IAgrE Journal

Landwards

Volume 53 No. 3 Autumn 1998

Agriculture • Forestry • Environment • Amenity

MUCK 99

Wednesday 28th and Thursday 29th April 1999
JSR FARMS LTD DRIFFIELD

A seminar, designed particularly for the trade exhibitors but of value to all interested in the likely impact of current and impending legislation on manure storage and spreading, will be held on the evening of the first day of MUCK 99.

Chairman: Professor Brian Legg, President of the Institution and Director of Silsoe Research Institute

Dr Ian Davidson, MAFF London: 'Legislation: Why, What and When'

Dr Brian Pain, IGER North Wyke: 'Research to reduce pollution and nuisance'

Ir Jan Huijsmans, IMAG-DLO Netherlands: 'Improved storage and spreading in the Netherlands'

Wednesday 28th April 1999
5.30-7.00pm on the Demonstration site
ADMISSION FREE

Landwards

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

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Front cover: *New Holland Rotor combines are renowned for putting more quality grain in the tank in less time in all kinds of crops and conditions.* *(photo: New Holland).*

ISSN 1363 8300

The 70 Series GENESIS™ tractor line from New Holland sets new standards in engine, drivetrain,cab and steering performance.

Private-public sector co-operation can be key to research

Allen Rider

It is a great pleasure for me to be with you at the Diamond Jubilee Conference, especially here at Silsoe, one of the world's great resources for agricultural engineering research and education. And it is a fitting setting for my topic today, the co-operation between the private sector - companies like New Holland, and public institutions such as the Silsoe Research Institute - in designing the technology and tools of the future. I'll explore this topic as part of an overview of some of the most exciting technological advances we see in the world of mechanised crop production.

The manufacturers of agricultural equipment of today are charged with inventing and developing the products which will help feed the world in the next century. So are the researchers and engineers at public universities and institutions around the world. That's a big challenge. When we work together, wonderful things can and do happen. And, when we work together, other challenges arise.

I'm mainly here to talk about the technological advances research and co-operation can create, especially in the equipment and systems used to grow abundant crops and harvest them efficiently. We at New Holland, along with our research co-operators around the world, are proud of our innovations, and I am honoured to share the highlights of many of them with you today. But first, let me tell you a little bit about who we are.

Dr Allen Rider presented this paper on 12 May 1998 at the Diamond Jubilee Conference of the Institution of Agricultural Engineers held at Silsoe College, Cranfield University, Bedford. Dr Rider is President of New Holland North America and was also President of the ASAE during 1996-97.

New Holland perspective

As many of you may know, New Holland is a global manufacturer and marketer of equipment formed from the merger in 1991 of the agricultural and construction divisions of Fiat, based in Italy, and Ford, based in the United States. The success of today's New Holland is built on some of the best-known and trusted names in ag and industrial machinery in the world: Agrifull, Benati, Braud, Fiatagri, Fiat-Hitachi, Fiat Allis, Ford, Laverda, New Holland, and Versatile.

We are adding a new line of telehandlers in conjunction with industry-leading Manitou BF S.A., and we are in the final stages of bringing Flexi-Coil, the world leader in air seeder systems and technology, under the global New Holland banner. Over the years, these names have been pioneers in mankind's transition from animal power to the tractors of today and to the radar, laser, satellite communications and other forms of electronic intelligence that will manage the cultivation, harvesting and earthmoving of tomorrow.

Today, one of every five tractors sold around the world carries the New Holland name. That's the most of any single brand. Worldwide, more than 1.5 million New Holland agricultural and industrial machines are now at work, adapted to every climate, season and land.

To do this, we rely on our nearly 19,000 employees located in 24 countries on five continents, and on a dealer base of about 6,000 worldwide. New Holland currently operates 19 manufacturing facilities around the world, in Belgium, Brazil, Canada, France, India, Italy, the United States and in Basildon, England. Our new engineering and manufacturing center in New Delhi, India, is the latest addition to the global family of New Holland. There, we are developing a new agricultural tractor range with the widest choice of tractors available to the farmers of India in the important 26 to 56 kW category.

The new Model 1412 New Holland Discbine® features 2-speed flail conditioning to allow gentler conditioning for leafy legumes or more vigorous treatment for grass type crops for even more rapid curing. The 8-disc modular cutterbar has a 3 m cutting width. Swath width is easily varied from one to two metres without tools.

I'm an engineer with the privilege of leading the team of New Holland North America, where we serve as the engineering Centre of Excellence for the global hay tools product line, support the design and development of many other lines, and manage the marketing, sales and service of all New Holland products in North America. I've been in the business for many years and, in that time, our industry has concentrated on making bigger, faster and more fuel-efficient machines that are also safer, more comfortable and friendlier to the environment.

Overview of technological advances

We have progressed about as far as we could with hydraulic controls and mechanical power. Now, tremendous technological advances in electronics, communications systems and information gathering and storage are being adapted to achieve new levels of performance, capacity and precision thought impossible only a few years ago. The role of electronics is an amazing and almost limitless one as agricultural engineers and designers use their creativity to adapt the latest technology to the unique needs of tillage, harvesting and processing equipment of all kinds.

The role of communications systems that gather and store information to support cropping decisions is huge as well, with the advent of site-specific crop management. The demand is great for a new set of management tools that link computers, on-the-go sensors, global positioning systems and other highly technical devices. In today's economic environment, farmers world-wide ask for help in maximising the potential of their land.

More timely ground preparation, precision seeding and the precise application of chemicals are all absolutely critical for higher yields and the economic success or failure of farmers today. Optimisation of the harvest - making the most of the crop that is grown by improving grain handling and enabling faster harvesting - is also critical.

Electronic advancements are a major part of what makes these improvements possible . . . . and New Holland has a strong heritage in electronics innovations. For example, we were the first to pioneer the crucial ability to detect metal debris coming into the feedroll of forage harvesters. Before our electronic metal detectors were introduced in the mid-1970s, there was no way to detect and therefore prevent metal objects from causing cutterhead damage or from becoming an unwanted part of the forage that could lead to hardware disease in cattle.

Similarly, New Holland was the first to provide rock protection for rotary combine harvesters with an electronic stone detector invented in the mid-1980s. First used on New Holland TR combines, the system detects rocks electronically by distinguishing the acoustic signatures of rocks striking a sensor. A mechanical trap door then automatically ejects the stones before they can be taken in by the rotors.

A third important innovation made possible by electronics was the first automated, self-propelled bale wagon developed by New Holland in the early 1980s. This machine gave operators the unique capability to program various bale stack patterns to fit their storage and transportation needs, giving them much higher productivity through electronics.

A more recent example of an advancement in productivity for field preparation and planting is the use of the microprocessor to control tractor transmissions, replacing traditional mechanical linkage to the clutch pedal or shuttle control and providing pre-programmed shifting patterns. The New Holland M/60 Series tractors, in the 75 to 120 engine kilowatt range, feature semi-powershift transmissions that replace shift levers with pushbutton controls, thereby simplifying operation and reducing fatigue for the operator.

Productivity in the field is maximized in several ways. The electronic control system makes about 4 million calculations per second and adjusts the performance of the transmission 100 times per second. Try to keep up with that as a human operator! Such monitoring also keeps maintenance downtime to a minimum.

Speed matching automatically matches forward ground speed to engine speed by selecting a suitable gear. The need to stop the tractor to change range during field work is minimised . . . . so this increases work output and decreases operator fatigue. By replacing many operator decisions and manual, mechanical shifting movements with electronic controls and programming for shifting on-the-go, the overall result is that field work

can progress much faster for timely soil preparation and planting.

Another area where the role of electronics is crucial to the achievement of maximum productivity is the area of harvesting grain efficiently, thoroughly and on schedule. Combine and forage harvesters have become very complex machinery, designed to process a large variety of crops. And, more grain-producing countries will be moving toward the high standards for grain loss that are already common in Europe today. In order to optimise these processes and therefore productivity, many sub-systems and parameters must be monitored and controlled. For these reasons, conventional mechanical or hydraulic controls are no longer capable of meeting the demands of the crop complexities and larger and larger harvesting units. That is why New Holland engineers chose go into a new direction - using fibre optics and CAN (Controller Area Network) protocol - in the design of New Holland TF combine harvesters. By doing this, they produced a new monitoring and operational system that improves operation, maintenance and safety in a machine that is much less complex to operate than its predecessors or competitors. These improvements, coupled with the increased physical capacity of the harvesters themselves, provide greater efficiency in the field.

Today, a modem on the farm allows us to reprogramme a combine or forage harvester from the central engineering office. Advanced diagnostics, combined with such automated systems as the Adjust-0-Matic™ system that fully automates knife sharpening and shearbar setting from the cab, allow the operator to cut more crop more efficiently, again adding to the productivity from a hectare of land.

Looking ahead to even more advanced technology, New Holland is pleased to be working with the Silsoe Research Institute here and with Dowdeswell and Lucas Advanced Engineering to investigate the potential to improve tractor and implement productivity by improving control systems communication and co-ordination. The integrated system is being developed to increase tractor and implement performance, improve quality of work, reduce operator workload and fatigue and reduce implement set-up times. The microprocessor has opened the way to completely integrated control which can be supervised or overridden by the operator if necessary, but which otherwise will manage engine, transmission, hydraulics and implements completely automatically according to a predetermined strategy. Productivity improvements of 10 percent or greater are achievable with such integrated control systems based on advanced electronics.

Decision support systems

There is no question that the innovations of site-specific crop management . . . precision farming . . . are becoming an important factor in the future of crop production. Precision farming involves gathering information dealing with the yield, location and time variation in a field, then using that information to manage inputs and practices on sections of that field versus treating the entire field in the same manner.

The goal is to be more productive, efficient and environmentally sensitive to natural resources. To accomplish this, precision farming relies heavily on application of the Global Positioning System of navigation and many new measuring and decision support systems. Using satellite-based information to map fields by matching input applications and yields with specific points is one way space technology has come to earth.

The space age has come to agriculture in another exciting way I'd like to address before I continue on the topic of precision farming as we know it today. Let me introduce you to the not-too-distant future of agricultural robotics using NASA and New Holland technology in a history-making co-operative venture.

Last fall, a New Holland Model 2550 SpeedRower self-propelled windrower cut 40 hectares of alfalfa in a California field with no operator on board. This robotic harvester ran continuously all night, guided only by GPS information programmed into its on-board controls and only stopping at all so the engineers observing its labour could eat supper. The windrower knew exactly where it was at all times as it cut the big rectangular field, divided up by flood irrigation borders. The machine's programming calculated the distances between borders and then calculated the cut width needed to make six even cuts . . . starting at one end and working its way all the way across in a regular pattern. When the sun came up, the field was well cut . . . the cut rows straight as an arrow.

Planetary technology in this experimental manless New Holland windrower will make the leap from moon to farm fields not such a giant step for farmers.

Earlier in the day, the automated SpeedRower cut six hectares of two-metre-tall Sudan grass by itself using only its vision system - video cameras and sensors that kept it going along the proper cut line without any help from GPS data. Again, there was no operator on board, and no operator in a base unit feeding it instructions.

This is where we are with Demeter, an exciting joint research project between NASA, New Holland and the National

Robotics Engineering Consortium at Carnegie Mellon University in Pittsburgh, Pennsylvania.

The mission of the consortium is to bring NASA-developed planetary rover technology down to earth. New Holland is the first commercial industry partner of this prestigious public institution, teaming up to create the world's first unmanned, fully automatic windrower.

Such automation will help reach the goal of higher productivity with more predictable performance, maximum use of manpower and optimisation of the harvest window. Most importantly, it will permit efficient harvesting at a higher operating speed than is possible with current equipment that depends heavily on the alertness and stamina of human operators.

Demeter is the prototype, not just for many types of agricultural harvesters, but also for other large, mobile machines operating outdoors in heavy and sometimes dangerous applications, such as excavating, mining and timbering. Demeter has been born from more than a decade of research, funded by planetary rover and road navigation research programmes. New Holland is supporting the Demeter research in the form of a prototype self-propelled windrower unit and technical support from our research and development and design groups. We are also excited to be exploring the incorporation of this automated technology into the engineering development process for our next-generation haytools, such as the New Holland Swather Model HW340 with disc header.

The background knowledge and software control architectures for wheeled on- and off-road vehicles has come from work with military land vehicles. The space agency's projects with rovers used on the moon and elsewhere provided multiple iterations of physical robot controllers, open-field navigation and vision-based perception. From this base, the Demeter team defined and implemented two core technologies for mobile agricultural equipment - FieldNav and FieldHand. Combined, these technologies represent Demeter, a system with the knowledge and capability to harvest without a human operator on board.

It uses onboard and remote sensing to accurately locate itself to the task; executes and monitors its physical actions in real-time with multiple levels of safety; and accepts high level directives, generates and executes plans and interacts with its operators.

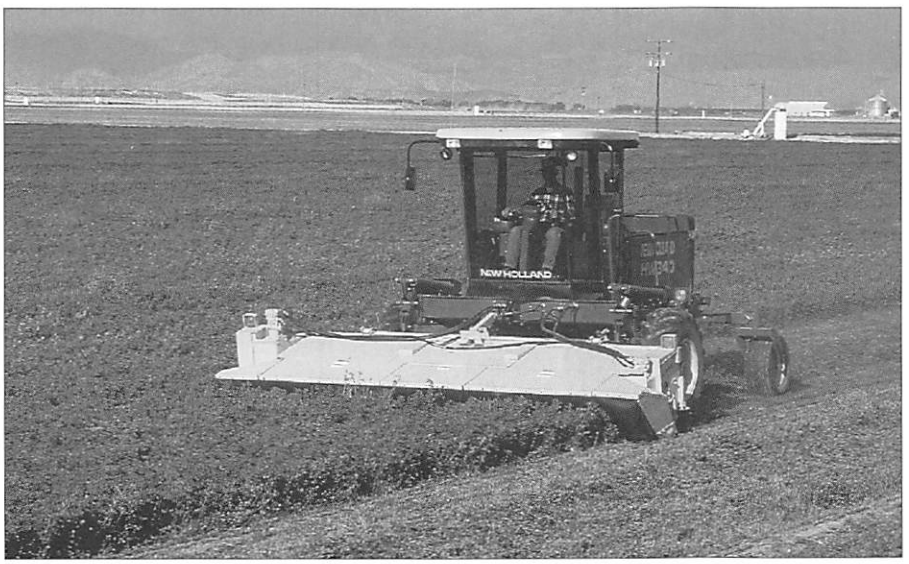
The essential functions are software-controlled, with manual operation supported through simple safety-circuit electronics and firmware. FieldNav is the hardware and software that transforms a self-propelled agricultural harvester into a machine controlled by computers. It includes the electromechanical adaptation of the equipment for drive-by-wire control (no mechanical linkage) and provides the physical control over the various motions of the machine. FieldNav also monitors operation to ensure safety (including emergency stop features) and possesses a core navigational capability through combined dead-reckoning, inertial and GPS data.

The other core technology, FieldHand, either assists or replaces the operator in the cab. FieldHand consists of a number of behaviours normally performed by the operator, including "seeing" and tracking the crop cut-line, monitoring the cut row, detecting the end of the row, executing turns and detecting and avoiding obstacles in the field.

Combining FieldNav and FieldHand provides the capability of unattended operation in the field. The vision system of FieldHand detects and tracks the crop cut-line using intensity segmentation and colour segmentation and sends steering and velocity commands to FieldNav. FieldNav takes the steering and velocity commands and converts them to electric signals which operate the hydrostatic transmission.

The primary benefit of the Demeter system will be increased productivity derived from its ability to operate continuously at very high speeds. The computer system does not feel stress or tire, as does a human operator. It is both productive and predictable. Demeter has been tested with the SpeedRower cutting at up to 10 km/h using its vision system. When coupled with our higher capacity machines, refined versions of Demeter will increase the top operating speed to far beyond the capacity of a human operator for any extended length of time, even in the best ergonomic seat. In turn, Demeter will allow agricultural equipment manufacturers to design even faster cutting implements, which will directly translate into significantly increased productivity.

FieldNav and FieldHand will first be evolved commercially to become CutCruise ... a revolutionary cruise control that will unburden the operator and increase productivity. The operator will only need to open the field and then engage CutCruise, which will then cut the



New Holland Model HW340 self-propelled disc mower-conditioners have 12 disc modules for a 5 metre cut. A 121 kW GENESIS™ engine provides ample power for all crops. A sicklebar header can be substituted for the disc-type cutterbar and draper headers with up to a 10 metre cutting width can also be adapted.

rest of the field at near maximum speed, confirming its actions periodically with the operator. The advantages of this parallel those of the integrated control system for tractors and implements discussed earlier.

Future commercial versions will be the full Demeter system as it is being tested now, an automated harvester capable of unattended operation in the field. Initially, the unmanned Demeter is expected to be the second machine used in a field as a "drone" behind a "master" machine equipped with CutCruise and a human operator on board who will operate both machines. This drone would be guided by its vision system backed up with GPS guidance to confirm and enforce the boundaries of the field.

While Demeter and our joint integrated-system research with Silsoe are perhaps the most spectacular of our co-operative projects, New Holland is also fortunate to be co-operating with several other public institutions. As I mentioned earlier, there is a growing demand for equipment with highly specialised decision support systems for use in site-specific or precision farming. Here's a quick review of some of the work New Holland is doing in this area, to a great extent with university researchers.

In the forage segment, New Holland has provided a Model 650 Roll-Belt round baler being used in the work Dr. Leonard Bashford is doing at the University of Nebraska to design a yield monitor for use on round balers. Dr. Bashford has taken the lead in this area by developing a yield mapping strategy for forages using a round baler. He believes that it is important that yield be obtained for all crops grown on a field, including forages, if one is to achieve a complete site-specific crop management scheme. His system for on-the-go yield monitoring with round balers uses differential GPS receivers, transducers and an instrumentation system using load cells in the baler axles and drawbar to calculate weight of the baler every three to four seconds. The weight readings and GPS field co-ordinates are displayed and recorded on a laptop computer and can be downloaded to an office computer to create yield maps of hay fields.

Measuring yields is only one part of precision. We believe measuring inputs is important as well. An important need for proper nutrient management, including meeting increasingly strict environmental standards, is the ability to distribute livestock manure accurately onto the land and have proper documentation when needed. New Holland and the University of Delaware are at work on this task in the United States. A new manure spreader now in the research and development stage at New Holland uses spinner disc distribution to control very precisely the amount of material applied, the spread pattern and the distribution. In our work with the university, GPS readings give a time and location stamp that helps us log and record the spread rate as we go for use in later mapping and documentation of how much manure went where.

New Holland Roll-Belt™ round balers deliver high capacity and high quality.

Forgive me for this transition, but it is time to talk about the messier points of co-operative research.

