's number one in the sale of backhoe loaders and telescopic handlers, while in India they have 98% of the market in backhoe loaders.

The start of the recession in 2008 had a dramatic effect on their production, this falling from an annual 72,000 machines to 32,000 by the deepest point of the recession. How they survived this cataclysmic fall in demand is difficult to imagine, particularly when they have 22 plants worldwide stretching from Brazil to China, India, the USA and Germany as well as their main manufacturing plant in the UK. These plants between them manufacture 350 different models which have recently been joined by compaction equipment and power and light generation. In terms of agricultural machines, 8000 of these are sold annually and following its introduction in 1991, JCB Landpower now has over 100 different models in its line-up.

There are three ranges of Fastrac, all made at Cheadle in Staffordshire. The 3000 series has a horsepower range from 230-270, the newly launched 4000 series (October 2014) comes in at between 159-189 hp, while the 8000 series has models from 280-310 hp. Major features of the Fastrac are its centrally mounted driver's cabin, full front and rear suspension and a 45:55 rear: front axle weight ratio. The suspension is self-levelling and there is a 5th wheel option. Braking on the Fastrac has to meet current truck regulation by virtue of its top speed of 60 km/h (which also means that it has to comply with fire regulations) and includes fail safe steering as well as an option for ABS braking.

The effectiveness of the ABS was demonstrated in a video of straight line stopping under full braking when one side of the tractor was travelling on ice, the other on tarmac.

The new power unit is an Agco 6.6 litre Tier 4 engine coupled to the wheels through a Fendt continuously variable transmission (CVT) while rear lift capacity is 9000 kg.

Charles said the 3 year development process for the new 4000 series was a series of 'Gates' numbering from 0 to 5 involving a large team. Gate 0 started with conceptual studies involving style and design but equally importantly, performance and ease of use as well as value/cost of ownership. Development then progressed through Gates 1 and 2 and involved quality and reliability/durability, serviceability and safety and security. The latter two needed to demonstrate that the vehicle was safe in the hands of customers and also now involved a Thatcham alarm system with 'Live Link' tracking of the vehicle. This has the possibility of immobilising the vehicle either during particular time periods or when it strays out of a particular geographic area.

Emissions versus fuel efficiency also came into these 'gates' as well as productivity and maintaining the vehicle's very tight turning circle and driver comfort. A big change to the look of the vehicle was achieved by incorporating a purpose designed exhaust system to be within the chassis rather than on the engine.

Development then progressed to benchmarking with other vehicles and frame testing using FEA and strain gauges, both on laboratory rigs and in 'real life'. The rig tests are expensive, not least because a lot of fuel is used when the engine is developing 200 hp for several days continuously.

Maintaining the engine over the front axle had implications as far as the suspension and steering were concerned. The suspension started off with a spring and damper system but progressed to single acting and then a double acting hydro-pneumatic system.

Gate 3 was the point at which 'Whole Vehicle Validation' was carried out. This involved climate chambers as well as real life tests at extremes of temperature - in Spain for example where tests on a 40,000 acre farm involved temperatures of 40 deg C and extremes of dust. At the other temperature extreme, tests in Norway and Sweden saw temperatures of -31 deg C. Finally, this 'Gate' involved customer evaluation under high levels of secrecy.

Gate 4 involved Pre-Series production followed by Gate 5 with dealer launch and press releases.

Seeing the range of demands on this vehicle compared with the family car for example, one has to applaud JCB's tenacity at getting the Fastrac into production at all!

Not only does it have to provide a high level of comfort and usability for the driver, but it has to meet the conflicting demands of high speed road use and high draught field use at low speeds.

The suspension has to cater for these high draught loads as well as the vehicle's high load carrying capacity. Added to that, the engine and transmission systems have to deliver full power to the back wheels and power take off as well as a similar level of power out of the front of the engine while the vehicle is stationary!

The electronic control on the Fastrac is considerable with many ECUs, far more than the construction equipment machines, and several million lines of code.

There was extensive questioning following Charles' presentation, some of which drew out development work, mainly of options, that still needed to be addressed. This included a cost effective and practical central tyre inflation/deflation system as well as the introduction of ISOBUS on the vehicle.

The tyres were also a major source of questioning and only the smaller tyres are able to be fitted to the higher speed models.

Finally what will the team do next? "We'll be starting on the next model!" was Charles' reply.

All in all this was a fascinating insight into how a rightly termed 'unique' vehicle was taken from its initial design through to an updated version, with we guess, all the initial criteria and design challenges being addressed afresh.

David Tinker

NORTHERN IRELAND BRANCH

WINDOW ON WELDING TECHNOLOGY AT THE SOUTH WEST COLLEGE

Recently members of the Northern Ireland branch of IAgrE were privileged to get a tour of the bright modern technology training facilities at the South West College (SWC) Dungannon, Co. Tyrone campus.

SWC, operating at 4 centres, has a current total enrolment of almost 20,000 students across 400 separate courses.

The course contents emphasise Training for success, Steps to work, Step-up for re-skilling and, amongst other topics, it offers higher level apprenticeships and a 4 year foundation degree course. The College has gained Grade 1 status awarded by the Education and Training Inspectorate (ETI). This places it amongst the top 4 of 350 colleges in the UK and the only one in Northern Ireland to achieve this recognition.

The courses are designed to meet the needs of employers including the Co. Tyrone based manufacturing sector for aggregate screening and crushing equipment. There is an Innovation in Partnership arrangement with Terex Powerscreen who design, manufacture and supply complete products in this sector for world markets.

The IAgrE visitors saw a live demonstration of computer aided design, simulation and testing on the hydraulic control systems of engine driven installations. Students on this combined course regularly get the opportunity to travel abroad and get on-site practical experience with service dealerships.

Welding technology

Alastair Booth (Curriculum Manager within the SWC's Department of Training) and his staff at SWC presented an up-to-date summary of welding technology.

There was also a back-up exhibition of the latest welding equipment by Allister Moore Welding and Engineering Supplies Ltd. As well as supplying equipment and accessories (through being the Northern Ireland dealership for ESAB and others) this company also provides on-site training and testing for welding procedures to the current BS EN ISO 15614 Quality Standards.

They also brought along a portable Fronius welding simulator on which trainees safely gain experience in achieving perfect tip-to-work distance, tilt angle and travel speed when using the torch or electrode holder. The trainee can subsequently replay the sequence and note progress and any aspects requiring further attention.

One of the main franchises is held for Swedish company ESAB ,which was formed in 1904 at the start of manual metal welding, and is now a world brand for welding and cutting equipment. One of ESAB's founders, Oscar Kjellberg, invented the consumable flux coated welding electrode and his initials, OK, still appear on their welding rod packs.

The ESAB product range includes welding and cutting equipment for manual or automated operation, accessories, welding consumables and personal protective equipment (PPE).

The visitors were impressed to learn how welding technology has been developed and to see what equipment is now available. This ranges from lightweight portable air-cooled welders to the wide range of inverter types with their improved efficiencies and automated electronic features such as Hot Start (for optimal striking of the arc), anti-stick and mains voltage compensation. This provides a controllable weld pool with minimal spatter.

For some applications it is just necessary to select material type and sheet thickness and the machine selects the best settings automatically!

During his presentation, Mr Booth summarised the main types of welding techniques which include:

- **Manual arc welding** in which the operator holds a consumable rod electrode (typically 2.5,3.2 or 4.0 mm. diameter) at a fixed clearance in the work as it melts in the electric arc. Mains current is transformed and rectified through the welding set. The flux coating on the rod melts in the arc to form a protective gas cloud which prevents oxidation (rusting in steel) of the molten metal as it cools. The traditional heavy oil cooled welder (many of which are still used on farms) has given way in the market place to portable, air cooled, compact, more efficient high-frequency inverter transformer types.
- **Inert gas welding systems** have now mainly taken over in production fabrication work. M. I. G. (metal inert gas) types also use a DC transformer / rectifier and a consumable metal wire electrode is continuously metered out through the electrode holder along with inert gas to protect the molten joint as it cools. This process provides a smooth , spatter free weld and can be manually operated or automated through selectable settings from a database. The T.I.G.(Tungsten inert gas) system works in the same way and is especially suited to welding thin section metals. AC current is used for welding aluminium, DC for stainless or mild steel with a negative electrode. The chosen polarity affects the balance of heat distribution between the electrode and the work base plate, unlike the AC system where the distribution stays around 50 / 50. The latest techniques provide the control and flexibility for welding or brazing of a wide range of metal types.