A fertile topic

Just who is in control of technology when the private and public sectors work jointly on development projects? Who ultimately has ownership of the technology, the rights to the intellectual property? Can public and private partners reach suitable agreements on matters of confidentiality? How and when do research partners know when to call it a day and end a project that may not be succeeding?

Before I comment on these issues, let me spend a moment on why we join together with the public sector for research in the first place. We in the agricultural equipment industry, and I daresay in all of agribusiness, are tremendously indebted to the years and dollars spent by public universities, institutions and government facilities doing basic research. There are so many new technologies and avenues to explore, and the public sector is much better suited with the resources and diverse disciplines to look at problems from a broad perspective and explore numerous angles.

Few of today's challenges in agricultural have a single answer from a single discipline. We in private industry tend to work in a very small, specialised field with an eye toward commercial applications of technology. We watch the progress being made in public basic research, and when we see a technology developing that we feel could benefit our customers, we approach the institution with a proposal to join in to develop practical applications for their basic research.

More and more, universities and other public institutions want to align themselves with industry to stay in touch with the 'real world' and help their students be better prepared for careers in the private sector. And when facing more and more cutbacks in money for basic research, public researchers usually welcome the influx of private funding so that they can continue their work and see it come to practical use.

That's where the first couple of issues come in, control and ownership of technology and intellectual property. In an ideal world, this is determined by the nature of the agreement at the beginning of

the joint co-operation. If the public institution is paying for the majority of the development of a technology and develop the patents, the private partner licenses the technology and pays royalties to commercialise it. If the private partner pays for the development, we own the technology.

It can be that simple. But then it gets complicated, particularly in the area of confidentiality. Even when the intentions are good, the worlds of private and public often collide in this area. The truth is that we as industry partners have our focus on offering exclusive, innovative commercial products that give us a competitive edge in the marketplace. That's why we're in business, and that's how we make the money that then becomes available to invest in joint research with public institutions. So it is in our best interest, frankly, to keep joint research projects as secret as possible until we are ready to launch the finished product.

This, unfortunately, runs counter to the objectives of our academic partners, whose professional livelihoods depend in great measure on publishing articles and books about their research. Most universities with whom we work will accommodate our needs, giving us two or three years of running room before going public with the work. Or if we agree to published information, we review the content carefully to avoid revealing information that could tip off the competition.

We are still vulnerable, however, to the times when students who work on these co-operative projects graduate and go on job interviews with our competitors. The students, of course, want to be able to promote the work they've been doing with their professors. And, in many cases, there goes some of our proprietary information. That's business.

On the final point, when to call it a day, I can only say that proper planning at the initiation of joint research is crucial. If concrete timetables and measurable checkpoints are established up front, then it is somewhat easier for joint partners to rise above the natural emotional attachment one has to a project and pull the plug if needed.

Before I conclude my remarks and open the floor for questions, I would like to take a few moments to talk directly to the students here with us today. You heard quite a bit this morning about the future and what it holds plus some of the exciting research underway, and there's more to come this afternoon on other specific areas of agricultural engineering. I hope you're sitting here asking yourself, "How can I be a part of that future?", because we need all the bright, creative, well trained people we can get to make that future a reality.

How can you be a part of it?

What does it take to join a company like New Holland and succeed not only as a practising engineer but as our managers and senior executives of the future? Here are *nine key factors* we like to see in our new hires and management candidates. Not only will these set you apart from the crowd, but I believe they will give you the foundation you will need to succeed in your job and move to positions of greater responsibility throughout your years as an agricultural engineer.

Be a team player.
As we and our fellow manufacturers have moved into the world of total quality management and flattened organisations using cross-functional teams instead of the traditional hierarchy, [simplify wording], everyone has to be a team player. The better you are at interacting with team members, respecting the talents and needs of other disciplines and taking pride in group effort, the more valuable you are to us.

Sharpen your communication skills.
I cannot emphasise this enough. Especially in the team environment, the ability to clearly communicate when speaking and writing will put you in the lead, whatever your position or specialty. Whether you are specifying a job for a supplier, presenting a production plan to a review committee or speaking before an industry group, clear communication is everyone's responsibility.

Be mobile.
As I mentioned early on, we are a global company with operations and opportunities in more than 150 countries. We need to be able to put our best people where we need them most, and that often means a move, or several moves, during your career. Being flexible and mobile as you look for your first job and after you accept it is a very desirable quality from an employer's perspective.

As an example, one of our young engineers, Brad Jorgenson, graduated from college and was hired at our New Holland, Pennsylvania, centre in January 1995. That July, just a month after he got married, he agreed to move to our Italian tractor design centre in Modena, Italy. He spent two years there on the team that developed the successful new TNF narrow tractors we launched this year for use in orchards and vineyards. Now he's back in the States as one of our test engineers with broadened experience, a second language, and enhanced potential for advancement.

Show proven leadership skills.
We look for your ability to be a self-starter and to motivate others in a team setting. We need team leaders who can translate our customers' needs into team goals that create industry-leading equipment for use around the world. We want that uncommon but essential combination of independent thinkers and leaders who work well in a team setting. Look for ways to polish those skills in your associations and classroom activities whenever you can.

Get experience.
Go above and beyond the classroom work required for your degree. We like to see candidates with hands-on experience in their field, gained through internships, prior work experience or other practical application of what they've learned in the classroom. Never hesitate to seek out and volunteer for chances to put your knowledge to work. Then we'll want to put you to work, because we'll know you can do it.

Put professionalism first.
Professionalism comes in many forms. It is the way you handle yourself; the way you treat a colleague, a supplier or a customer; the way you approach your work. We want ethical, responsible, fair-minded people on our teams. Professionalism is a way of thinking, and a way of life that should start while you're in school and stay with you throughout your career.

Technical courses count.
There is no question that we are dedicated to being on the cutting edge of engineering technology, and we need engineers who are well trained in using the most advanced tools available. But one of our standard interview questions for engineers is 'Are you good with a

wrench? How about a cutting torch?' Your first two years as an engineer with New Holland are spent getting your hands dirty in on-the-job field test training, often in remote areas where if it breaks, you fix it. You'll pull out your toolbox a lot more often than your briefcase during those travels, so don't neglect the technical basics during school and training.

Keep that grade point up.

You may hear different things from different people, but I still believe your grade point is important. We look for demonstrated competency in your field, and grades are still an important measure of competency at the collegiate level. Study hard in all your courses so that your marks reflect what you know you can do.

An advanced degree is a plus.

I understand that many of you are in post-graduate programmes. Good for you. There is much to be learned, and the extra time in academic work and research will give you an advantage in the job market in both the private and public sector. We also encourage our engineers to continue their training and education while with New Holland as time and finances permit.

Conclusions

I hope you will take these desired qualities to heart, because we need you. Our industry needs you. It will always be one of New Holland's objectives to be on the leading edge as we improve our offering to farmers. We'll do that by developing and applying the latest technology to meet our customers' needs. We need to continually add good new people to accomplish that objective.

Advanced electronics and support systems will be some of the most important components of farm equipment now and in the future. As the Demeter project is proving, the private and public sectors working in co-operation will be a key factor in the growth of this technology.

Let us go forward to solve not only the engineering challenges but also the important auxiliary issues in the realm of joint private and public technological research.

FOR YOUR DIARY

BIO–ENGINEERING IN NEPAL

Developing an institutional capacity in biological techniques for slope stabilisation and erosion control in road construction in Nepal.

An early evening meeting jointly sponsored by:-
The Institution of Agricultural Engineers (Overseas Development Specialist Group)
The Institution of Civil Engineers (Appropriate Development Panel)
The Tropical Agriculture Association

WEDNESDAY 14th OCTOBER 1998

18.00 hrs

(Refreshments from 17.30)

at

The Institution of Civil Engineers
1, Great George Street
London

Speakers : Dr Jane Clark, Forestry Adviser, DFID
Mr John Howell, FRR Consultants

Further details from:
Rob Petts at Intech Associates 01372 458955, rob@intech-consult.demon.co.uk
Derek Sutton, 01525 860000, derek.sutton@bbsrc.ac.uk

Genetically modified organisms - the debate continues

The use of Genetically Modified Organisms (GMOs) has the potential to offer real benefits in agricultural practice, food quality, nutrition and health, although there are aspects of this technology which require further research and monitoring. This is the conclusion of a statement published by a Royal Society Working Group established to examine the development of genetically modified plants for food use.

The Working Group, which published its statement on 3 September, focused particularly on the scientific evidence concerning the risk of uptake of genes from genetically modified (GM) food by the digestive system, and the risk of gene transfer from GM crop plants to wild species and non GM crops. They concluded that the chances of gene transfer happening are slight provided the appropriate regulatory processes are followed.

Sir Aaron Klug OM, President of the Royal Society, said, "Although the debate surrounding GMOs has focused mainly upon the risks of this technology, we must not lose sight of its huge potential benefits. Just as the food requirements of today's population of nearly 6 billion people could not have been met by the technologies of the 1940s, we cannot assume that current practices will feed the population of 8 billion expected by 2020. New approaches are needed in addition to the continued improvement of existing methods of crop and animal husbandry and food processing."

The Royal Society Working Group urges Government to establish an independent overarching, regulatory body to span departmental responsibilities, monitor the enforcement and scope of regulations and strengthen the guidelines to growers of such crops.

"All parties must appreciate the public's legitimate concerns," concluded Sir Aaron. "Consumer confidence, based on an appreciation of the scientific evidence and the regulatory checks and balances, is central to whether GMOs will contribute to feeding the world's rapidly expanding population."

Globalisation and sustainable development for the 21st century

Bo Kjellen

It is indeed an extraordinary pleasure to address this important event. First of all, it gives me great satisfaction to return to Silsoe, where I had the privilege to receive an honorary degree last year; and second the opportunity to share with you some reflections on globalisation and sustainable development for the 21st century. I find it very significant - as an international negotiator - to elaborate on this subject in the company of agricultural engineers: you are the cutting edge of so much present effort to solve the problems of global sustainability. After all, food security for the growing world population is the basis for the future.

And as we stand on the threshold of a new millennium, we also have to realise that we are in a unique situation. We are the first generation to face a truly global challenge. Our action - or non-action - will bear on all future generations of this planet - small and blue and beautiful, as it was described by one of the first US astronauts. And it will bear, first of all, on a world population of close to 10 billion people by the middle of next century. We carry a heavy responsibility. As the French writer Antoine de Saint-Exupery put it: ".....to be a human being is to be responsible. It is to know that, when you lay your stone, you are building the world."

I have had the privilege of participating in the Rio process from the beginning. What started out in Stockholm 25 years ago as a concern for the environment has grown into a broadly-based search for sustainable development.

The Brundtland Commission in 1987 defined sustainability as the capacity to care for the needs and aspirations of the present without prejudicing the needs and

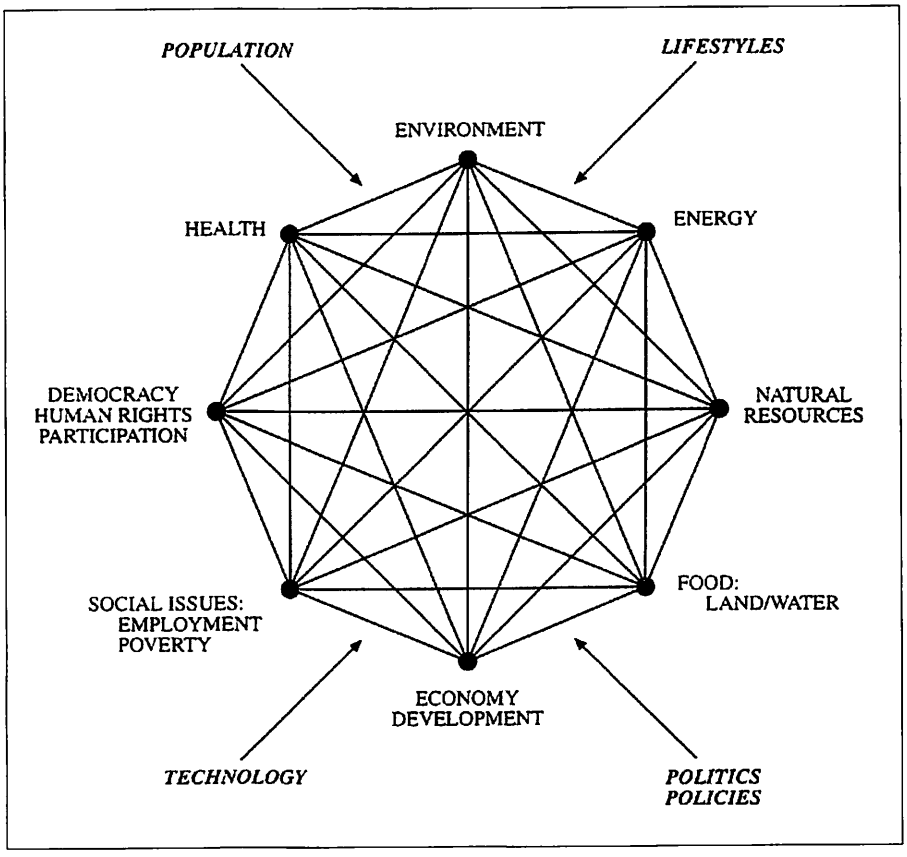


Fig. 1 Elements of sustainability

Bo Kjellen presented this paper on 12th May 1998 at the Diamond Jubilee Conference of the Institution of Agricultural Engineers, held at Silsoe College, Cranfield University, Bedford. Ambassador Kjellen is in the Ministry of Environment, Sweden, and is presently Chairman of the Intergovernmental Negotiating Committee formulating an international convention to combat desertification in low rainfall countries. He was awarded an honorary DSc by Cranfield University in 1997.

aspirations of future generations. This is the basis for the various elements of the process launched through the Rio Conference on Environment and Development in 1992.

In the course of this long negotiating journey, we have learnt to understand better the components of sustainable development. I have tried to bring them together in the "Diamond of Sustainability" *(Fig. 1)*. This is an appropriate metaphor, since we are attending a Diamond Jubilee; and furthermore "Diamonds are forever".

The purpose of this figure, however, is simply to demonstrate the links between the various aspects of sustainability and to illustrate that we have to consider not only environmental concerns but also social and economic impacts. But the balance has to be struck if we are not going to experience what the evolutionary biologists would call "punctuated equilibrium", the economists "black Friday" and the political scientists "revolution".

We also have to realise that these various elements of sustainability are influenced by a number of external factors, some of which I have indicated here. It is obvious that demography has a major impact: at the global level it means that we have to plan for sustainability in a world of close to 10 billion people in 2050. How are we going to meet that challenge? And these perspectives in turn are clearly influenced by the behavioural patterns and lifestyles of the affluent: "no man is an island".

Similarly, technology has its role to play. Some people might believe that technological fixes are going to bail us out of the struggle for sustainability, pointing to past experience. This seems to me to be a risky confidence. You, ladies and gentlemen, know the potential of technology much better than I, but I think you also know its limits and shortcomings. And you realise that, rather than technology itself, it is the management of technology that matters.

This also brings me to the final consideration here: that ultimately it is the political framework that defines sustainability, and it is the policies pursued that will decide the future. There is no mechanic or deterministic path: we define the future ourselves.

That is why sustainability is a democratic concept; that is why the Rio process has highlighted the importance of civil society and the role of Non-governmental organisations.

Defining factors in a dialectic process

As we look towards the next fifty or hundred years I have been struck-by a number of contrasting elements, which suggest themselves as defining factors in a dialectic pattern.

Globalisation vs local empowerment
The first one deals with globalisation itself. No doubt this is one of the most striking characteristics of the world of today. When I chose the term for the title of this presentation, it was in recognition of this fact. Yet I am not sure that we understand the true nature of the word. In a way, the world before the first world war was also global. The rich could travel wherever they wanted without a passport; and big companies operated on a worldwide scale, moving money easily. The main difference - I think - is in the perception by the general public; and I venture to say that the pictures we all saw in the late seventies of the world as a planet floating in space has contributed to that. Now the fabulous development of information and communication technology is creating a new paradigm. The multinational enterprises become universes of their own.

But in parallel with this, we see an increasing attention at the local level, on local participation and empowerment. Maybe this is in the nature of things: in a rapidly changing global environment we feel the need for a firm attachment to the well-known and familiar.

Governments vs civil society
This development has another aspect which can be seen in dialectical terms. On the one hand Governments - or international organisations or transnational companies get more and broader responsibilities; but on the other hand, we see that civil society, generally in the form of non-governmental organisations (NGOs), becomes better organised and plays an increasingly important role. One aspect of this has been the break-through of NGOs in the United Nations, in the Rio Conference itself and more generally in the Rio process.

Affluence vs poverty
This new world of ours at the threshold of the new millennium is a world in which more people than ever before live in relative affluence and in material comfort. But it is unfortunately also a world in which more people than ever before live under conditions of terrible and unacceptable poverty.

This is not a sustainable state of affairs. It is simply not possible to envisage that the divide between the 'haves' and 'have-nots' – for in terms of nations and of individuals - should continue to grow without creating potentially dangerous situations for both stability and peace.

And let me add the gender aspect. Among the poor, women are the poorest. Their relative situation has improved, but real equality is still far away. This will have to change and it will change.

Urbanisation vs rural development
Around 2010, the majority of the world's population will live in cities. There are obvious consequences for land-use planning. And it means revolutionary changes in lifestyles for many people. It means new challenges for urban services and for infrastructure, not least with regard to energy and transport. Should cities in the future be more compact? Would people be able to re-conquer the city from the automobile?

In parallel with this trend towards urbanisation, there is also the need to support rural development and to strengthen the links between the cities and the rural areas. This is particularly important in the broad agglomerations if developing countries, where suburbs are in fact rural communities.

New technology vs existential, ethical reflection
In all this, technology is the critical factor. The revolutionary economic changes over the last one hundred and fifty years have been brought about by technology. In looking at the impact on the global environment, some of us may ask if we have come to the end stage of an industrial paradigm characterised by big production units requiring heavy inputs of energy. Is the revolution of information and communication technology only beginning?

Such reflections take us in two directions. One is to say that science and tech-

nology can now open up new avenues: the obvious example is just information and communications technology with the laptop computer, the internet and the development of multi-media as the chief symbols and icons. These point in the direction of eco-efficiency and better use of available resources, thereby creating new space for sustainability for the growing world population.

But there is another dimension to this, another direction: we begin to think about the role of man and the evolution of man on this small planet. What is the sense of technological improvement? What kind of society should we have? What are the implications for ethical and moral values? It seems to me that we need to face these issues squarely, not least in promoting educational systems that will enable students to have a broad and non-sectoral outlook. Culture has an obvious role in this context. And I cannot avoid quoting the French writer and politician Andre Malraux, who said that: "the twenty-first century will have to be spiritual, or it will not be at all".

Rapid change – concern for the long term

Maybe all this is linked to my last set of contrasting or dialectical elements: on the one hand, unprecedentedly rapid change and on the other a strongly perceived need to think in the long term.

A Swedish poet, Erik Lindegren, once wrote that "we have no other nest but our wings". There is no static stability any more, we have to accept change mainly driven by technology - in order to master it. But change is not a quality in itself. We have to know in which direction we are heading.

This is where long term thinking comes in. Our systems are probably too much designed to cater for the short term. In business, the results for the next quarter take on a major importance. And in politics, the next election becomes the main focus of interest. And yet we know that our common responsibility as human beings stretches way beyond our own short lifespan or indeed beyond that of our children and grandchildren. One week may be a long time in politics but, in terms of the adventure of man, three centuries is just a fraction of time.

Central clusters of attention

As a bureaucrat and as an international negotiator I know that as we try to accommodate these many conflicting demands in the struggle for sustainability, many powerful interests are challenged. These interests are political, economic and social; and they cannot and should not be dismissed lightly.

But all the time we must combat the inertia and the natural tendency to stay with conventional wisdom. In 1964, the American Senator William Fulbright said that "We must learn to think unthinkable thoughts. We must welcome and not fear the voices of dissent".

This certainly holds true to-day as we face major challenges related to the environment and sustainable development. I wish briefly to comment on a few central clusters of attention for national and international action as we approach the new millennium.

Atmosphere – climate, ozone layer, energy, transport

The first cluster relates to the atmosphere. It is here that the most obvious global threats are appearing. The 'fragilisation' of the ozone layer has led to the Montreal Protocol and the ban on CFCs. The risks for global warming brought the international community to agree on the Convention on Climate Change and the recently concluded Kyoto Protocol. We also know of the European agreements on long-range air pollution, a very important issue for my country.

This is a good start and there are very significant steps within the framework of the Rio process: I recall that the Climate Change Convention was signed in Rio in 1992 and that it was carried forward through the Kyoto Protocol last December. But it is just a beginning; and it is obvious that action to combat global warming goes straight into the heartland of our industrial civilisation: energy and transport.

Oceans – land based pollution, coastal zone management, fisheries

The second cluster of key problems are linked to the oceans. Their health may well be decisive for future generations, not least because of the role of fisheries for food security. Land-based pollution and the impact of land-based activities on coastal waters need to be addressed with priority. This year is the international year of oceans; and in 1999 the Commission on Sustainable Development will give priority to these issues.

Urbanisation – water, sanitation, planning, transport infrastructure

Issues connected with urbanisation build the third cluster. Both the megacities and smaller urban centres need to be 'livable' and sustainable. This means tremendous efforts in terms of urban planning and development of infrastructure. The management of water, sewage and waste in the cities will be of major importance for health conditions in the twenty-first century.

Food security – land management, agrochemicals, genetics & technology

And finally I see food security as a major problem area for the future. With about 800 million people undernourished today, there is no room for complacency in looking towards the year 2050 with a world population estimated to rise from today's 5.8 billion to close to 10 billion.

The food problem touches in one way or another on almost all the issues connected with sustainable development. The UN Commission on Sustainable Development has just concluded two weeks of discussion with freshwater as a central theme. I myself have chaired intense negotiations for an International Convention to combat Desertification. This Convention entered into force two years ago and is ratified by more than120 countries. We all realise that national and international decisions on land use planning, e.g. with regard to urbanisation or forestry, will have a bearing on future food security. And social considerations, such as those related to gender, will obviously influence agricultural production.

I feel privileged to discuss these matters before such an eminent group of experts, on such an occasion. Because it's obvious that you are in the frontline of mankind's continuous efforts to push back the spectre of Malthus. Agricultural engineering is behind the progress that has been made to obtain ever-increasing yields from the land over a long period of time.

Achieving sustainability

As we discuss the future of agriculture and the role of agricultural engineering today, it seems to me that we need a cool and non-emotional analysis. It is easy to criticise obvious cases of engineering hubris, such as the environmental and human disaster of the Aral Sea region.

There, the Soviet leaders and their water engineers forty years ago believed that they could turn the deserts of Kazakhstan, Uzbekistan and Turkmenistan into green regions for the production of cotton and rice. Sure, their plans for irrigation of enormous areas succeeded; but the desert struck back and, today, enormous areas of formerly productive sea has been turned into desert; and the groundwater and the air are polluted by chemical fertilisers and pesticides. The socialist dream turned into a human nightmare.

The Aral Sea disaster carries important lessons for us all. It teaches us to reflect on the long-term effects of our actions. It teaches us to reflect very carefully on the broader consequences of land-use planning. And it teaches us to be critical of too grandiose schemes. Nature is not simply a sort of clay which man could sculpture at will.

Now this seems very obvious. But we also know that all decisions involving agricultural policies and the use of agricultural engineering are taken in an economic context, where strong actors are exerting many different sorts of pressure.

The ethics of international environmental negotiators and those of the agricultural engineers somehow seem to be rather similar. We are both facing the main parameters of sustainable development - social, economic and ecological factors - and we both have to steer a steady course between conflicting demands.

And all of us are facing the equity dilemma: intra-generational equity and inter-generational equity. Present poverty and hunger is unacceptable: but so are policies and production methods that would compromise the livelihoods of future generations. It is a dilemma no generation can escape - but for us, technology has made it more dramatic than ever before.

The use of chemicals is a case in point in terms of production capacity, improvement in people's living standards. In combating weeds and disease, there is no doubt that chemicals have worked wonders, that they have been one of the pillars of the green revolution. But we also know the downside, and in a few months negotiations will open which are designed to ban at least twelve of the persistent organic pollutants, the POPs including PCBs. Their accumulation in humans and animals pose grave threats, *inter alia* to human reproduction. So what was once seen as tremendous technological advances turn out to be a blind alley in the progress of mankind.

The promises, fears and dynamics of animal and plant genetics are part of the same problem. The prospects of increasing scarcity of basic foods underline the importance of genetic research. But the moral and political controversies surrounding this whole area can not be dismissed lightly. They have to be addressed in a rational and dispassionate dialogue.

The general character of this debate is of course greatly coloured by our vision of the global food security situation for the next fifty years. There are diverging views. The FAO tends to take a more relaxed attitude, whereas the Worldwatch Institute in its latest State of the World report paints a picture of increasing scarcity of grains, leading to radical price increases already in the coming decades, obviously adding to the problems of poverty which I have already mentioned.

It would carry me too far to elaborate on these conflicting views of long-term food security. However, I think that there is a common understanding that factors such as the overall availability of water or the factors affecting allocation of land and water between agriculture and other uses are increasingly important.

Agricultural Engineering in the next millennium

Therefore, as we look towards the next millennium, it is crystal clear that a broad overview of all the factors affecting sustainability is needed. Eco-efficiency and an economic use of all factors of production are essential elements of future global well-being. And food security must be a priority issue.

No doubt, agricultural engineering has a key role to play in this global endeavour. Your technical and organizational skills; your overview and capacity of broad thinking - all this will be important contributions to the future. A noble task indeed; and demanding.

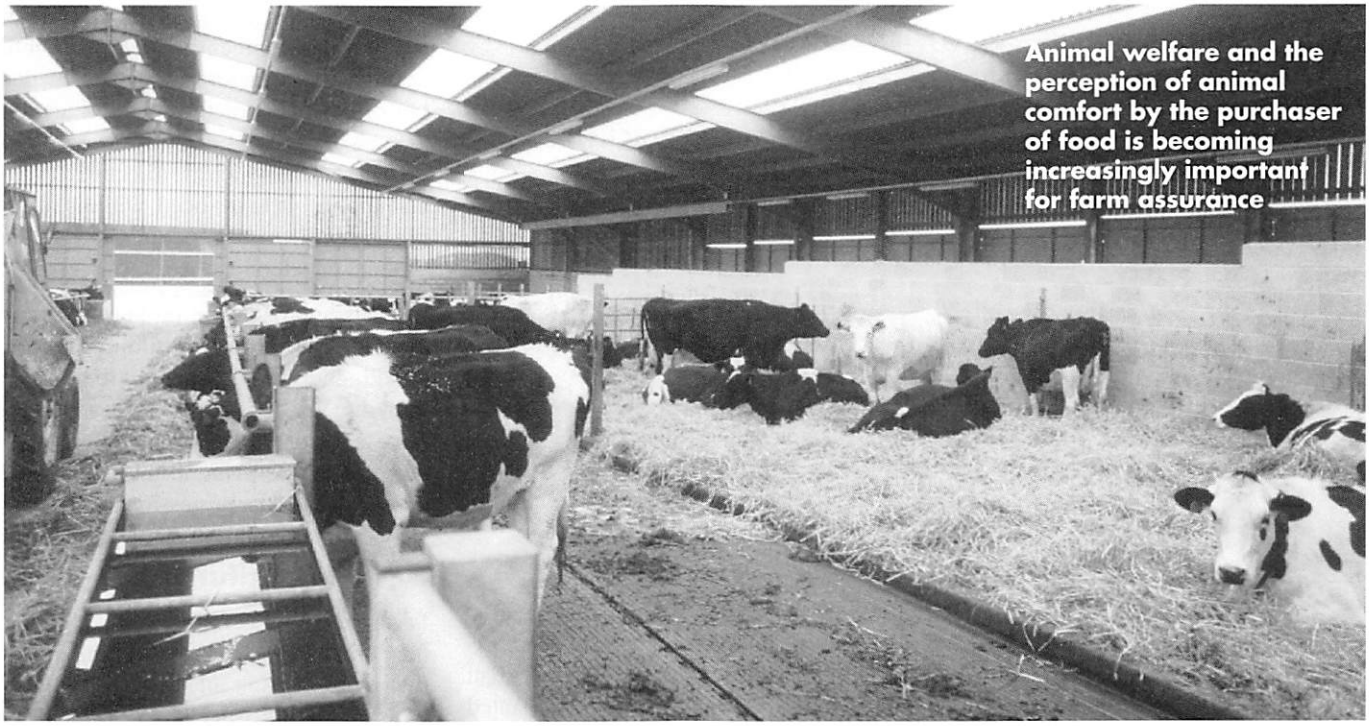
I feel a little embarrassed to elaborate on these themes, because I know that you have the expertise and that I venture into landscapes where I am a stranger. And as Carl Sandburg once wrote: an expert is a damned fool a long way away from home.

However, I seek courage in my conviction that we all need each other and that the perspective of the negotiator and of the scientist, of the practitioner and of the researcher, in fact complement each other. We all need a better overview. We all need a sense of direction in approaching the future. That is why I hope that this rapid reflection on some of the challenges of the new millennium, as seen from the negotiations in New York, Bonn or Nairobi can help you - can help us - in better understanding the nature of our long-term problems.

250 sprayer 'MOT' tests

The Test Scheme has been running since 'Sprays and Sprayers' 1997. During the year, the AEA has enrolled twenty test centres, with others waiting to be accredited. In addition to this, over 250 machine tests have been completed.

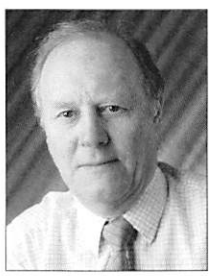
The test scheme has been accepted as the industry standard with assurance schemes likely to demand the AEA test. With this in mind, the AEA will continue to ensure that test centres abide by the strict test protocol, and to promote and enrol test centres around the country. To give the scheme guaranteed credibility, spot checks on sprayers will continue to be carried out and test centres checked for accuracy of reports. With the *New Sprayer* scheme running along side the existing scheme more machines will come into the test and continue to improve its recognition throughout industry.



Animal welfare and the perception of animal comfort by the purchaser of food is becoming increasingly important for farm assurance

Livestock housing - a continuing design challenge

Mike Kelly, George Burnett and Jamie Robertson



Dr M Kelly FIAgrE is head of the SAC Building Design Department based at Auchincruive in Ayrshire. He is active in consultancy work, primarily in dairy cow housing and associated facilities.

G A Burnett is a lecturer and consultant within the SAC Building Design Unit at Aberdeen. He specialises in designing environmental control systems for livestock housing, in addition to lecturing over a wide range of courses.

J F Robertson is based in the SAC Animal Biology Division based at Aberdeen. His specialism is pig housing, including animal welfare and air quality measurement. He is currently working on low-cost structures for pig accommodation.

The environmental complex

The most important environmental components of any livestock housing are of a social, climatic or structural nature. These make up the 'Environmental Complex' described more fully by Baxter (1969), and diagramatically outlined in *Figure 1*.

Each overlap represents the interactive zone, leading to environmental interactions, sometimes involving multiple relationships. Such interactions can be complex, and as the number of interactions increases, then the difficulty of identifying major influential factors becomes more apparent. These problems are not new, and have been with us ever since livestock have been confined within housing.

The ever-increasing scale of livestock units with more onerous welfare demands, together with the need to provide safe and healthy working conditions for stock persons, is forcing designers to provide the best possible solutions to meet social, climatic and structural demands. Good layout planning and system design can minimise social problems, whilst detailed attention to building hardware and equipment will do much to alleviate climatic and structural environmental shortcomings. Good, attentive management is the key to success, with well-designed facilities and equipment contributing positively to a consistently high level of stockmanship.

External forces are becoming ever more influential in the design of livestock housing systems. Legislation, consumer demand, public perception, farm assurance, welfare issues and deregulated markets are all contributing to difficult decision-making with respect to livestock accommodation. For example, application of the EU Directive of Integrated Pollution Protection and Control will be extended to the pig and poultry industry. This will take effect from October 1999 for new and expanded units, whilst existing operations will have a further eight years to comply. Units having 750 sows

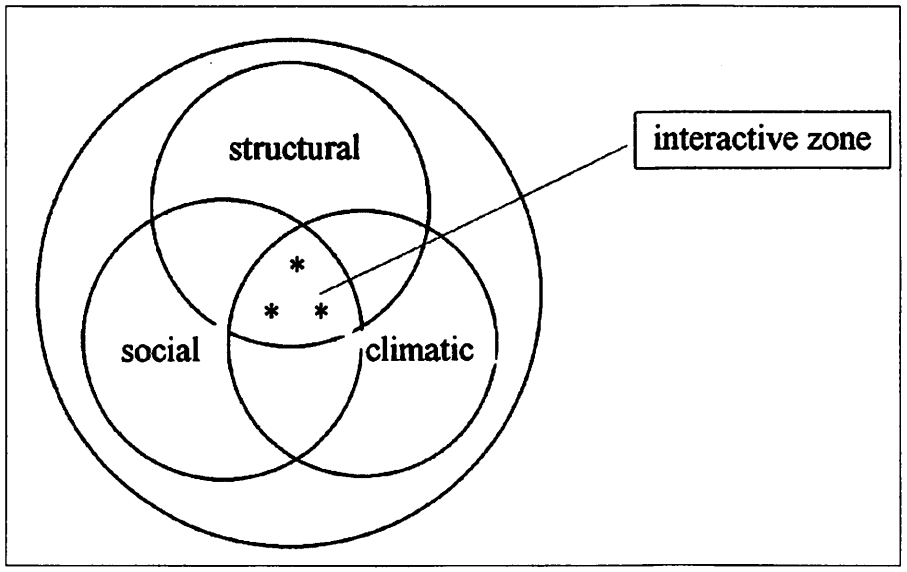


Fig. 1 The environmental complex.

or 2000 pig places (for pigs over 30 kg) will be affected. Thermal insulation and slurry/manure management will need to comply.

The perception of consumers is important, and this aspect should never be underestimated. Straw-based systems are perceived to be animal welfare friendly. Cages, crates, meshed or slatted floors all struggle to meet perception criteria, and access to some form of bedded or comfort area is likely to be increasingly demanded. Sometimes this cannot be achieved without considerable expense, dirty stock and high dust levels. Hence, designers of systems must be clear what performance criteria any building system or component is meant to achieve, and in this respect engineers have a vital role to play.

Performance design criteria

Building designers, component suppliers and engineers must be more rigorous about setting performance design criteria for building systems and components, in order that customer demand is satisfied. The design customer base is far more complex than in the past, when farmers made decisions, often based on the lowest production system or component costs. The design customer base now increasingly comprises the farmer, the stock person, the purchaser and consumer, the legislator and of course the stock themselves.

Consequently, building and component designers must be far more receptive to information on animal biology, and behaviour relevant to the environmental complex. There is a growing global emphasis to improve efficiency, based primarily on investment return rather than initial cost. The setting of clearly stated performance design criteria leads to improved building and equipment design, by ensuring that all environmental factors have been taken into account. A survey by Taylor (1997) of equipment manufacturers indicated a consistent gap between product design and customer need.

An example of the benefits of setting design criteria, is the design of a cow lying area within a cubicle housing system for dairy cows. This sector is presently inundated with mattresses, mats, water beds and floor treatments. SAC has identified a set of relevant performance design criteria, following an investigation of animal behavioural information, some product testing and cow trial work. The presentation of such criteria assists component manufacturers in evaluating existing, or developing new products to meet the stated requirements. This approach minimises the risk of inadequate products being foisted onto the farming industry.

A checklist of the criteria to be met for a cow lying area, is shown in *Figure 2*. This approach helps manufacturers in product development, which takes into account all the factors likely to influence performance in practice. Quantification of such items helps manufacturers to develop products which are directly relevant and applicable to the need, without missing out performance requirements at the product development stage.

This approach can be taken for any element of a complete building, such as handling facilities, or the entire building system. Ventilation is an important aspect which needs rigorous definition in performance terms, and the disciplined approach taken by professional engineers is well suited to this task.

Is big beautiful?

Farm incomes seem likely to come under continuing pressure, resulting in further consolidation and specialisation of livestock units. Big units are likely to get bigger, whilst small units which can operate on a part-time basis may increase. Mid range units, which cannot fully benefit from the economies of scale, nor achieve off-farm income, are the most vulnerable.

The agricultural industry is also an 'ageing' industry with many of those older farmers without obvious successors. They may reduce the intensity of their farming practices and neglect all but the most essential infrastructure maintenance. Alternatively, they will retire, resulting in the consolidation of units into more viable sizes.

These consolidated or expanded units will need to control costs, including labour, and hence labour efficient infrastructure layouts will become increasingly important. Other factors such as feeding efficiency, energy use, water recovery, heat recovery, etc., will continue to present challenges to the engineering profession, albeit on a smaller number of large, livestock enterprises. Those advising the industry will need to be well-in-

• **impact resistance**	• **adaptability**
• **durability**	• **sustained loading resistance**
• **abrasion resistance**	• **hygiene**
• **cost limit**	• **bedding retention**
• **availability**	• **ease of repair**
• **slipperiness resistance**	• **ease of fixing**
• **insulation**	• **give under load**
• **flexibility to suit divisions**	• **power washing resistance**

Fig. 2 Performance design criteria checklist for a cow lying area.

Fig. 3 Information gathering and processing are essential features of a large livestock enterprise.

formed, specialised to a degree, with a broad understanding of the problems facing the livestock industry. Innovations will continue to be made, which increase the overall efficiency of livestock enterprises, yet satisfy the demanding requirements of the customer.