Welding standards

Graham from Allister Moore Welding explained some of the aspects of weld quality assurance such as Coded welding certification to BS 5614 for 10mm to 40mm work. The welder being assessed has to produce 3 runs of 1 fillet to the acceptable standard to support their 3 year certification.

The completed test piece is sent to the Edinburgh test station for assessment. CE marking is authorised after a specified check list has been completed and recorded for the work.

H Barr says thanks at SWC

Demonstration on Powerscreen machine rig at SWC

Live demonstrations

The evening included a demonstration of plasma cutting.

This fusion process uses a very high temperature arc in an ionised plasma column between a non-melting electrode and the metal work piece to provide a very clean cut. It can be programmed to copy a wide range of patterns and is now widely used in manufacturing to make components. Live demonstrations of welding were also provided as well as the opportunity to use the welding equipment in the booths.

Following a most interesting and informative evening, which concluded with some question and answer items, branch member Harry Barr thanked Mr Booth and the SWC staff, as well as the team from Allister Moore welding, for making it all happen.

More details about the South West College's activities and courses can be viewed at *www.swc.ac.uk*

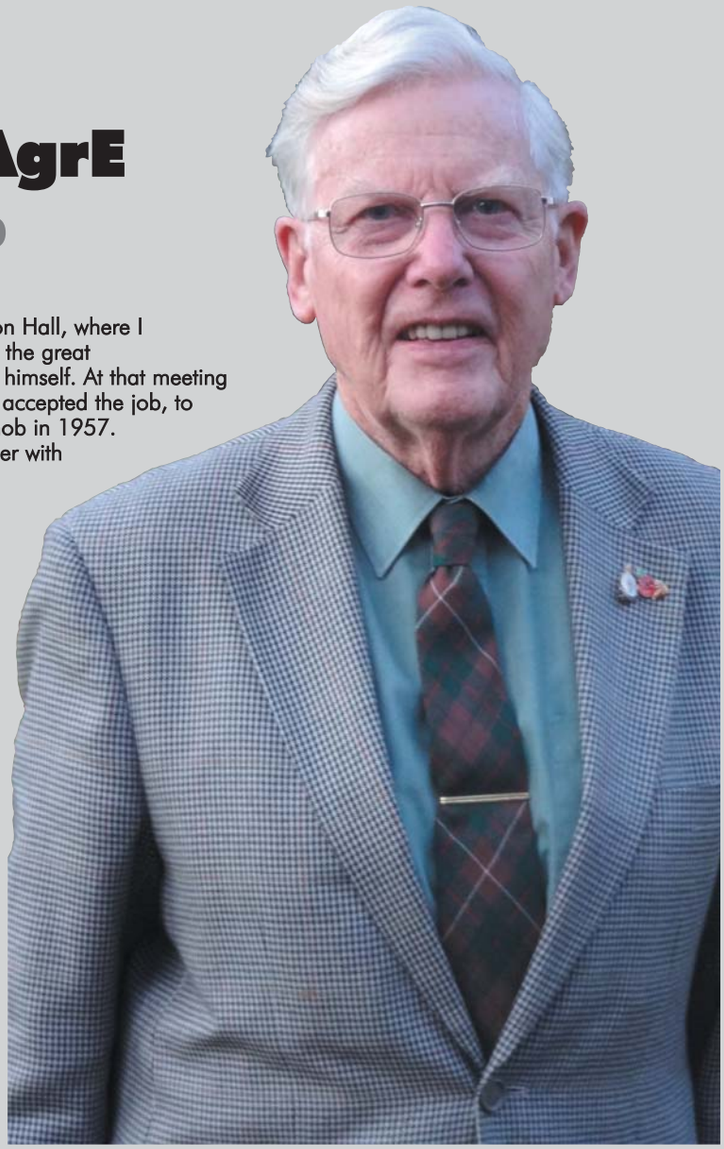
More about Allister Moore Welding Supplies Limited services and products can be viewed at *www.moorewelding.com*

Terence Chambers

MEMBERS MEMORIES

John V Fox, HonFIAgrE

60 years membership



It was an epic moment when I opened an envelope from the Institution to find a letter of congratulations from the President, together with a very fine Certificate in recognition of my 60 years as a member of the Institution.