Dairy housing

Figures from the National Milk Register indicate that average yields for larger dairy units are higher than for smaller units. For less than 50 cows, the average yield, per year per cow is 6,000 litres. For 100 cows, the average yield per year per cow is 6,700 litres. For 200 cows, the average yield, per year per cow, is 7,200 litres.

The average herd size continues to increase, with farmers continuing to seek faster throughputs at milking, looking at rotary or rapid-exit herringbone parlours for large herds. Robotic milking for smaller herds will increase in popularity as unit costs decrease and this milking system will increasingly be applied to medium and larger herds, as development costs are absorbed by sales.

Skilled labour will demand good, safe working facilities, with increasing sophistication of information gathering and analysis. The average dairy farmer receives over 36,000 pieces of information a year. This must be presented in a way in which it can be readily used to make management decisions.

Acquisitions and mergers will mean fewer, larger processors of milk, with more than 80% of liquid milk sales within the hands of only four retailers. Farm quality assurance documentation will become more focused and refined, as assessors gain training and on site experience. Those milk producers not willing to make a full commitment to upgrade their premises or improve efficiency will come under ever greater pressure to survive in an increasingly competitive market.

Beef and sheep housing

The general economic climate hanging over the beef and sheep sectors remains a concern. Moves towards these sectors operating at world market prices would indicate little improvement, if any, in profitability.

Dirty stock at market and at the abattoir is an increasing concern, and farmers will need to make housing provision which cleans up animals prior to sale. Slats for cattle will raise increasing welfare concerns, and the area of improved comfort on slats, and bedding type and availability, is a complex issue, with no ready solution for areas short of straw. There is an obvious gap between the design criteria applied to solid and slatted floors and the quality of existing floors. The future for solid floors lies in an improved application of existing knowledge at farm level as well as improved design.

Pig and poultry housing

Pig and poultry housing is becoming increasingly specialised, with developments being influenced by a smaller and smaller number of players. Specialised construction companies design and erect the vast majority of buildings, which are tending to become larger, clear-span structures. There are still opportunities for development and innovation, and SAC has recently been involved in three different types of pig housing systems.

The first, in collaboration with Grampian Country Food Group, is an all-in, all-out straw based system for 2200 pigs to 95 kg liveweight. The emphasis has been to develop a building with a maximum of automation, to allow the best use of staff time and maximum care of the pigs. The initial crop of pigs produced

Fig. 4 Large livestock enterprises are housed in clear span structures with good light and ventilation. This one is designed for beef cattle, dairy young stock and pigs.

an average growth rate from 35 kg to 95 kg of 860 g per day. There was, however, a substantial problem with dunging behaviour which was subsequently investigated, and resulted in design changes which cured the problem.

The second structure investigated by SAC is a low-cost shelter for 150 finishing pigs, again based on an all-in, all-out production system. The pigs are deep-bedded on straw, with an outside veranda for the dunging area. SAC is investigating both the health and performance of the pigs, and initial results show growth rates of 845 g per day, 0% lung damage and 1.2% liver damage. Temperature profiles will be presented which show a temperature lift of 5°C over ambient air during a Scottish winter, and further temperature increases at pig level in the deep straw bed. The tent, made of proofed canvas, has a design life of ten years.

Straw based systems are perceived to be animal welfare friendly. However, Professor Gerald Schwarting of the University of Murtinger in Germany is no fan of straw based systems. He is particularly concerned about dust levels in fan ventilated systems where dust tends to remain in aerial suspension rather than in settled form. He suggests that modern pig friendly housing should not only take care of the usual needs of pigs, but focus more on all aspects of their behavioural needs. He believes there is scope for 'more private facilities' a facility for rooting, scratching and for showering in hot weather. He suggests that the time for fundamental changes has arrived and suggests single-site production and all-in, all-out system as being a way forward.

The straw argument is a complex one which goes back to a rigorous performance criteria approach. Impact and comfort of straw beds is a major factor, but so is the quality of the straw itself. Bad straw has been shown by SAC to have 20 times more relevant bacterial spores than good. A design criteria specification for a pen additive may be the way forward, trying to identify a product which has the good components of straw, without the bad.

The third example of SAC involvement concerns one major producer in Scotland looking towards single-site, all-in, all-out farrowing with 500 sows in each building. This will not be straw-based, however, but will use farrowing crates.

The farrowing crate continues to be the most common farrowing system currently used by pig producers in most developed countries and an estimated 75% of all sows in the UK farrow in crates. The majority of the other 25% are housed outdoors. Within the UK, the use of the farrowing crate continues to be criticised by the animal welfare lobby.

If confining the sow in a farrowing crate over the entire lactation is unacceptable in welfare terms, there are a number of alternative farrowing systems which are already in use on commercial farms in some European countries. This is yet another example of customer perception, welfare driven pressures forcing designers to take a true, performance requirement approach.

Ventilation is important in pig and poultry production. Modern electronics allow the development of reliable control systems, provided they are protected, in dust and moisture proof enclosures. These controls not only control ventilation and heating but also record, store and transmit data to the farm office or to central monitoring stations. Properly installed, these systems will provide reliable data. Automatically controlled, natural ventilation (ACNV) systems using curtains are continuing to improve and can provide reliable, draught free ventilation with adequate temperature control and low energy requirements. The use of geotextile curtain material will increase in livestock housing as strong versatile products are developed. Such products will increasingly be used for feed storage containment in hoppers or bags.

Conclusions

The opportunities for engineering involvement in livestock housing continue to be diverse, from 'high-tech' large units, to 'low-tech' solutions for extensive, or smaller enterprises. The ability to define performance requirements and think laterally to solve problems is a vital component in moving the livestock industry forward.

All sectors of the livestock industry are becoming more competitive, demanding and specialised. The industry will continue to require professional, competent assistance in meeting increasingly onerous demands within tight financial restrictions.

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Patent application fees abolished

Small firms and private individuals will benefit most when the United Kingdom Patent Office abolishes the application fee for patents from 1 October 1998. The Office will be the first in the industrialised world not to charge a patent application fee.

Abolition of the filing fee forms part of a 20 per cent cut in Patent Office fees to come into effect on 1 October. Other reductions include a cut in the trade mark application fee from £225 to £200, a cut in trade mark registration renewal from £250 to £200 and cuts in patent renewal fees by an average of 18 per cent.

The cuts will assist entry into the systems of patents, trade marks and registered designs and encourage their use by small firms and private individuals. The greatest savings to be made will be in patent renewals in the earlier years, when companies are frequently still in the phase of product development and have yet to make a return on their investment. Savings to industry will equal £12 million, or 20 per cent of the Patent Office's fee income.

Welcoming the fee reductions, Patent Office Chief Executive Paul Hartnack said, "The reductions in Patent Office fees make a significant contribution to the competitiveness of British industry, particularly among the small firms which are the source of innovation and creativity in Britain.

"The fee reductions have been made possible by the continuous and successful efforts of management and staff to raise the quality of service and reduce unit costs since the Patent Office relocated to Newport, South Wales, in 1991."

Contact: **Michael Binns, Prowse & Co, on 01372 363386**

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Autumn 1998

Weir Shield and Jim Pascal Trophy

Iain MacKinnon, right, from Oatridge College accepts the Jim Pascal Trophy from Geoff Freedman.

Creating a craft award

The Scottish Branch of the Institution of Agricultural Engineers was formed shortly after the Second World War. Initially, it suffered from inadequate funding and secretarial services. In the early 1950s, however, Jim Weir, Agricultural Engineering Officer of the Hydro Electricity Board, was appointed Branch Secretary and through his enthusiasm the Scottish Branch went forward. Jim Weir became Branch Chairman in the early 1970s when he was working for S.S.E.B. (now Scottish Power). In appreciation of all the work Jim Weir had carried out for the Branch, the Weir Shield and Prize were named after him. These awards were presented annually to the best apprentice in the London City and Guild exams for agricultural service engineering, the Prize being awarded to the apprentice and the Shield to the company employing the apprentice.

Owing to changes in training and employment, student candidates are now entered from the land based colleges with courses in service engineering (the best two students in each college) and the winner is invited to represent Scotland in the biannual UK final of the Skills Olympics. The Weir Shield is now awarded to the college at which the winning student was trained and a new award, the Jim Pascal Trophy, is presented to the winning candidate.

The Jim Pascal Trophy has been inaugurated by the Scottish Branch of the Institution to recognise over 30 years of service given to the Scottish agricultural engineering industry by Jim Pascal. Jim worked at the Scottish Institute of Agricultural Engineering, initially as Liaison Officer but later taking on additional roles until closure of the Institute in 1987. He then set up his own successful agricultural engineering consultancy business until he retired in 1997. From 1971 to 1985, Jim was an enthusiastic secretary of the Scottish Branch of the Institution, serving on a number of national committees including being Editor of the Institution journal for some years. He is a past Chairman of the Scottish Branch and represented the Institution on SCOTVEC Advisory Boards for many years. In recent years, Jim worked part time for SCOTVEC and he is regarded as the main architect of modern agricultural engineering service qualifications in Scotland.

The 1998 competition held on 30th May

This year, the following candidates were entered for the competition having been selected as the best two students from each of the land based colleges with courses in workshop skills for the repair and maintenance of agricultural machinery:

from Aberdeen College, Clinterty - John Smith & Iain Weir;
from Barony College, Dumfries - Kevin Blacklock & Gordon Howit;
from Borders College, Duns - James Henderson & Michael Walden;
from Elmwood College, Cupar - Brian Glendinning & Jamie Wood;
from Oatridge College, Uphall - Gavin Freer & Iain Mackinnon.

The candidates were set 5 repair/maintenance tasks, *viz*:

1) inspect a used tractor and report on repairs required;
2) inspect a used forager or baler and report on repairs required;
3) test and repair tractor electrical circuits;
4) repair a hydraulic cylinder seal; and
5) with the aid of a technical drawing, fabricate a box spanner to fit a specified hexagonal nut, using steel strip.

Marking was undertaken by Jim O'Regan (Borders) for task 1, Alan Mowitt (Oatridge) for task 2, David Ritchie (Barony) for task 3, Nigel Ford (Elmwood) for task 4 and Terry Southcote (Aberdeen) for task 5, with Jim Pascal (ret'd) chairing the group.

Awards were declared and given by Geoff Freedman of Forest Enterprise, currently President Elect of the Institution of Agricultural Engineers, and Past Chairman of the Scottish Branch. Winners were as follows:

Jim Pascal Trophy plus £100 plus one year's free membership of the Institution - **Iain MacKinnon** from Oatridge College;

Second Prize of £50 plus one year's

continued overleaf

Full group of participants for the Weir Shield and Jim Pascal Trophy competition.
Front row, lst left - Alan Mowitt, judge of implement servicing, who also accepted the Weir Shield on behalf of Oatridge College; 2nd left - Keith Blacklock, Second Prize winner from Barony College; 3rd left - Iain MacKinnon, Jim Pascal Trophy winner and the Weir Shield for his college, Oatridge; 4th left - Jim Pascal, Chairman of judging panel; 5th left - Geoff Freedman, President Elect; lst right- Jim O'Regan, judge of tractor servicing from Borders College.
Back row, lst left - Dave Ritchie, judge of tractor electrics from Barony College; 3rd left - Iain Weir, third prize winner from Aberdeen College; 2nd right - Nigel Ford, judge of hydraulic cylinder repair from Elmwood College; lst right - Terry Southcote, judge of fabrication from Aberdeen College.
Remaining members of the group were: Jamie Wood, Brian Glendinning (Elmwood); John Smith (Aberdeen); James Henderson, Michael Walden (Borders): Gavin Freer (Oatridge): Gordon Howat (Barony): all being entrants from their particular colleges.

free membership of the Institution - **Kevin Blacklock** from Barony College;

Third Prize of £20 plus one year's free membership of the Institution - **Iain Weir** from Aberdeen College;

The Weir Shield was awarded to Oatridge College, since their candidate had won the competition, and accepted by their staff representative, Alan Mowitt. Each candidate entered in the competition also received a certificate of merit stating they had achieved a level of excellence in the competition.

Finally President Elect Geoff Freedman thanked all the Judging Panel (previously named), Ian Hair, his colleagues Tom Finlay and Jim Clark from the Scottish Agricultural College at Auchincruive, for providing all the comprehensive facilities for the competition, and Ted Kernahan for the overall organisation of the event.

Scantlebury Award for Ben Suffield

The now customary presentation and judging of the BEng Agricultural Engineering final year projects by the Herts & Essex Branch of the IAgrE took place on Wednesday 29th April, at Writtle College. Although the group of students was somewhat smaller than usual, there was still a wide and interesting variety of topics on display.

Notable projects completed this year included: the study of the respiration and ventilation of potatoes in storage by measuring the levels of carbon dioxide; an experiment to determine whether the ultimate strength of concrete is affected by cement storage conditions; a study into designing a set of hammers for a (Richard Western) green waste shredder; and a detailed study into ventilation of non-purpose built calf houses.

Small teams of judges met the students, asking searching questions and prying into the most minute of details. It was evident that many of the students found their presentations quite an ordeal to start with, but as the evening wore on, they seemed to become more at ease. It was certainly good practice for their communication skills.

After two hours or so, the judges gathered in a separate room with the aim of (not only eating a few plates of sandwiches, but also) agreeing which project should be the overall winner. It did not take long to decide upon the best project of 1998, which was an investigation into alternative materials for small scale water filtration, written by **Ben Suffield**. These materials had to be suitable for the developing world, and comparisons were made between sand and polyester fibre. Ben received a silver salver and a tankard for all his efforts.

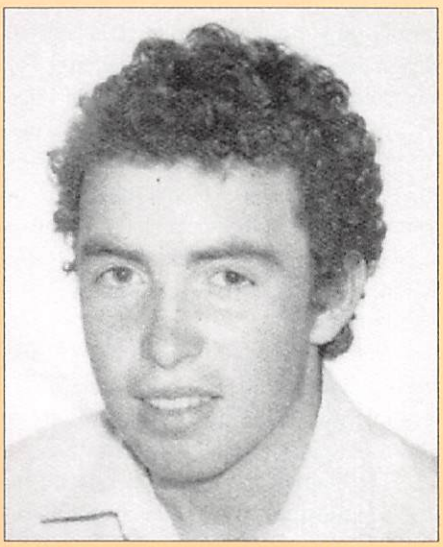
A 'Highly Commended' prize was awarded to **Rebecca Deacon** for her study into spray nozzle wear, applicable in particular to potato application systems. She conducted experiments into the wear rate of nozzles, measuring flow rate over a period of 150 hours. Rebecca received a certificate for her endeavours.

The prizes were presented by Jean Scantlebury, wife of the late Brian Scantlebury, a stalwart supporter of the Herts and Essex Branch. The silver salver had been kindly purchased by the family, and will be awarded each year in memory of Brian and so will become known as the "Scantlebury Award". This would be a very fitting tribute indeed.

All the students were thanked for their hard work in preparing for the evening, and although there could be only two prizewinners, they had all made positive contributions and could feel justifiably proud of themselves. It was gratifying to see a member of the agricultural engineering press taking an interest in the engineers of tomorrow.

Richard W Langley

Thomas Hennessey harvests the Johnson New Holland Award



Thomas Hennessey has been awarded the Johnson New Holland Trophy Award in 1997 for his work on a combine harvester cleaning system.

The Award is presented annually, with the object of encouraging and recognising innovation by younger students, to the best final year project submitted by a student or group of students, as part of a first Degree, Higher National Diploma or Higher National Certificate course in Agricultural Engineering. In addition to the student prize, the college submitting the prize-winning project receives the trophy to hold for one year. This year, the presentation was made by Mr Hedley Cooper of New Holland UK Ltd, the kind sponsors of the Johnson New Holland Award

The winner comes from Ireland where he progressed for school to Tralee Regional Technical College. From there, he moved to a BEng course at Silsoe College, emerging with a 2.1 honours degree in 1997. It was during this course that he undertook the project which has received wide acclaim.

Manufacturers of combines are continuously trying to increase the efficiency of the harvesting operation, where efficiency may be defined as the area of crop harvested at a given grain loss for a required quantity of energy. Thus, in terms of combine harvester adjustments, the widest possible concave clearance and slowest drum speeds are used to just thresh the crop adequately. Fuel consumption is reduced and the quality of the straw improved by this approach.

Crop feedrate is the greatest variable that affects efficiency. The operator has a major influence on the feedrate. Firstly, the full table width should be used to allow even feeding of the crop to the drum. The forward speed can then be adjusted, so that grain loss from the straw walkers and the sieves is at an optimum value. Whilst this works well in good conditions with low moisture contents, a standing even crop and level fields, combining efficiency is greatly reduced on sloping ground. Steep gradients affect the cleaning shoe's performance, increasing grain loss and providing a poor quality sample.

In the project, the problem of grain loss on gradients was investigated by varying the cleaning fan speed. A change in fan speed was used to compensate for longitudinal slope changes to the cleaning sieves. The research and test work was carried out on a Laverda cleaning shoe, which was taken from a commercial combine and modified for the testing procedures. An electronic control system was designed to automatically vary the fan speed in response to slope changes. Previously to this, the shoe had a mechanically variable fan speed. The control system was tested for longitudinally sloping terrain, (both up-hill and down-hill). A further method was then proposed to compensate for slopes, that is, a three-dimensional self-levelling sieve. Finally an expanded control system was outlined, using a microprocessor to control most operator functions except steering. Further testing and development was proposed, especially field tests on a harvester, to establish the full possibilities of such a control system.

The project has also attracted interest for other quarters, as Thomas has been awarded the IMechE prize for the best project and the SKF Trophy for the best final year student of engineering design.

A career for all seasons

Harper Adams, A University Sector College, have produced an excellent careers brochure on *Engineering a Sustainable Future.* They are sending copies to a large number of schools to promote not only their own courses in Agricultural Engineering but also to publicise the work of the Agricultural Engineering profession. "We are in danger of losing the educational base for the industry and for the Institution if we do not get more young people interested in working with us", said Geoff Wakeham, Senior Lecturer in Agricultural Engineering.

The total number of engineers graduating from Harper Adams has steadily increased over the years but the overall pool of interest has stayed the same at some 120-150 serious enquiries per year which convert into some 80 graduates/diplomates per year. This is hardly enough to support one educational institutions let alone seven who claim to run Higher National Diplomas or Degrees in agricultural engineering and related areas and less than the natural wastage from the industry of Incorporated or Chartered level engineers. "We will be happy to forward copies of the leaflet to any Personnel/Training Manager who might be able to make use of it", he added.

Contact: **Harper Adams Agric. College, Newport, Shropshire TF10 8NB. Tel: 01952 820280**

Membership movements

Mem No	Name	From	To
5258	P W Ashenden	Buckinghamshire	Hertfordshire
4787	R H Berry	Tanzania	Gloucestershire
4172	M A Bird	Berkshire	Gloucestershire
6209	J C Booty	Cambridgeshire	Lincolnshire
0372	E D Coles	Indonesia	South Africa
6639	M B Douthwaite	Philippines	Berkshire
5515	G N Foster	Cambodia	Cheshire
6666	M R Hemsted	Tyne & Wear	Kenya
4497	K Hopkins	Zambia	South Africa
5677	B A Kendall	Somerset	Bedfordshire
3207	A J Landers	Wiltshire	USA
5264	I Livingstone	Lancashire	Scotland
6572	R B Low	Surrey	USA
6522	E Lusambo	Tyne & Wear	Zambia
5857	G V Marks	Oxfordshire	Middlesex
3890	C Meek	Malaysia	Philippines
6658	P D Mitchell-Rogers	Shropshire	Norfolk
5962	A W Moore	Nottingham	Western Australia
3866	S P Pearson	Nigeria	India
2683	M J Percy	Pakistan	Canada
5121	T Reeves	Staffordshire	Warwickshire
5912	R J Richardson	Scotland	Leicestershire
6528	K R Scrivens	Gloucestershire	Worcestershire
6625	M Shamsi	Bedfordshire	Iran
5472	J N Short	Yorkshire	Kent
6594	E J Siecker	Bedfordshire	Suffolk
5127	P R Smith	Shropshire	Germany
4769	R W Taylor	Bedfordshire	Warwickshire
4755	S J Temple	Malawi	Norfolk
6171	D M E Thompson	Devon	Staffordshire
6009	A E Turner	Argyll	Lincoln
1676	J Tyblewski	Northamptonshire	Lincolnshire
5513	P J Williams	Cambridge	Cardiff

Gone away

Name	Last known address
John Anthony Earley	Morley Cottage, Westonbirt, Tetbury, Gloucestershire
Richard Henry Garnett	39 Scotch Firs, Fownhope, Hereford HR1 4NP
Peter David Rowland	Mufindi Tea Co Ltd, PO Box 70192, Dar es Salaam, Tanzania

Behind the scenes at HRI

A combined visit on the 3rd of March by members of the Horticultural Engineering Group and the Institute of Electrical Engineers provided a new challenge for the staff at HRI Wellesbourne. For once it was not the significant research work that they undertake on horticultural crops that was the subject of the all-day visit, but rather the engineering and control systems that maintain the strict environmental regimes in the glasshouses and laboratories.

Any visitor would be surprised to see how extensive these systems are and the complexity of the equipment housed in the roof space above the laboratories.

The heart of the whole operation was the monitoring of virtually all the individual regimes by a centralised computer system which gives instant warning on site of a fault, or by a 'phone-up' system off site. Such an extensive control system is not without its problems – not least for the engineers, who are currently reviewing its close on 1000 microprocessors in readiness for the millennium. A highlight for some was the visit to the engineering workshops where special pieces of equipment are custom built for the researchers and many ingenious ideas are born.

This highly successful visit was of equal interest to both disciplines, largely due to the enthusiasm of the members HRI Engineering staff who, as hosts, earned the gratitude of the total of the 30 members attending.

Geoff Lawson

Horticultural Engineering Specialist Group Autumn Event

Title: Advanced engineering for protected crop production and handling incorporating the application of combined heat and power.
Venue: Van Heyningen Bros. Ltd., Littlehampton, W. Sussex.
Date/Time: Thursday 26 November 1998, all day meeting starting at 10.30h.
Contact: **John Weir tel: 0181 788 0062**

Inspecting the new £ multi-million, state-of-the-art glasshouse unit.

Institution membership changes

Admissions – a warm welcome to the following new members:

Fellow
J V Stafford (Bedfordshire)

Member
J H O Cull (Hampshire)

Associate Member
N D Barwick (Yorkshire)
J E Fox (Kenya)
M R Ireland (South Yorkshire)
P A James (Oxfordshire)
P B Lynham (Mid Glamorgan)
M McKee (Staffordshire)
G T Queen (Argyll)
N A Robinson (Wiltshire)
M J Thakoordin (Guyana)
D G Wedd (Kenya)
M E Worth (Bedfordshire)

Associate
M H Ayagi (London)
J Cale (Oxfordshire)
S Caley (Lancashire)
M Dunn (Lancashire)
S I McTavish (France)
S D Methven (Hereford)
M A Mushref (Saudi Arabia)
G K Musyoka (Kenya)
D G Thurgarland (Staffordshire)

Student
S H M Aikins (Bedfordshire)
A N M Bolton (Northern Ireland)
A D Brawn (Buckinghamshire)
V W J Brown (Northern Ireland)
D Bunting (Cumbria)
A M Campbell (Scotland)
I H J Cromie (Northern Ireland)
B P Days (Worcestershire)
J Dineen (Surrey)
K J Eatough (Wales)
S W Fletcher (Cambridgeshire)
M Forsyth (Scotland)
M E Hinton (Suffolk)
R T Ingram (Essex)
B J Jackson (Ireland)
P J E Jones (Merseyside)
T C Kindred (Essex)
M R Kitson (Cleveland)
D Pettigrew (Scotland)
G S Rogers (Lancashire)
D Sayer (North Yorkshire)
S G S Steger-Lewis (Hampshire)
P Talling (Devon)
B Tomkinson (Shropshire)
V Tsakiris (Essex)
J Wange (Bedfordshire)

Readmission
J M Boardman (Lancashire)
A C Mwitwa (Zambia)
J A H Williams (Gloucestershire)
W A S Wyllie (Argyll)

Reinstatement
A Engoru-Ebinu (Canada)
H N Lalsa (USA)
A I Olorunfemi (Nigeria)

Transfers – congratulations on achieving a further phase of your professional development:

Hon Fellow
J B Finney (Bedfordshire)

Fellow
P C H Miller (Bedfordshire)
D H Sutton (Bedfordshire)

Member
N D Barwick (East Yorkshire)
R V Bhusia (Guyana)
M B Douthwaite (Berkshire)
P W Jones (Staffordshire)
L U Opara (USA)
A J Scarlett (Bedfordshire)
J C Timmons (Ireland)
P N Wheeler (Hertfordshire)

Associate Member
J J Dale (Herefordshire)
K A Doyle (Ireland)
N Hammond (Tyne & Wear)
M R Hemsted (Kenya)
G K Moller (Argyll)
M Shamsi (Iran)
E J Siecker (Suffolk)

Deaths – with great sadness, we record the deaths of:
T S Bowett (Norfolk)
N Smith (USA)

Engineering Council
Registrations
CEng
M B Douthwaite (Berkshire)
P N Wheeler (Hertfordshire)

IEng
D R McCullough (Northern Ireland)

EngTech
N Hammond (Australia)
P A James (Oxfordshire)

European Engineer (Eur Ing)
D K Morris (Northern Ireland)

Engineering, high profile

When I joined the Engineering Council as its Director General three years ago, the profession was in the throes of unification. This was the culmination of prolonged debate and discussion within the profession about its future direction. At that time, there seemed as many doubts about the future as there were aspirations for it.

I am pleased to say, however, that we have seen the doubters confounded and the Council and Institutions working most effectively together - fighting the corner for engineers and engineering with growing confidence and with no little success. With my departure from the Council now in place and a new era approaching, it is perhaps an appropriate time to review the effectiveness of what became known as the 'new relationship'.

To my mind, it has been an extremely effective and successful period. What has resulted from the partnership between the Council and the Institutions is a single powerful voice that has earned credibility for the profession and commanded the respect and attention of the key audiences we have targeted.

Although we can take satisfaction from what has been achieved, there is no room for complacency. The Council is fully conscious of this and in a forward-looking move to maintain its momentum is developing a major strategy for its operations. In the short term, we are looking to the year 2005 but are also creating a vision for the year 2020 and beyond. It is not the Council's vision alone, of course, but a shared vision formulated from the contributions of many eminent figures from within the profession, operating through the Strategy Working Group.

I believe that there have been many significant achievements during the past 2-3 years, in addition to unification itself. The imaginative '20/20 Vision' programme, for example, brought a profession wide focus to four key areas - telecommunications, energy, transport and the environment - in which engineers have a major contribution to make. The conclusions have generated much interest and been very well received, including by Government, and we can only hope that they will have an influence on the national policy making processes over the next twenty years.

It is by routinely expressing an authoritative view on such national issues that the Council has been able to achieve a higher profile and establish much stronger links with Government, Parliament and Whitehall. The signing of the Memorandum of Understanding between the Government and the Council in March 1997 is a tangible sign of the progress we have made.

The greatly improved relationship we now enjoy has opened doors to the most senior levels of Government and resulted in recent meetings with Tony Blair, Gordon Brown, John Prescott, Margaret Beckett and John Battle among others.

The election of seven professional engineer MPs, allied to the support of others with an interest in the engineering industry, means that engineering now has a significant and vibrant presence in the House of Commons. We have established a successful mechanism for briefing 'the seven' and I am confident that this relationship will prove to be very beneficial to the profession's influence on national affairs.

A key role for the Council since unification has been continuing to ensure that UK engineers remain world-class. Setting proper standards of education, training and professional development is clearly fundamental to this responsibility. The major revision of standards was a process almost as long and involved as unification itself, so publication last year of the new Standards and Routes to Registration (SARTOR) was indeed a landmark and a considerable achievement for the new Council. I am only too aware that there is still a major task in hand to help Institutions implement SARTOR successfully. This is particularly important in higher education, where new standards are already taking effect and will start to be policed from September next year.

A major challenge, and one for which there is no quick fix, is the long-term mission of 'selling' to the general public the role of engineers and the contribution of engineering to wealth creation. We also recognise the need to address employers new proposals to promote the Register to them are being considered by the Council.

The national dimension in promoting the profession is vital, but no less essential are the many activities and initiatives that operate regionally. The radical overhaul of the profession throughout England, Wales, Scotland and Northern Ireland has seen the establishment of the 15 Professional Engineering Institutions (PEIs). If ever there was a demonstration of the effectiveness of Institutions working together for the good of the profession it can be seen in the fast developing joint ventures that are now becoming established. The PEI network's contribution to schools is also due to be developed through a Schools' Institution Working Group that is currently being formed.

If we are to attract the best-qualified and most talented youngsters into engineering in order to maintain a world class, technologically advanced workforce, then the profession must be positive about its achievements. We need to be bold in portraying what we know to be the excitement, challenge and creativity of engineering. That is why the Council has committed itself to playing a key role in a National Marketing Campaign that we hope and believe will change the national culture towards engineering. We have appointed the country's leading advertising agency, J. Walter Thompson, to carry the project forward.

Our existing partners in the enterprise are the Engineering Employers' Federation (EEF) and the Engineering and Marine Training Authority (EMTA). We have also received significant Government support. However, we believe that making a real dent in the public consciousness will require the commitment of the whole of the engineering community and I would urge the profession to throw its weight behind the campaign.

This initiative will, of course, be compatible with the aims of Quinco - the company set up to manage the follow-on campaign to the Year of Engineering Success (YES). We see it as essential that our own marketing campaign is a full part of the Quinco initiative and that both are sustained over a number of years.

With the backing of Institutions, I see the Council working more closely than ever with the wider engineering community. If we continue to be outward looking and to draw on the knowledge and wisdom available from within the whole profession, I feel sure that we can gain engineering the recognition its deserves and make it one of the most popular career choices for the brightest and best.

I have greatly enjoyed my stewardship of the Engineering Council and consider it a privilege to have held the position of Director General. I believe that through the skill and hard work of the Council's dedicated staff and the imagination and foresight of its Honorary Officers, I have been fortunate enough to preside over many achievements during my time there. I am confident that the work that has been done over the past three years will herald the dawn of a golden age for the profession in the new Millennium.

Mike Heath,
formerly Director General,
Engineering Council

Top US honour for Engineering Council chairman

Engineering Council Senate chairman Alan Rudge received a top honour from the United States engineering profession. The Institution of Electrical and Electronic Engineers (IEEE) - the world's largest technical professional society - presented Dr Rudge with its 1998 Founders Medal in recognition of "distinguished leadership in the field of telecommunications and for advancement of the electrical and electronic engineering profession." He is the first UK engineer to be honoured in the 47 year history of the award and was presented with the medal on 27 June at a ceremony in Detroit.

Alan Rudge, who has been chairman of the Senate, the Council's governing body, since 1996, is also chairman of the Engineering and Physical Sciences Research Council and a former president of the Institution of Electrical Engineers. He is chairman of both W S Atkins and ERA Technology and was deputy chief executive of BT until his retirement last October.

Long service certificates

50 years

Name	*Title*	*Date of Anniversary*
Arthur John Muldowney	FIAgrE	14 Jun 1998

25 years

Peter Edwards	IEng MIAgrE	6 Jul 1998
Koa Yit Wan	IEng MIAgrE	6 Jul 1998
William Richard Walton	EngTech MIAgrE	13 Jul 1998
Alan David Wilcher	IEng MIAgrE	17 Jul 1998
Philip Alan Chapman	AMIAgrE	9 Aug 1998

"Fatal Traction"

The Health and Safety Executive (HSE) is to target the largest single killer on Welsh farms during the past 12 months with a Workplace Safety Transport campaign in agriculture which was launched at the Royal Welsh Show in Builth Wells. Speaking at the show, David Mattey, HSE's Chief Agricultural Inspector, said: "During the last 11 years, the largest single cause of agricultural fatal accidents in the UK has been what we classify as 'being struck by a vehicle.' This includes tractors and all types of mechanical handlers, lorries, harvesters, *etc.* Four of the five farm deaths in Wales in 1997-1998 involved transport and, since 1991, a total of 22 people have been killed in the Principality in accidents involving moving farm vehicles.

"Seventeen of those accidents involved tractors, the other two were All Terrain Vehicles and three involved four wheel drive vehicles. During the same six year period the total number of fatalities in Wales was 53 almost half of which were caused by farm vehicle movements. Two thirds of the people killed were aged 50 or over."

Mr Mattey launched a video and a free new leaflet, both called 'Fatal Traction'. Each gives guidance and advice on simple control measures which can help reduce the risks with transport on farms.

Commented Mr Mattey: "Increased mechanisation and reduced labour resources have led to larger and sometimes faster agricultural machinery being produced to increase efficiencies in modern farming practices. It has been easier for farms to change and improve machinery but generally the buildings are not changed as often. This can lead to some very large machines trying to negotiate down narrow passages between buildings."

"Drivers and operators need to be aware of the differences between machines and of control layouts and functions before setting off. Training for new users is essential. Employers also need to look at their workplaces and consider what improvements need to be made to ensure that modem farm machinery can pass safely into and around buildings. The solutions can be as simple as fixing up a mirror or ensuring farm traffic travels around buildings in a certain direction."

He added: "The video is aimed primarily at the student audience and features graphic reconstructions with interviews of accident victims' families. It stresses the importance of assessing the risk from vehicle movements on the farm and ensuring safe systems of work are put into place to reduce these risks.

"The leaflet, which is available in the Welsh language, follows a series of case studies and looks at preventative measures which could have been taken to help prevent the accidents. Copies of both the video and the leaflet are being supplied free to agricultural colleges.

"The video follows on from HSE's Tractor Action campaign which was launched in 1995 and brings in other self propelled machines used on farms."

News of Members

About 3 years ago, **Adrian Baker** joined Blaw Knox in the UK as Engineering Manager. Subsequently, this company was taken over by Ingersol Rand and about a year ago production was moved to the USA and Germany. At this stage, Adrian moved to the USA to assume responsibility for Electrics, Electronics, Hydraulics and Technology on the line of Asphalt Pavers. He has recently been promoted to Manager of Product Engineering. Blaw Knox is a $130M company manufacturing Ashalt Pavers and material transfer vehicles. They are part of the Ingersol Rand Construction and Mining Group, have nearly 60% of the USA market and export products all over the world. Adrian is now living in the rural mid west, 200 miles south of Chicago and right in the grain belt, where the area is very flat. He says that the people are hospitable and have made him feel welcome. He is learning the rules of American sport but is still baffled by baseball. Adrian says that if anyone is passing through the area they would be welcome to call in.

Mohsen Shamsi has returned to Kerman University in Iran after completing his PhD at Silsoe. He was sponsored by Kerman University for research on the Design and Development of a date harvesting machine. He is now a lecturer and researcher in the Department of Agricultural Machinery which has 80 undergraduate students. Kerman is an ancient city (5000 BC) and the University covers 400 hectares where 12,500 students are studying Agriculture, Engineering, Science, Medicine, Culture and Economics up to PhD level. At present Mohsen is trying to find a sponsor to test and develop the date harvester (which was built at Silsoe) under commercial conditions and he is also completing the design of a small rotary mower to harvest alfalfa.

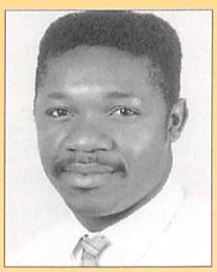
Dr **Linus Umetz Opara** has been recently registered as a Chartered Engineer by the Engineering Council. He is also a life member of the Asian Association for Agricultural Engineering.

Currently he is a lecturer in Postharvest Engineering at Massey University, Palmerston North, New Zealand, and the Coordinator of the Bioproducts Quality Research, which includes postharvest processing, preservation and packaging in the Institute of Technology and Engineering. He is also the Coordinator of the Personal Programme Option of the Bachelor of Applied Science Degree in the College of Science.

Prior to moving to New Zealand in 1990 from Nigeria, his area of specialisation was in Agricultural Mechanisation, having received his BEng (First Class Hons.) and Meng from the University of Nigeria, Nsukka. In 1989, he co-authored the "Agricultural Mechanisation Study" report which was commissioned by the Federal Governmental of Nigeria as part of the 1989-2004 Agricultural Development Plan.

His current interests are in research, teaching and consultancy in postharvest engineering and quality of food and other biological products. He has international consultancy experience in China, the Kingdom of Tonga, Mali, Nigeria and New Zealand.

He would like to mention that Professor Cliff Studman (FIAgrE) introduced him to the Institution, first by asking (nicely!)



him to comment on manuscripts for the Journal of Agricultural Engineering Research and later by recommending the Institution as worthy of membership. Contact details: E-mail: L.U.OPara@massey.ac.nz Fax: +64 6 350 5640

Alan Moore is in Australia, as an unpaid guest, while his wife is taking part in a teaching exchange programme. He hopes to return to work with the Northamptonshire Police again in February 1999.

After graduating in December 1997 with a PhD in Agricultural Engineering from the University of Newcastle upon Tyne, **Edward Lusambo** moved to Zambia. He is now a lecturer in Farm Buildings in the Department of Agricultural Engineering at the University of Zambia.