Immediately my mind went back to 2005 and the occasion of my 50th anniversary, and then to 1955 and a student at Writtle, part-way through one of the earliest of the NDAgrE Courses, designed and sponsored by IAgrE. At that time there was no first degree course in Agricultural Engineering anywhere in the country, the National College of Agricultural Engineering (later Silsoe College and now part of Cranfield University) did not exist and the Institution itself, founded by Colonel Johnson just before the Second World War and marking time during the 1940s, was only then, with Douglas Bomford as President and Ron Slade as Secretary, really getting into its stride.

Little did I realise, when I joined as a Student Member all those years ago, that I had taken a step which would change my life and open the way to a successful and fulfilling career as an Agricultural Engineer, a job description I use with pride to this day.

It started with the Institution's National Diploma, which provided the basis, and continued with the appointments service - a call to the Secretary put me in touch with a company looking for a Technical and Production Manager.

I was serving with REME in Cyprus at the time, on National Service. I wangled a lift home with the RAF for Christmas 1956 and on Boxing Day visited the factory of Bomford & Evershed Ltd, near Evesham, and later Bevington Hall, where I was introduced to the great Douglas Bomford himself. At that meeting I was offered and accepted the job, to start after my demob in 1957. That led to a career with the Company, later to become Bomford Turner Ltd, and to the privilege of serving it as Managing Director and Chairman over many years.

Many vital and career-shaping benefits of membership came with Branch and National meetings and conferences, and the personal contacts and broadening of knowledge and experience that went with them. The 'networking' between members - "If I don't know the answer I know someone who will" is indispensable to the effective management of any enterprise and the Institution provides it par excellence.

Even my attempts to 'put something back' have produced yet more benefits: the privilege of serving the Institution as its President (I believe the only one to hold the National Diploma in Agricultural Engineering) and that most cherished of all awards - Honorary Fellowship.

With the Company aircraft (Piper Aztec F)

Following my retirement from the Bomford Company I have remained in close contact with the Institution and with the Douglas Bomford Trust, which I set up in 1972 with the support of the Bomford family.

The Trust has gone from strength to strength over the past four decades, and I am proud to be associated with it.

I have also worked over the past twenty years for a wide range of clients in agriculture, manufacturing and the legal profession as an Agricultural Engineering Consultant, producing expert reports on a wide variety of cases relating to agricultural engineering, and appearing in Court on many occasions as an Expert Witness.

All of this has been made possible by my membership of the Institution.

To all our Student Members of today I have this message - your membership of our Institution will open many doors, and it will open your mind. It is a passport to success in your chosen profession - hold it with pride, treat it with respect and do not let it go.

Membership changes

Admissions

A warm welcome to the following new members:

Member

Furness A (Wrekin)
Harrison J (Yorkshire)
Seabrook T (South East Midlands)
Stacey T I (Wrekin)

Associate Member

Ellis Jones R ((Western)

Associate

Birch J J (South Western)
Canavari M (Italy)
Davies W (Western)
Healy S (Ireland)
Taylor J A (Yorkshire)

Student

Coleg Sir Gar

Chinn T
Jones T D
Jones P S

Warwickshire College

Baker W (GreenMech Ltd)

Deaths

We have recently learned of the death of the following members and we send our condolences to their family and friends.