After more years than he says he cares to remember, working in and latterly heading up the Machinery Department at Rodbaston College in Staffordshire, **Denis Cartmel** has opted to change career direction. He says that he will still be involved in training but on a freelance basis – part-time teaching and Lantra (nee ATB Landbase) work. In addition, he will also be looking to exploit other interesting sources of income such as expert witness work, writing and mechanisation management consultancy.

Basile Kotschoubey has spent a year as Technical Manager for Cargill Corn Milling in Russia. Cargill acquired a Soviet built factory in Tula Oblast which, while needing and undergoing a total transformation, had to be kept running. In a continuous process, this is rather daunting from a technical and managerial point of view at the best of times, but in the conditions of Tula Oblast, it was a real challenge. It had the reputation of being the toughest Cargill project worldwide, but was in fact very interesting. In May this year, Basile has moved to a new job as Programme Officer for agriculture in Kiev. The job, financed by the European Commission, involves following up agricultural projects in the Ukraine by acting as a co-ordinator between the Delegation, international consultants and local beneficiaries – ministries, farmer's associations and farms. Basile says that he is pleased with his new job, and although it is much less hands on, it brings him closer to agriculture and especially gives a good insight into the country's agricultural situation. The previous job was really in industry rather than agriculture and also life in Kiev is more civil and sociable than in the middle of Tula Oblast.

Many thanks to **Oliver Statham** for the photograph of the Southern Branch AGM and dinner.

Tony Chestney

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Tillage - soil, plant and implement considerations

Richard Earl

The aim of this paper is to provide an overview of soil, plant and implement considerations for optimising tillage operations. The paper focuses on:-

- tilth criteria for minimising risk of poor crop establishment and subsequent development for a range of common situations,
- basic principles of soil mechanics pertinent to the use of tillage tools/implements, and
- factors to consider to maximise the chances of achieving a desired tillage outcome following a cultivation operation.

Tillage can be defined as the use of implements to manipulate soil structure. Tillage operations in the field fall into two broad categories:-

- *operations within the top soil*, for example, primary cultivations, secondary cultivations and seedbed preparations;
- *operations within the subsoil*, for example, amelioration of structural damage (deep loosening) and enhancement of drainage and aeration status (subsoiling and mole drainage).

1. Tillage operations within the topsoil - seedbed requirements

Attributes required of a seedbed to encourage optimal germination, establishment and subsequent crop development are often a compromise depending on the situation encountered in the field and implications for tillage are discussed below

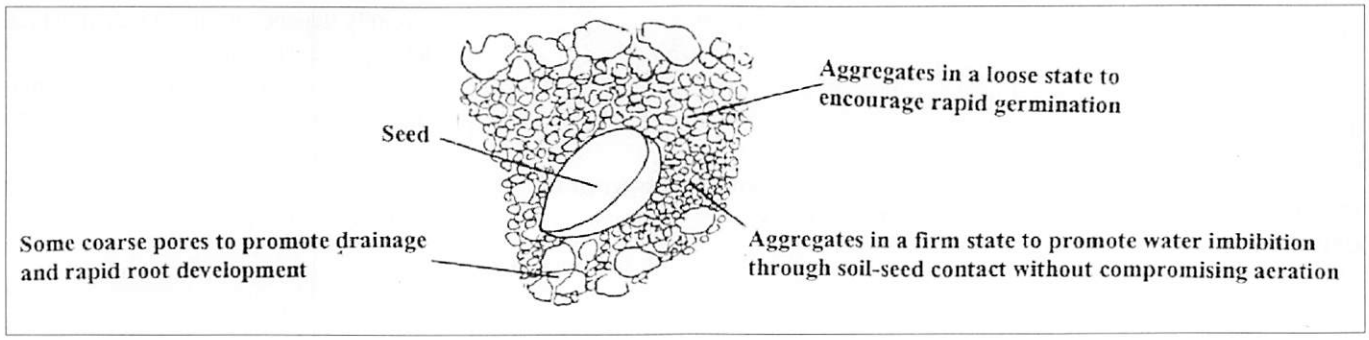

Fig. 1 Diagram of ideal tilth to promote rapid germination.

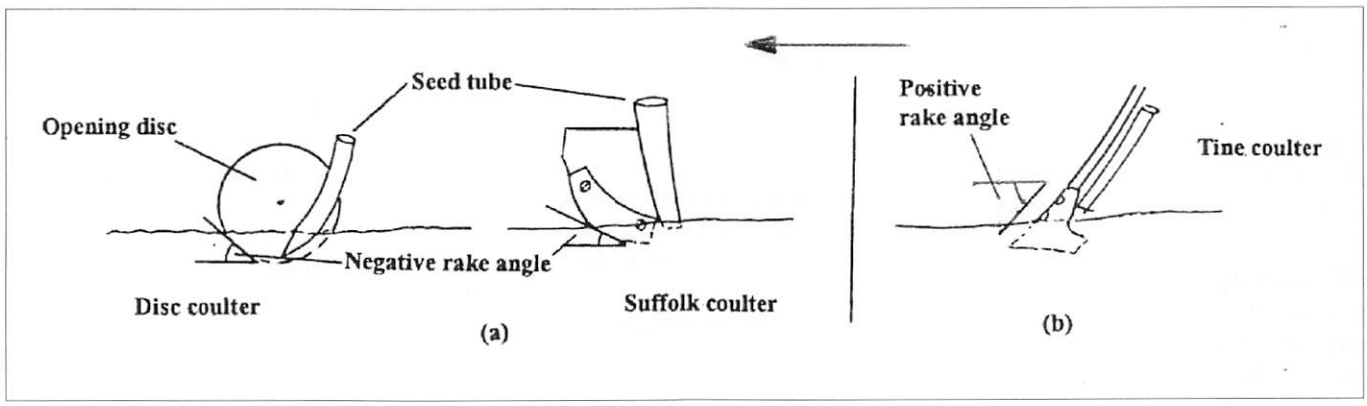

Fig. 2 Examples of seed coulters with (a) negative, and (b) positive rake angles.

Rapid germination

To promote rapid germination, adequate aeration and water availability is essential. Tillage is required which will produce a fine tilth to encourage water imbibition through capillary action, but with sufficient air-filled porosity to maintain adequate aeration. A diagram of an ideal situation is presented in *Figure 1*.

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The optimal size and packing state of aggregates will depend on the size of the seed, however, fine, firmed aggregates are required to the side and below the seed to encourage water movement, with looser packing above the seed to promote rapid emergence.

Drainage status and root development

Prolonged waterlogging immediately after seeding can be very detrimental to crop health. Past work (Cannell *et al.*, 1980) has shown that for cereals, long term effects occur after nine days of waterlogging, with crop death after fourteen. In wet conditions, it is essential that there is an adequate distribution of coarse aggregates, and hence pores, within the tilth directly below and to the side of the seed to promote free drainage and rapid root development.

A common cause of poor drainage in the vicinity of the seed is local smearing through the use of inappropriate seed coulters. In moist clayey soils, the use of coulters with backward inclined (negative) rake angles *(Figure 2)* increases the likelihood of smear.

Minimum impedance to emergence

The main tilth factor governing shoot elongation and emergence is soil strength immediately above the seed. According to Spoor (1984), aggregate size, within reason, is of secondary importance compared to packing state which also influences gas diffusion to depth. For fine aggregates, a loose condition above the seed is desirable, however, if coarser material is present, this provides greater opportunity for unimpeded emergence.

Minimising risk of capping

Certain less stable soils exhibit an increased risk of structural collapse at the surface which can culminate in the formation of a tough layer of soil (cap). Drilling techniques such as "hill dropping" (placing more than one seed at a given location to increase the pushing force on the soil cap) can have some effect, however, past work (Spoor, 1978) has shown that coarser surface tilths provide greater resistance to capping than finer tilths.

Minimising risk of erosion

Water, and wind, erosion can result in soil loss and deposition in certain situations *e.g.* on sloping land, fine sandy/silty soil, exposed areas. The mechanisms of erosion rely on wind or water transportation of fine detached particles. Soils are particularly at risk following cultivation prior to crop establishment. Generally, a tilth comprising an appropriate distribution of coarse aggregates will reduce risk of erosion, although, in extreme situations, other conservation tillage measures may be appropriate (Morgan, 1995).

Minimising frost effects

Severe cold weather can affect crop establishment, particularly if harsh early frosts occur (Earl *et al.*, 1994). Damage to seedling roots can occur as water in the surface layer expands on freezing, causing frost heave *(Figure 3)*.

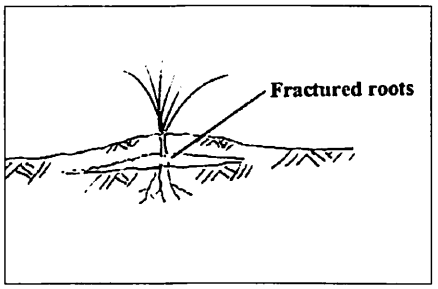


Fig. 3 Schematic diagram of frost heave.

A coarse, loose tilth will resist frost heave by enhancing surface drainage and the movement of warm air from within the profile to the surface, and reducing soil-induced stresses on the seedling.

Large quantities of surface trash may exacerbate the effect of early frosts on seedling viability by thermally insulating warmer soil air from the exposed foliage.

Minimising drought risk at depth

Lack of water in the early stages of crop establishment can undermine the long term health of a crop particularly in freely draining coarse-textured soils with low water holding capacities. In these cases, a fine tilth at the surface may reduce the rate of soil drying at depth (Spoor, 1984).

Efficient seed drill performance

There are a number of criteria (listed below) which must be met during any seeding operation to encourage optimum crop establishment:

- adequate depth control of seeding coulter,
- correct spacing/population of seed within seed slot,
- efficient closure of seed slot,
- sufficient soil/seed contact to encourage water imbibition,
- minimal incorporation of surface trash within the seed slot.

In order to optimise seed drill performance by meeting the criteria above, a smooth surface of fine tilth, free of wheelings and undulations, with minimal surface trash is required prior to seeding. This is of particular importance for precision seeding operations (seeds spaced out uniformly along the seed slot e.g. sugar beet and maize).

Herbicide efficacy

Some soil-acting herbicides provide greater crop protection when applied to a fine tilth (Spoor, 1984).

Manipulation of soil within the topsoil

The outcome of any tillage operation is strongly dependent on the way in which an implement applies load to the soil, and conditions (confining stresses) surrounding the soil under load. In order to achieve any desired tilth criteria, it is necessary to develop a fundamental understanding of soil behaviour under load.

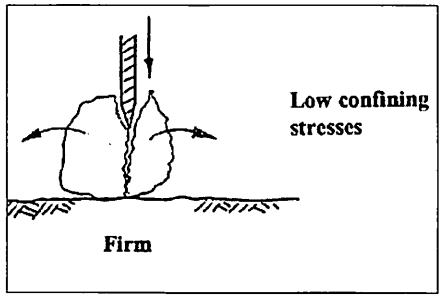


Fig. 4 Brittle soil deformation.

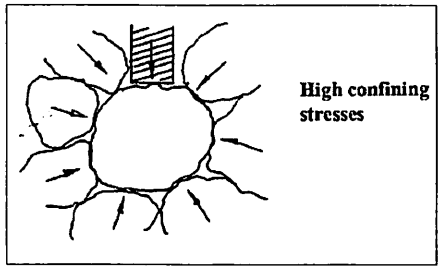


Fig. 5 Compressive soil deformation

2. Soil behaviour under load

It is widely recognised that there are two main categories of soil deformation (Spoor and Godwin, 1979):

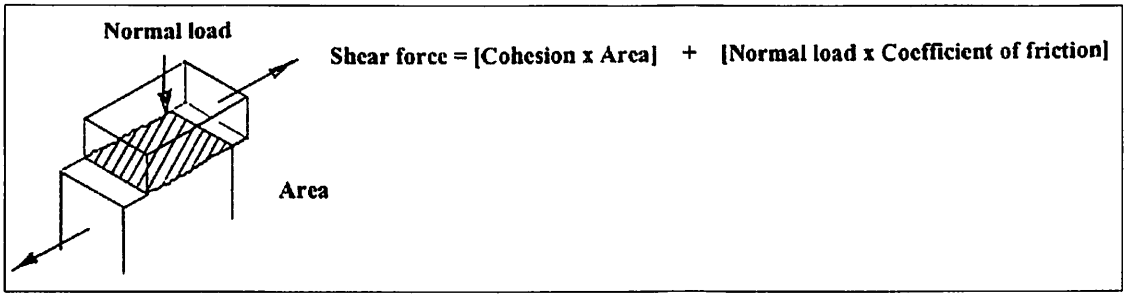


Fig. 6 Relationship between force required to shear soil and other soil mechanical properties.

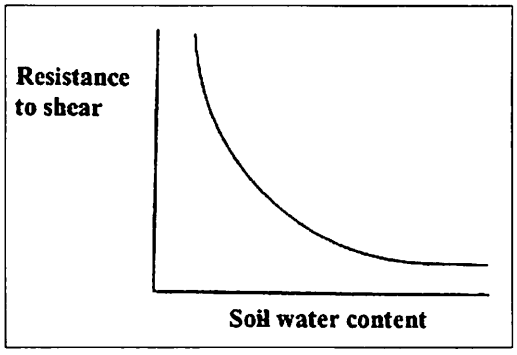


Fig. 7 Typical relationship between resistance to shear and water content for a clay clod.

- brittle soil failure,
- compressive soil failure.

Brittle soil deformation is characterised by the development of a few planes of weakness through contact with a tillage implement culminating in an increase in soil bulk volume and a reduction in bulk density *(Figure 4)*.

Compressive (plastic) soil deformation occurs under conditions of high confining stress. Loading causes the development of many interacting failure planes resulting in a decrease in soil volume and an increase in bulk density *(Figure 5)*.

The resistance of soil to deformation is very dependent on soil type, moisture status, applied load and confining stresses prevalent during loading (Earl, 1997). Soil under increasing load will always deform where resistance to deformation is at a minimum. To achieve any desired tillage outcome, it is therefore necessary to arrange for that outcome to coincide with minimal resistance by adjusting the loading force and confining stress to encourage appropriate modes of failure to occur (Spoor, 1984).

The effect of load, size of clod, cohesion and friction on soil strength during shear is summarised in *Figure 6*.

The resistance of soil, in a given condition, to deformation is dependent on a combination of:

- cohesion acting over a given area of shear, and
- friction, which is strongly affected by the load applied at 90^{o} to the area of shear (Coulomb, 1776).

If the water content of a particular soil is increased, then the resistance to shear reduces *(Figure 7)*.

Cultivation operations

A comprehensive review of the principles of tillage tool design is provided by Spoor (1969a,b). According to Spoor (1984), any tillage operation can be classified under five broad categories:

- loosening,
- clod size reduction,
- clod sorting,
- compaction, and
- surface levelling.

To achieve these outcomes using implements requires the selection of appropriate tillage tools to meet the following soil mechanical considerations.

Loosening

Loosening is usually carried out using forward inclined tines to encourage brittle failure *(Figure 8)*.

The lifting and shattering action of these tines loosens compacted land with minimum draught and risk of smear in moist clayey soils, however, care must be taken to control depth of operation and to limit the production of large, unmanageable clods *(Figure 8a)*. The size of clods produced can be controlled by working the land progressively deeper either using multiple passes of the same tool, or by using tines of differing lengths (shallow at the front, deep at the rear, *Figure 8b*).

Clod size reduction

This is often necessary following soil loosening operations, which typically leave a tilth comprising large clods which are of greater strength than the bulk strength of the soil. Given this situation, there are three main mechanisms by which the size of clods can be reduced:

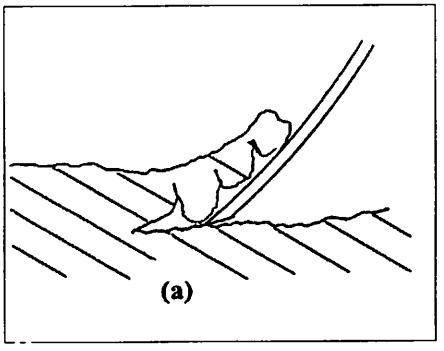
(a) direct loading,

(b) impact, and

(c) cutting.

(a) Direct loading

Direct loading encourages brittle failure to occur, however, for this to be achieved, it is necessary to apply load such that minimal confining stress is encountered *(Figure 9)*. Generally, greater loads can be applied vertically using the general soil mass to push against, than laterally which



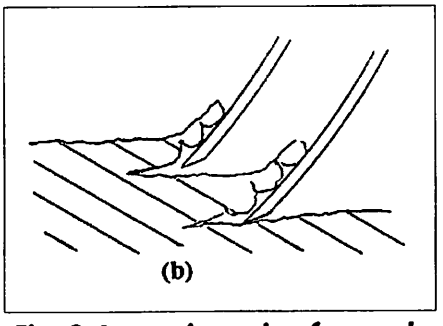


Fig. 8 Loosening using forward inclined tines (a) at a uniform depth, and (b) set to work progressively deeper.

is more likely to effect a stirring operation (Spoor, 1984). Narrow tines are inappropriate for this operation as clods will have a tendency to move sideways under load. Wide, backward-inclined, implements are most effective e.g. ring rolls,

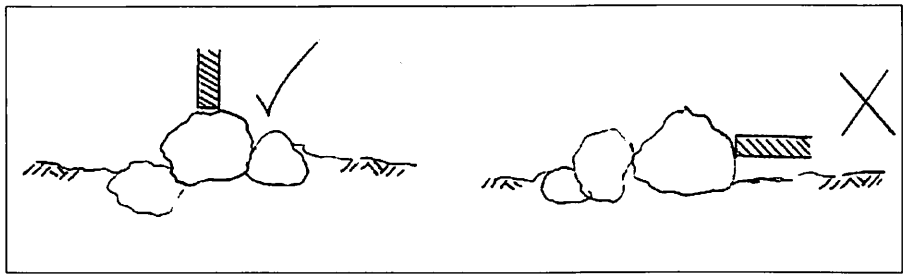


Fig. 9 Direct loading operations

crumber rollers, levelling boards and disc harrows.

As greater clod breakage occurs at the soil surface, it may be necessary to bring deeper clods to the surface. Soil water content can greatly influence the efficiency of the operation as moist clods merely deform plastically and dry clods become too strong to load against the weaker bulk soil. Greater loading velocity increases breakage (*e.g.* power harrows), however, this creates more dust and primary particles and these fines readily move down the profile.

(b) Impact

Clod breakage is effected either through implements striking clods, or the throwing of clods against something hard. In both cases, brittle failure occurs. These operations necessitate the use of power-driven implements (*e.g.* power harrows or rotary cultivators). The size of clods produced depends on rotor speed and forward speed of the tractor (*i.e.* slow tractor with high speed rotor produces fine clods). These implements tend to break clods evenly throughout the working depth. In moist soil conditions, clod size reduction through impact tends to be more successful than direct loading.

(c) Cutting

Blades, discs and rotary tools can be effective in reducing clod size, particularly in moist conditions, however, some risk of smear in the seedbed accompanies these techniques.

Clod sorting

Narrow tines operating in loosened conditions tend to bring large clods to the surface and cause fines to move down the profile under gravity (Spoor, 1984). This effect can be used to some advantage in combination tillage operations by bringing large clods to the surface immediately prior to loading to reduce clod size. This sorting effect is enhanced with greater forward inclination of tines, increased tine share width, reduced forward speed and soil water content.

Power-driven rotary cultivators produce a more even distribution of clod sizes throughout the working depth. Implements which incorporate a metal hood behind the rotor to increase clod breakage through impact have a tendency to leave a layer of fine material at the surface.

Compaction

Compaction is the process of bringing soil aggregates and particles closer together through a reduction in air-filled porosity resulting in an increase in dry bulk density (Earl, 1993). A number of implements are suitable for compacting tilths.

- Wide backward-inclined tools
  Flat rolls and levelling boards are effective in compacting the top 10 to 20 mm of soil *(Figure 10).*
- Ring rolls
  If slightly deeper compaction is required, e.g. to encourage adequate soil contact to the side and below a seed, then ring rolls may be more appropriate *(Figure 11).*
- Crumbler rollers/flexicoils
  Some tillage operations leave a tilth which requires compaction in the top 20 to 80 mm. In these situations, rollers comprising either a number of helically mounted circular bars, or a continuous coil of circular bar, can be effective as they tend to sink through the surface layers and compact at depth where confining stresses of the surrounding soil are greater.

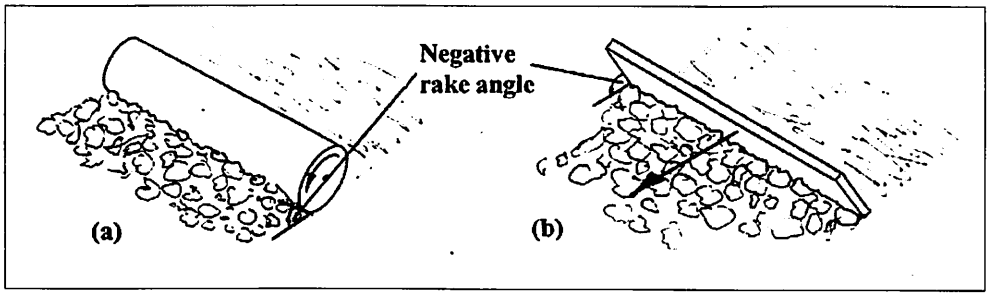


Fig. 10 Compacting implements; (a) flat roll, and (b) levelling board.

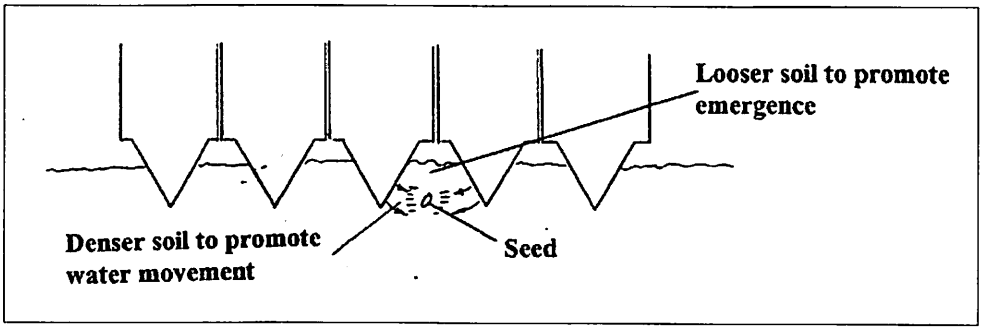


Fig. 11 Ring rolls.

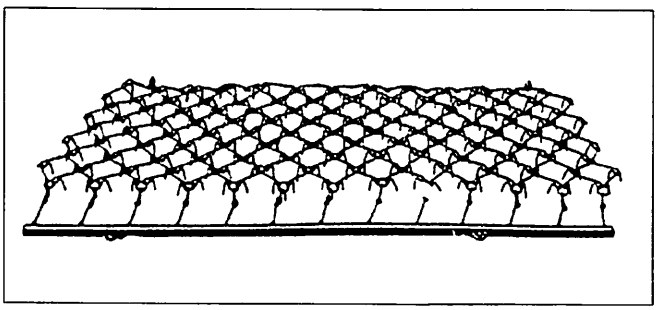


Fig. 12 Chain harrows.

Surface levelling

The production of a level surface following tillage operations can be achieved either through the use of wide backward-inclined blades (*e.g.* a levelling board, *Figure 10*), the stirring action of numerous vertically mounted narrow tines (*e.g.* spike-toothed harrows) or the gentler action of chain harrows (*Figure 12*).

3. Tillage operations within the subsoil

Subsoil tillage operations are generally carried out to effect amelioration of deep structural damage and improvements to drainage and aeration status. The outcome of any deep tillage operation is very dependent on implement size, geometry and depth of operation, as these factors dictate the likely mode of failure the soil will undergo (brittle or compressive failure). The concept of critical depth (*Figure 13*) is useful in assisting the management of subsoil operations.

For any given situation, a critical depth can be identified whereby tillage operations conducted above it will result in a loosening action through brittle failure, whereas those conducted below it result in compaction and consolidation through compressive failure. According to Godwin and Spoor (1977), critical depth is influenced by a number of factors including width of share, rake angle and soil moisture status. As a general rule of thumb, critical depth occurs at approximately six times the implement width, *e.g.* for a mole plough foot of 75 mm diameter, critical depth could occur at around 450 mm.

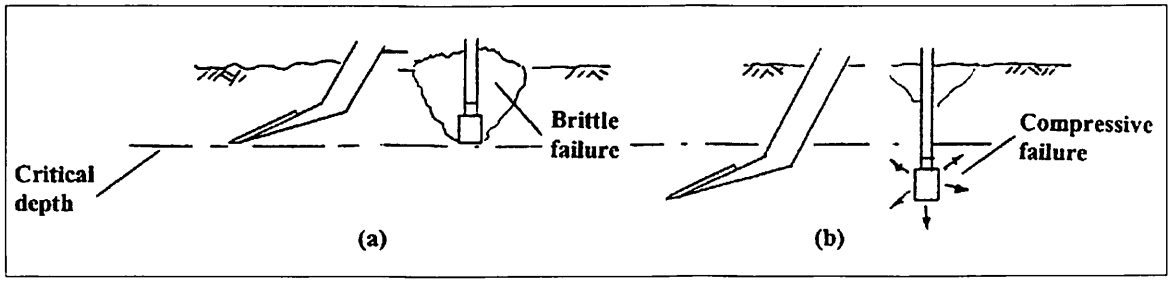


Fig. 13 Cultivations (a) above critical depth and (b) below critical depth.

Cultivation operations within the subsoil can be classified under six broad categories (Davies et al, 1993):

- deep cultivations,
- subsoiling,
- plough subsoiling,
- mole ploughing, and
- subsoil raising and mixing.

Deep cultivations

Deep cultivations are conducted at depths of around 300 mm. The aim of these operations is to break up hard layers (pans) at the base of the topsoil to improve water infiltration and root growth. To achieve pan breakage requires tillage to be carried out just below the pan, but above critical depth. Typically, tools of low positive rake angle to encourage penetration and soil lift, are used (*e.g.* chisel plough, *Figure 14*).

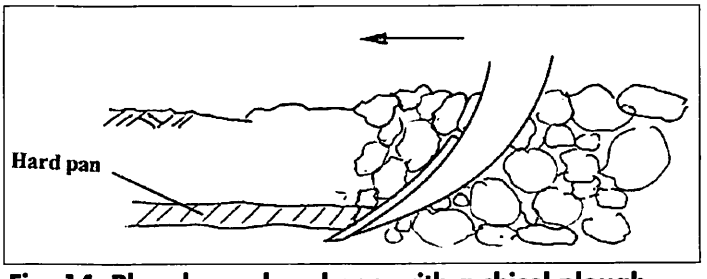


Fig. 14 Plough pan breakage with a chisel plough.

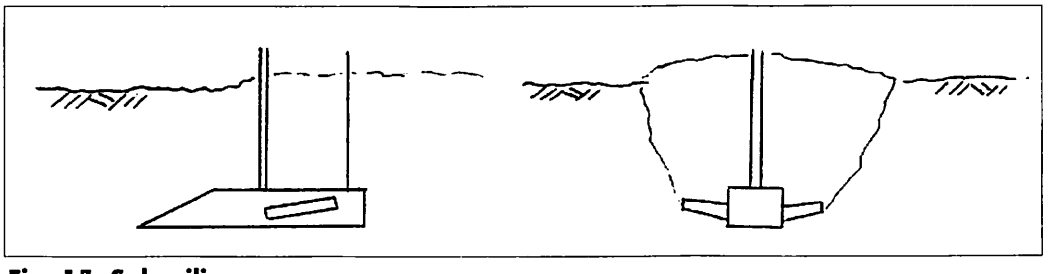


Fig. 15 Subsoiling.

If a pan is encountered which is below critical depth for the tillage tool operating under the prevailing conditions, then either a wider tool must be used or shallower leading tines can be used to reduce confining stresses ahead of the deep tines to lower the critical depth.

Subsoiling

ameliorate compaction which extends to depths greater than 300 mm. Deep loosening can increase fissuring which improves infiltration of water, the availability of soil water for crop growth and resistance to droughtiness through increased root development. These operations are carried out when the subsoil is relatively dry to encourage shatter but not so dry that draught requirements become excessive. Implements typically comprise a 25 mm thick leg with a 75 mm foot of low positive rake angle (25^{o}) to encourage penetration and brittle failure. Commonly, wings are fitted to both sides of the foot to increase the volume of soil loosened by 3 to 4 times (*Figure 15*) with a corresponding increase in draught of only 20 to 30 % (Davies et al, 1993).

Shallow leading tines may be necessary to reduce confining stresses and therefore ensure that the operation is carried out above critical depth (Spoor and Godwin, 1978).

These operations should be undertaken with care as there is little evidence to suggest that routine subsoiling of whole fields is beneficial (Marks and Soane, 1987). A more appropriate strategy is to target vulnerable areas within fields (*e.g.* in gateways and short headlands) using profile pits to establish whether loosening is necessary (Earl *et al.*, 1996).

Plough subsoiling

The use of mouldboard ploughs for primary cultivation can produce a smeared and compacted zone at plough depth.

This can be alleviated using a small tine which extends 75 to 150 mm below the furrow bottom. This technique is effective on light land, however, clayey soils are often too moist at ploughing for efficient loosening.

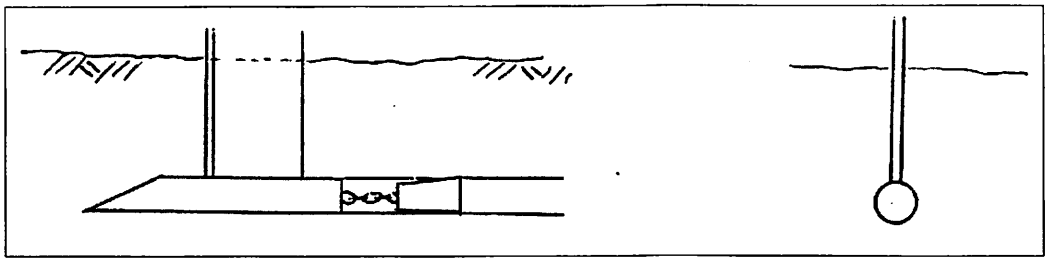


Fig. 16 Mole ploughing

Mole ploughing

Mole drainage systems comprise a network of channels formed at depth in soil to facilitate the removal of excess water in the profile. Satisfactory channels can only be formed below critical depth through compressive failure (Godwin et al, 1981). Mole laterals either connect up with a mole collector (moled main system) or are pulled through the gravel backfill of a permanently installed collector. The success or otherwise of a newly installed system is dependent on a number of factors including the soil moisture status, clay content and mineralogy, prevalence and size of fissures transporting surface water to the channel and length of time between formation and first wetting. As a rule of thumb, the following criteria should be met for a soil to be moleable (Spoor *et al.*, 1992):

- soil greater than 30 % clay content,
- a moulded sample of soil from mole depth should maintain its shape for a number of hours when dropped into a glass of water,
- the field should not contain isolated pockets of coarse textured soil,
- soil at mole depth should be in a plastic state, however drier conditions are required at the surface to provide sufficient draught,
- moling should be avoided if rain is imminent as a maturation period is required (ideally 2 weeks) to increase long term stability,
- undulations in the channel must be avoided as water will sit in the troughs resulting in unconfined swelling and eventual channel failure,
- the mole plough must operate below critical depth in order to form a stable channel through compressive failure, and
- adequate grades (slope) must be present to ensure water moves quickly out of the channel but does not erode the walls.

A mole plough typically comprises a 25 mm thick by 200 mm wide leg to which is attached a 70 mm diameter foot of approximately 500 mm in length and 25° rake. An expander of 75 mm diameter is trailed immediately behind the foot to smooth and stabilize the newly formed channel *(Figure 16)*. Grade control can be effected either by keeping the plough frame in contact with the soil surface (scrubbing beam plough) or by using a specially design plough which resists sudden changes in grade (floating beam plough) (Spoor *et al.*, 1987).

Subsoil raising and mixing

In some situations (*e.g.* shallow peats, shallow clay over peat and silty clay soils over sand) the raising and mixing of subsoil material can be beneficial. This can be achieved using a wide blade which is pulled through the soil at a positive rake angle of 45° which causes subsoil material to ride up the blade and mix with the topsoil.

Conclusions

Seedbed requirements for promoting optimal crop establishments are very dependent on the soil and climatic conditions likely to limit crop performance in a given situation. There is, therefore, no single ideal tilth condition to suit all situations. Often, risk from a number of limiting factors needs to be considered, however, this leads to a conflict regarding seedbed attributes and so a compromise is generally necessary.

To achieve a desired tilth condition is fraught with difficulties as the outcome of any tillage operation is strongly dependent on prevailing soil conditions. However, the application of basic principles of soil-implement interactions will increase the likelihood of accomplishing tillage objectives.

Acknowledgement

The author would like to thank Professor Gordon Spoor for the provision of information (both verbal and published) used in this paper.

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Genus acquires leading international consultancy

Genus plc, the UK's leading cattle breeding and whole farm consultancy business whose shares are traded on OFEX, announced that it has purchased Hunting Technical Services Ltd ('HTS'), the international consultancy practice, from Hunting plc. The cash consideration, which is subject to completion accounts, will be in the region of £830,000.

In the year to 31 December 1997, HTS made sales of £7.7 million. The majority of this turnover is generated by long term contracts. Based in Hemel Hempstead, Hertfordshire, HTS employs about 70 full time professional staff and is the largest UK based international consultancy of its kind. The company has a broad range of experience and internationally recognised expertise in agricultural, environmental, social, institutional, scientific and engineering disciplines, enabling it to offer a total package of natural resources consultancy services.

HTS has two specialist subsidiary companies, Hunting Land & Environment Ltd which provides environmental consultancy in the UK and Europe, particularly in rural, industrial and infrastructural development, and Hunting AS Ltd, the procurement arm of the business.

The company is involved also in two joint ventures. Hunting Aquatic Resources is a joint venture with the University of York Tropical Marine Research Unit, which specialises in freshwater and marine development, including fisheries and coastal management. HTS Polska SP z.o.o. is a joint venture with a Polish mapping company with which HTS has been working for several years.

Commenting on this transaction, Richard Wood, Cliief Executive of Genus, said: "The purchase of HTS is an exciting development for Genus and represents an important step in the expansion of our environmental capability in the UK as well as our broader, international consultancy interests. Our five-year strategic plan identified international consultancy as a key area for growth and one that offers significant synergies with our existing consultancy practice. Indeed, the market for much of our expertise and product is becoming increasingly global as a result of the technological advances that are being made, and we are determined to remain at the forefront of our industry and to keep pace with this change."

Since its formation in 1953, HTS has completed over 1,300 projects in more than 130 different countries. Typically, these projects are supported financially by the major international aid agencies. As a result, the consultancy has developed an excellent reputation with all the leading aid agencies, leading international institutions, private sector companies and many governmental bodies. These include: the World Bank; several departments of the UN, particularly its Food and Agricultural Organisation; the European Commission; both the African and Asian Development Banks; and the UK Department for International Development (formerly the ODA).

Major areas of technical expertise provided by HTS include:

- Agricultural Extension
- Agricultural Research
- Aquatic Resources and Aquaculture
- Coastal Management
- Drainage
- Economic Evaluation
- Environmental Planning & Management
- Field & Tree Crops
- Forestry
- Geographical Information Systems (GIS)
- Groundwater
- International Development
- Land Reclamation (including Salinisation & Waterlogging)
- Land Settlement
- Land Use Planning
- Livestock
- Mechanisation & Agro-industry
- Monitoring & Evaluation
- Project & Programme Management
- Remote Sensing
- Sociology
- Soil & Water Conservation (including Watershed Management)
- Soil Survey & Land Classification

Contact: **Richard Wood, Chief Executive, Genus plc on 01270 536501**

CDC - a significant investor in forestry emerging markets

CDC (Commonwealth Development Corporation), the UK-based financial institution has been investing in forestry in developing economies for nearly 50 years. At the end of last year, CDC had investments of £1.6 billion in over 400 businesses, including forestry, in 54 countries. More than £125 million is invested and committed to forestry worldwide and CDC continues to look for new business opportunities in the sector.

As a long-term investor, the corporation's role is to assist overseas countries in the development of their economies. It does this by investing in new or existing enterprises across a wide range of industries focusing on the private sector. In spite of its success, CDC Chief Executive, Roy Reynolds believes much remains to be done. He explains: "Sustainable forest requires committed long-term investors with a clear appreciation of environmental factors. CDC has tile expertise and a long-term perspective. It is therefore taking a leading role worldwide in developing, managing and conserving forest resources."

CDC applies both social and environmental policies to all its investments. Its environmental policy is to encourage the efficient and sustainable use of natural resources and to seek investment opportunities where sound economic development is coupled with the protection and improvement of the environment. It requires all businesses in which it invests, to be designed and operated, using internationally accepted environmental good practice and managed with regard to both public and operational health and safety.

Tropical forests in developing countries are being destroyed at a rate of 17-20 million hectares a year. One fifth of the world's tropical forests have been destroyed since the beginning of the century. Most countries, for socio-economic and environmental reasons, must conserve their forest resources and protect watersheds and bio-diversity, provide energy in the form of fuel wood, supply basic housing and other building materials, and meet educational, business and industrial needs for paper products.

Sustainable use of forest resources is essential to conserve natural forests, meet market demands, stimulate exports and generate wealth and employment. These goals are rarely achieved outside the private sector. The potential for industrial plantations in many countries remains unrealised, while natural forests become a dwindling resource and a drain on government funds.