Mr Michael John Elliott (IEng MIAgrE) (South Eastern) - a member since 1984

Mr Timothy Frank Stephens (IEng MIAgrE) (France) - a member since 1982

Long service certificates

Name	*Grade*	*Date of anniversay*
50 years		
Francis John **Pirie**	IEng FIAgrE	24/06/2015
35 years		
Simon **Westwood-Bate**	IEng MIAgrE	03/04/2015
Lawrence Milford **Knox**	IEng MIAgrE	30/04/2015
Michael Francis **Ryan**	AMIAgrE	22/05/2015
Michael Albert **Zoebisch**	CEng FIAgrE	12/06/2015
25 years		
John **Lyons**	AMIAgrE	17/05/2015
David William **Seccombe**	CEng MIAgrE	28/06/2015

We want to hear from members

Send branch reports or correspondence to:

Landwards

The Editor, Chris Biddle
Email: *chris.biddle@btinternet.com*
Or the IAgrE Communications Officer, Marion King on:
pressroom@iagre.org

Academic members

Babcock Training Ltd
Babcock
Ruddington Fields Business Park
Ruddington
Nottingham
NG11 6JZ

Bicton College
East Budleigh
Budleigh Salterton
Devon
EX9 7BY

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

Easton & Otley College
Easton
Norwich
Norfolk, NR9 5DX

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

Harper Adams University
Newport
Shropshire
TF10 8NB

Institute of Technology
Tralee
Clash, Tralee
Co Kerry, Ireland

Myercsough College,
Bilsbarrow
Preston
Lancashire
PR3 0RY

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

SRUC - Auchincruive
Auchincruive Estate
Ayr
KA6 5HW

Wiltshire College - Lackham
Lacock
Chippenham
Wiltshire
SN15 2NY

Commercial members

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
Heddington
Calne, Wiltshire,
SN11 0PS

BAGMA
Middleton House,
2 Main Road,
Middleton Cheney,
Banbury,
Oxon,
OX17 2TN

Bomford Turner Limited
Salford Priors
Evesham
Worcestershire
WR11 5SW

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

Douglas Bomford Trust
The Bullock Building
University Way,
Cranfield
Bedford,
MK43 0GH

FEC Services
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2LS

Fullwood
Grange Road
Ellesmere
Cheshire SY12 9DF

Huntaway Consulting
Ivy Cottage
Torlundy
Fort William
Inverness-shire
PH33 6SW

John Deere Ltd
Harby Road
Langar
Nottinghamshire
NG13 9HT

Shelbourne Reynolds
Shepherds Grove Ind. Est.
Stanton
Bury St Edmunds
Suffolk, IP31 2AR

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

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

EVENTS

IAgrE Branch Meetings and Events

Wrekin Branch
July 2015 TBC
SUMMER VISIT - TBC
For information on this and other Wrekin Branch meetings, please contact the Branch Secretary, David Clare.
Tel: 01952 815087
Email: dclare@harper-adams.ac.uk

West Midlands Branch
Tuesday 8 September, 7.15
VISIT TO BOMFORD TURNER LTD (AMS LTD) SALFORD PRIORS
Venue: Bomford Turner Ltd, Station Road, Salford Priors, Nr Evesham WR11 8SW
We will be shown around their modern factory with a special emphasis on their very recently completed production facilities. Please report to Reception on arrival.
Please let the Branch Chairman (Ian Moore) or the Branch Secretary (Michael Sheldon) know if you intend to attend.
Tel: 01926 498900
Email: IanM@whale.co.uk or michael-c-sheldon-iagre@outlook.com
Web: http://www.bomford-turner.com/

West Midlands Branch
Tuesday 29 September 2015, 19.00
VISIT TO CLIFTON HALL FARM & MAGPIE LODGE FARM
Venue: Magpie Lodge Farm, Lilbourne Road, Clifton on Dunsmore CV23 0BB
Visit to Clifton Hall Farm and Magpie Lodge Farm courtesy of Jenny and Roger Spencer. We will have a farm walk to see their pioneering English Nature conservation projects and see how well conservation can be incorporated into modern mixed farming practice. The visit will include their private collection of working machinery dating back to the 1950s to today and all in regular farm use. Commencing 7.00 please gather in Magpie Lodge Farm yard (100 yards beyond Clifton Hall Farm) Lilbourne Road , Clifton on Dunsmore CV23 0BB (Nearer the A5)
If you intend to be present at an event, please contact the Branch Chairman (Ian Moore) IanM@Whale.co.uk or Branch Secretary (Michael Sheldon) michael-c-sheldon-iagre@outlook.com so that your name can be added to the attendance list and so you can check the status of the event.
Tel: 01926 498900
Email: michael-c-sheldon-iagre@outlook.com

Other Events:

17-19 June 2015
CTF - SmartAgri Platform
CTF CONFERENCE 2015 - PRAGUE
Venue: Czech Republic
An extensive programme with inputs from leading CTF practioners is now ready. This summer farmers from all over Europe will meet with intercontinental colleagues.
The conference will be held in the Czech Republic comprising a day of presentations and posters followed by a field day at Horsch's 3,150 ha Agrovation farm which has an established 12 m CTF system. Here we will see where new methods and technologies are being developed and tested.
The conference is organised by the Smart Agri Platform, CTF Europe.dk, the Czech University of Life Sciences and the Slovak University of Agriculture
Web: smartagriplatform.com/CTF2015

23 June - All Day
Women's Engineering Society
WES CONFERENCE, LONDON
Speaker: Engineering Women: Are they Returning to Work?
Venue: 1 Birdcage Walk, London
The Women's Engineering Society 2015 conference is focusing on the theme of women returning to engineering. It has been estimated that 22,000 qualified women have not returned to the engineering sector after a career or maternity break, and these are skills that we can ill afford to lose when we face such a massive skills gap in the coming years. Web: www.wes.org.uk

23 June 2015, 12noon-5pm
NIAB
NIAB PARK FARM OPEN DAY
Venue: NIAB Park Farm, Villa Road, Cambridge CB24 9NZ
Pesticide resistance, yield plateau, loss of triazoles, new disease races, changes in EU legislation and climate change. The NIAB Open Day, free and open to all, demonstrates solutions to these challenges that are already on-farm or in the pipeline. Access the latest independent advice and research on plant breeding, varieties, crop agronomy, soils and plant innovation with an afternoon of indoor seminars, exhibits and field and glasshouse demonstrations.
Web: www.niab.com/shop/civicrm/event/info?reset=1&id=1842

3 September - All day
Forestry Engineering Group
SYMPOSIUM 2015 - PLANNING YOUR FUTURE FOREST
Speaker: Various
Venue: Newton Rigg College
The current forest estate presents many engineering challenges as we get to grips with harvesting some steep, remote, even-aged plantations. The timber industries are looking to restock and expand the timber resource but what will we be planting and where? What are the future constraints?
Stuart Goodall considers the features of our future forests and some of the challenges for the infrastructure and operations that will be required. Future forests will be more diverse, and have a wider spread of age classes. They will need to allow for wildlife, recreation and local use and will be under ever-more public scrutiny. Forest design and operations will need to well-planned and well-managed to improve economic efficiency as well as to allow us to meet modern safety and environmental regulations.
Email: bruce.hamilton@forestry.gsi.gov.uk
Web: www.iagre.org/eventbookpay/FEGSymposium2015

16 September 2015
AEA & Farm-Smart
TILLAGE-LIVE 2015
Venue: Croft Farms, Croft on Tees, North Yorkshire
Tillage-Live, the national cultivation event that gives the farming community a unique opportunity to see the latest equipment at work alongside the chance to discuss new ideas with industry-leading experts Web: tillage-live.uk.com/

EVENTS OF INTEREST

JUNE 2015

14-16 Three Counties Show, Malvern
www.threecounties.co.uk/threecounties
18-19 Cheshire County Show
www.cheshirecountyshow.org.uk
19-20 Lincolnshire Show
www.lincolnshireshow.co.uk
20-23 Royal Highland Show, Edinburgh
www.royalhighlandshow.org
22 Derbyshire County Show
www.derbyshirecountyshow.org.uk
26-27 Royal Norfolk Show
www.royalnorfolkshow.co.uk

JULY 2015

1-2 Royal Norfolk Show
www.royalnorfolkshow.co.uk
4-5 Smallholders Show, South of England Showground, Ardingly
www.smallholdershows.co.uk
5 Malton Show
www.maltonshow.com
6 Cumberland Show
www.cumberlandshow.co.uk
8-9 Livestock Event, Birmingham NEC
www.livestockevent.co.uk
11 Newport Show
http://newportshow.org/
10-12 Kent County Show
http://kentshowground.co.uk
14-16 Great Yorkshire Show
www.greatyorkshireshow.co.uk
18 Camborne Show
www.camborne-show.org.uk
20-23 Royal Welsh Show
www.rwas.co.uk/en/welsh-show
22-26 RHS Flower Show - Tatton Park
www.rhs.org.uk/shows-events
24-25 Border Union Show
http://www.buas.org/
25 Mid Devon Show
www.middevonshow.co.uk
28-30 New Forest & Hampshire County Show
www.newforestshow.co.uk
31-1/8 Dumfries Agricultural Show
http://www.dumfriesshow.co.uk/
31-2/8 CLA Game Fair, Harewood House, Leeds, Yorkshire
www.gamefair.co.uk

AUGUST 2015

1 Garstang Show
www.garstangshow.org
1 Emley Show
www.emleyshow.com
5 North Devon Show
www.northdevonshow.com
6 Honiton Agricultural Show
www.honitonshow.co.uk
5-6 Bakewell Show
www.bakewellshow.org

AUGUST 2015 continued

8 Chepstow Show
www.chepstowshow.co.uk
9 Ripley Show
www.ripleyshow.co.uk
12 Vale of Glamorgan Ag Show
www.valeofglamorganshow.co.uk
11-12 Anglesey County Show
www.angleseyshow.org.uk/anglesey-show.html
14-15 Shrewsbury Flower Show
www.shrewsburyflowershow.org.uk
16 Mid-Somerset Ag Show
www.midsomersetshow.org.uk
18-20 Pembrokeshire County Show
www.pembsshow.org
19 Gillingham & Shaftesbury Show
www.gillshaftshow.co.uk
21 Cranleigh Show
www.cranleighshow.org.uk
27 Monmouthshire Show
www.monmouthshow.co.uk
27 Bucks County Show
www.buckscountyshow.co.uk
30-1/09 spoga-gafa 2015
www.spogagafa.com

SEPTEMBER 2015

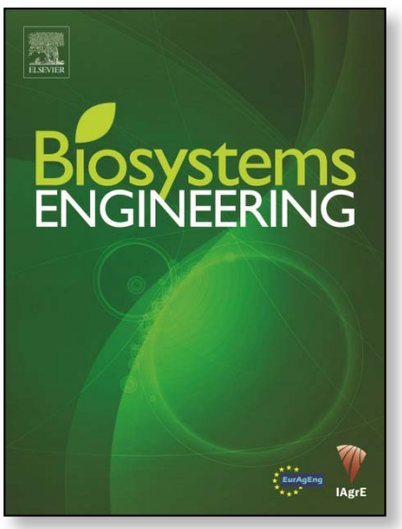
5 Alresford Show
www.alresfordshow.co.uk
5-6 Dorset County Show
www.dorsetcountyshow.co.uk
6-9 Autumn Fair, Birmingham NEC
www.autumnfair.com
10 Westmoreland County Show
www.westmorlandshow.co.uk
12 Usk Show
www.uskshow.co.uk
12 Romsey Show
www.romseyshow.co.uk
14-16 Glee 2015
www.gleebirmingham.com
19-20 Royal Berkshire Show
www.berkshireshow.co.uk

OCTOBER 2015

7 The Dairy Show, Bath & West Showground
www.bathandwest.com/dairy/96/
3-4 South of England Autumn Show & Game Fair, Ardingly
www.seas.org.uk/autumn-show/
17-18 Countryside Live, Harrogate
www.countrysidelive.co.uk
21-23 Green Industry & Equipment Expo, Louisville, USA
http://gie-expo.com

NOVEMBER 2015

4-5 IOG Saltex 2015, Birmingham NEC
www.iogsaltex.co.uk
10-14 Agritechnica 2015, Hanover, Germany
www.agritechnica.com/home-en.html



Biosystems Engineering

Biosystems Engineering publishes research in **engineering** and the physical sciences that represent advances in understanding or modelling of the performance of **biological systems** for sustainable developments in land use and the environment, agriculture and amenity, bioproduction processes and the food chain. The subject matter of the journal reflects the wide range and interdisciplinary nature of research in engineering for biological systems.

Papers may report the results of experiments, theoretical analyses, design of, or innovations relating to, machines and mechanisation systems, processes or processing methods, equipment and buildings, experimental equipment, laboratory and analytical techniques and instrumentation.

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