Reynolds says: "CDC has a successful track record in the forestry sector and a proven ability to act for governments in the privatisation of plantation resources and forest industries. It has international business, financial and management experience and the technical expertise to realise commercial potential, ensure sustainability, protect forests from fire and introduce, transfer and adapt technologies to improve productivity and quality. CDC also attracts other private sector investors to business ventures."

The following are examples of CDC's current investments in forestry.

USUTU PULP CO LTD (Swaziland)
One of the largest tracts of man-made forest in Africa was planted by CDC between 1949 and 1959 on open grassland. Today the forest covers over 50,000 hectares. The pulp company was set up 34 years ago and is one of the world's lowest cost producers of unbleached pulp for export and which accounts for about ten per cent of Swaziland's total exports. The company is managed and controlled by the South African company, Sappi.

SHISELWENI FORESTRY CO LTD (Swaziland)
This is a wholly-owned CDC subsidiary, which was incorporated in 1967. Initially it aimed to plant 2,500 hectares of eucalyptus on previously underdeveloped grasslands. Under CDC management, the plantation has grown to 6,200 hectares planted with eucalyptus, 2950 hectares with pines for timber and/or pulp and 670 hectares of oil bearing eucalyptus.

KOLOMBANGARA FOREST PRODUCTS LTD (Solomon Islands)
CDC, in partnership with the government of Solomon Islands, owns and manages this company, which was incorporated in 1989.
A forestry plantation of 16,000 hectares of mixed hardwoods, mainly of the fast-growing *gmelina arborea* species, has been planted. Land which had previously been logged is being reforested and a processing factory is planned. Rapid progress has been possible by introducing new clonal nursery technology and by carefully matching planting stock origins with the planting site.

KILOMBERO VALLEY TEAK CO LTD (Tanzania)
Established in 1992, the company is a wholly owned CDC subsidiary. It develops teak plantations for the production of telephone poles and sawlogs both for the domestic market and for export. The first poles are expected to be produced in 2001, from plantings on a eight year rotation. The sustainable annual production is expected to be 64,000 cubic metres of teak sawlogs and veneer logs, 50,000 telephone poles, 300,000 building poles and 23,000 cubic metres of firewood. The plantation is designed to protect the semi-evergreen woodland within its boundaries and help reduce the exploitation of Tanzania's natural forests.

Kemira Grassland '99

Dates have been confirmed for Kemira Grassland '99, Europe's premier grassland demonstration, attracting between 15,000 and 20,000 visitors over the two days of the event.

Organised by Kemira Fertilisers in association with the Royal Agricultural Society of England, the demonstration will once again be held at the National Agricultural Centre's Crewe Farm, Stoneleigh, Warwickshire on Wednesday and Thursday May 19 and 20, 1999.

Around 100 seed and agrochemical companies have already been invited to apply for one of the demonstration's grass variety and treatment plots. Once these have been allocated later this summer, the main trade exhibitor invitations will be issued before the end of the year,

Working demonstrations over the bulk of the Kemira Grassland '99 site will feature the latest grassland equipment from UK and European manufacturers. Whatever the weather, machines will be seen harvesting, handling and ensiling the grass crop grown from seed blended specially for the event.
Further details can be obtained from the Grassland '99 office at Kemira, on **0151 357 5311**.

European machine standard less safe

The Health & Safety Executive (HSE) announced that the Government has lodged a formal objection to a European standard which it believes will allow lower safety protection levels for power harrows, increase risks to agricultural workers and result in increased accidents.

The standard in question, EN 708 *Agricultural Machinery: Soil Working Machines with Powered Tools - Safety*, was produced by the Comite Europeen de Normalisation (CEN) to help elaborate, for the benefit of manufacturers, Essential Health and Safety Requirements (EHSRs) of the Machinery Directive 89/392/EEC. CEN is one of the European bodies mandated by the European Commission to produce European standards.

However, the UK considers that the standard does not adequately satisfy certain EHSRs of the Machinery Directive, in particular those dealing with guarding of the machinery and safe positioning of the adjustment handle. Under these circumstances, Member States are required, under Article 6.1 of the Directive, to lodge a formal objection.

Any new power harrows built to EN 708 will lower current safety protection levels in the UK. Up to the mid 1980s, there was a history of serious accidents in the UK caused by power harrows; the rotating blades that cultivate soil can easily amputate feet and legs. The problem was solved by UK safety specialists insisting on more rigorous guarding specifications and there have been no further such accidents at machines designed to that specification. The fear is that safety will be compromised by the new standard and the accident record rise to its former level of five to eight fatal or serious injuries a year.

To meet current UK safety requirements, the front and rear distance guards must be capable of withstanding a vertical and horizontal force of 1200 N (equivalent to a 121 kg worker) and the in-fill to the barrier must meet the distance requirements of EN 294 *'Safety of Machinery - Safety distances'*. This prevents feet slipping between bars on the guard and coming into contact with the blades. These requirements are omitted from EN 708.

EN 708 has legal status because the European Commission has published a reference to it in the Official Journal of the European Communities (the OJ). This means that manufacturers who produce power harrows in compliance with the standard have a presumption of conformity to the relevant EHSRs of the Machinery Directive.

The European Commission will reach a view on the validity of the UK's concerns after considering the views of a committee of Member State representatives, which it chairs.

In the meantime, HSE will not hesitate to take enforcement action to prohibit the supply and use of machines that do not meet current UK requirements. HSE's advice to manufacturers and suppliers is that they should not rely on EN 708 to comply with their legal duties under the Supply of Machinery (Safety) Regulations. These Regulations implement the Machinery Directive in the UK.

Contact: **HSE's InfoLine on 0541 545500, or write to HSE Information Centre, Broad Lane, Sheffield, S3 7HQ.**

The impact of contaminated land on buried cables and pipework

A large amount of new civil work takes place on sites that were previously occupied by some form of industrial operation. Over the years, these sites may have become contaminated by spillages and waste products.

A new report, just published by ERA Technology, concentrates on the effect that contaminated land will have on materials buried in the soil such as those used in the construction of power and telecommunications cables. The safety of personnel working on the site during the construction phase of a new development is also looked at briefly. Much of the information also applies to other similarly buried services.

To assess the risk at a particular site, it is necessary to know the types of contamination that are likely to be present. The report provides advice on:

- how site histories can be determined
- the types of contamination that are associated with specific industries
- the methodology set out in the British Standard code of practice for identifying and investigating contaminated land
- data on the effects that various chemicals have on the long term performance of materials used to sheath electric cables
- removing or containing the source of contamination.

Chemicals causing deterioration of medium density polyethylene (MPDE) are listed and current research into contaminated land is looked at briefly.

The redevelopment of industrial sites such as landfills, chemical and paint factories, gas and steel works, and railway sidings will not only continue but is likely to increase in the future. The report will help to provide the careful consideration necessary for the installation of power cables and other services on areas of contaminated land.

The report 'The Impact of Contaminated Land on Buried Electric Cables' (98-0416R) is available priced at £75 per copy (free for ERA Technical Services Scheme members).

Contact: **Publication Sales at ERA Technology, Cleeve Road, Leatherhead, Surrey KT22 7SA. Tel: +44 (0)1372 367014.**

New Holland increases stake in Pakistan joint venture

New Holland N.V. announced that the Company has increased its stake in Al-Ghazi Tractors Ltd, the Company's joint venture operation in Pakistan, from 5% to 42.3%. In late May, New Holland acquired 24.7% of the outstanding shares from Pakistan's state-run National Investment Trust. Subsequently, the Company acquired a further 12.6% stake on the Karachi Stock Exchange. The Al-Futtaim Group remains the majority shareholder, with approximately 50.1%, and the remaining shares are traded on the Karachi Exchange.

"We have increased our position in Al-Ghazi tractors with the full support of the majority partner," Franco Fusignani, New Holland's Vice President for Business Development stated. "By taking a larger position in Al-Ghazi Tractors, we will be able to foster the investment necessary to support future domestic market needs and export opportunities."

New Holland's presence in Pakistan dates from the formation of the joint venture in 1983. In the following year, New Holland's predecessor company, Fiat Trattori, supervised the construction of a 30,000 square metre manufacturing facility in Dera Ghazi Khan. In 1997, the facility produced more than 7,000 three and four cylinder agricultural tractors. Al-Ghazi Tractors hold a 45% share of the domestic tractor market, and employs nearly 600 people.

New Holland is one of the world's leaders in the engineering, manufacturing, marketing and distribution of agricultural and construction equipment. New Holland is the market leader in agricultural tractors in most of Europe's markets and in a number of important markets in Latin America, Asia, the Pacific Rim, Africa and the Middle East. The Company also has the third largest share of the agricultural equipment markets in the United States and Canada. With consolidated revenues of over $6 billion, New Holland employs over 20,000 people, and has approximately 6,000 dealers around the world.

Cut down risks in the Forestry Industry

As part of a national campaign to improve health and safety management in commercial forestry and woodland operations, the Health and Safety Executive (HSE) have issued a new report which highlights the catalogue of deaths and injuries in tree work. It aims to focus forest managers' and workers' minds on the key industry hazards. The free report *'Tree work accidents - an analysis of serious and fatal injuries'* has examples of the many accidents which happen every year in forestry and arboriculture.

As HSE's Chief Agricultural Inspector, David Mattey, said: "Our latest analysis of accidents shows that forestry remains one of the highest risk industries. In the 11 years from 1986, fifty two forestry workers were killed. A common thread in the report is inadequate health and safety management and it is for that reason that we are taking this major initiative to address forestry safety management.

"Forestry work is increasingly organised through contracts rather than by direct employment and too often HSE Inspectors find that health and safety is left to the sub-contractor when others higher up the contractual chain neglect their own legal duties."

He added: "This initiative is aiming to ensure that everyone in the chain, from landowners and purchasers down to contractors and sub-contractors, recognise and act on their duty to manage health and safety. Good health and safety practices don't just happen themselves, they must be made to happen. Everyone in the chain must play their part and work together."

Together with the forestry industry, HSE is developing a framework of action to help these people co-operate so that they can all fulfil their duties. The framework will give guidance on:

- how landowners should gather and pass information down the contractual chain about site hazards, such as disused mine shafts, windblown trees, public access, *etc*;
- what information contractors should pass up the chain, such as changes in working methods that become needed as the work progresses;
- who should liaise with utility companies, *etc* and agree safe working practices for hazards, such as overhead and underground power lines;
- what landowners and purchasers should consider to protect workers and the public when planning work on forestry sites;
- how all this information feeds into the risk assessment for the work.

This framework is being presented to the industry by HSE at seminars around England, Scotland and Wales this autumn. These seminars are aimed at landowners, agents, purchasers and contractors who have responsibility for managing health and safety in forestry. The seminars will present a framework detailing what is expected to all parties involved in forestry contract work. The dates and venues for the seminars are listed below:

Wales, 30 September, Gregynon Hall, Tregynon, Newtown, Powys.
Midlands, 6 October, Stephenson College, Bath Yard, Moira, Swadlincote, Derbyshire
North West, 8 October, Newton Rigg College, Penrith, Cumbria.
South West, 13 October, Almondesbury Interchange Hotel, Gloucester Rd, Bristol.
East Anglia, 15 October, The Comfort Woodland Inn, Thetford Road, Northwold, Norfolk.
North East, 20 October, Askham Bryan College, Askham Bryan, York.
South East, 22 October, Alice Holt Social Club, Wrecclesham, Farnham, Surrey.
Scotland, 3 November, St Johnstone FC, McDiarmid Park, Perth.

There is no attendance fee but numbers are limited. Places can be reserved by faxing Ruth Williams on 01203 696542 or email to <ruth.williams@hse.gov.uk> stating: company name and address, type of business (*i.e.* grower, purchaser, agent, contractor); names and positions of those who will attend, which seminar, and where entry passes are to be sent.

Summing up the initiative, David Mattey said: "This is about saving forestry workers' lives. Everyone with a role in the process must be able to say they have played their part to the full to ensure the work is safe. They should all ask themselves what they are doing to ensure the work is done in the safest way. HSE Inspectors will be asking these questions, especially of the people further up the contracting chain."

Barrie Hudson, Chief Executive of the Forestry Contracting Association, said: "An initiative such as this can only be a good thing. All of us working in the industry welcome the opportunity to clearly set down who should do what, when and where. Health and safety is not something that can be franchised or sub-contracted. Growers, purchasers and contractors all have a part to play in making forestry a safer industry."

Branch Diary

Northern Ireland Branch

October 1998 Evening meeting
Venue: Greenmount Agric. College
Precision farming

November 1998 Afternoon meeting
Visit to concrete products manufacturer

January 1999 Evening meeting
Visit to Electricity Distribution Control Centre

Hon Sec: John Mawhinney Tel: 01232 685044

Scottish Branch

Wednesday, 7 October 1998 at 19.30 h
Venue: Moredun Foundation, Pentland Science Park, Bush Estate, Penicuik
Trends in farm machinery needs of the future
by John Cameron

Wednesday, 4 November 1998 at 19.30 h
Venue: SAC Auchincruive
New ATV attachments, safety and use
by Ian Murgutroyed of Forestry Research and John Thompson of JMT Manufacturing, Forth, Lanark

Tuesday, 8 December 1998 at 19.30 h
Venue: Lomond Hills Hotel, Freuchie, Fife
Buying second hand equipment, the pitfalls
by Jim Christie

Wednesday, 20 January 1999 at 19.30 h
Venue: King Robert Hotel, Bannockburn, Nr Stirling
Members' night
Various members will speak on a selection of topics after a bar meal - note the venue change.

Hon Sec: G M Owen Tel: 01968 675943

S E Midlands Branch

Thursday, 22 October 1998 at 19.30 h
Karting - Haverhill
Contact Secretary by 1 October

Tuesday, 27 October 1998 at 19.30 h
Venue: Silsoe College, Englands Hall
Development of a transmission for the World Rally Championship
by David Prior, Prodrive
Joint Meeting with IMechE

Monday, 2 November 1998 at 19.30 h
Venue: Silsoe College, Dining Room
Mechanisation in Eastern Europe
by Chris Graf Grotia, Farmwealth Ltd

Monday, 7 December 1998 at 19.30 h
Venue: Silsoe Research Institute, Conference Room
Dairy automation - the state of the art
Cow identification
by Robin Sadler, Agricultural Technology Ltd
Automatic productivity monitoring
by Toby Mottram, Silsoe Research Institute

Monday, 11 January 1999 at 19.30 h
Venue: Silsoe College, Dining Room
Research Papers
Relationship between composition, conformation and carcass quality in pigs
by David Abrutat, Silsoe Research Institute

The effect of soil structure on the movement and behaviour of pesticides
by Fiona Marsh, Silsoe College

Impact of tillage on crop water availability in semi-arid Zimbabwe
by Frans Bauke van der Meer, Silsoe Research Institute

Spray transport from moving booms
by Seamus Murphy, Silsoe College

Tracking field machinery to predict and target soil damage
by Terence Richards, Silsoe College

Machine vision for an autonomous agricultural vehicle
by Ben Southall, Silsoe Research Institute

Hon Sec: M D P Matthews Tel: 01525 860000

Southern Branch

Saturday, 19 September 1998 at 12.00 h
Visit to British Heritage Motor Museum
Location: Banbury Road, Gaydon, Warwickshire. Exit J12, M40
Definitely for wives and children as well as Dad. Bring a picnic lunch.

Wednesday, 7 October 1998 at 19.30 h
Venue: Sparsholt College
Diesel fuel injection systems and engine management
by Tim Roberts, Lucas International Training Centre

Tuesday, 17 November 1998 at 19.30 h
Venue: Rycotewood College
Biodegradable oils
by Richard Hey, Millers Oils Ltd

Hon Sec: 0 J H Statham Tel: 01865 782259

West Midlands Branch

Monday, 14 September 1998 at 19.30 h*
Location: Massey Ferguson AGCO, Banner Lane, Coventry
Visit and talk on: Making tractors fit for farmers
by Rob Oliver, Prototype Build and Test Manager

Monday, 12 October 1998 at 19.30 h
Venue: Evesham College
Welding techniques
by David Baker of Technilock

Tuesday, 27 October 1998 at 19.00 h*
Visit to Brinton Carpets, Kidderminster
Social event looking round the well-known Kidderminster carpet factory

Monday, 9 November 1998 at 20.00 h*
Venue: Motor Heritage Centre, Gaydon
Rover Freelander
by Mr. D. Elsey, Chief Engineer
A talk on the development of the Rover Freelander

Monday, 14 December 1998 at 19.30 h
Venue: Evesham College
Lister/Petter Engines
by D H Parrott
History of the early years

Monday, 11 January 1999 at 19.30 h
Venue: Massey Ferguson Training School, Stareton, Stoneleigh
Case Quadtrack
by P Wade/S Smith
Concept of the high power, four-tracked vehicle
* Numbers restricted, pre-booking via Hon Sec essential

Hon Sec: M C Sheldon Tel: 01926 318333

Wrekin Branch

Monday, 12 October 1998 at 19.30 h
Venue: Harper Adams College, Newport, Shropshire
An Investigation of the Claas Green Harvest and Xerion ranges
by Mark Daniel, Territory Manager, and T Tyrrell, Business Manager West, Claas UK

Monday, 9 November 1998 at 19.30 h
Venue: Reaseheath College, Nantwich, Cheshire
The Millennium Bug - finding an appropriate pesticide!
by R P Harrison, IT Department Manager, Reaseheath College.

Tuesday, 10 November 1998 at 19.30 h
Venue: Reaseheath College, Nantwich, Cheshire
Lubricants on the land
by Tony Crozier, Greenway Lubricants Ltd.
This meeting is in association with Cheshire Farm Machinery Club. Further information from Brian Nichols on 01270 625131.

Wednesday, 25 November 1998 at 13.30 h
Visit to JCB Transmissions, Wrexham

Monday, 7 December 1998 at 19.30 h
Visit to the Titanic Brewery, Stoke on Trent

Monday, 18 January 1999 at 19.30 h
Venue: Harper Adams College
Power-shifting with a Fendt - a closer look at that bit under the driver
by speaker from AGCO to be confirmed.

Hon Sec: Denis Cartmel Tel: 01785 712690

Professional engineers bid to improve public confidence

Professional engineers, represented by the Engineering Council, are being asked to support a new initiative to certify their skills in work that affects public safety and health. It would mean employers would find it advisable to use only licensed engineering practitioners for certain tasks.

"The case for such schemes is particularly strong in areas of public interest or concern," said Robin Wilson, Chairman of the Council's Regulatory Board. "Whilst we know that most Registered engineers keep themselves up to date, we recognise the public need to see formal re-certification of skills that particularly improve safety, health, welfare of the public and protection of the environment".

Under proposals considered by the Council's governing body, the Senate, the Council would accredit schemes whereby engineering Institutions licensed individual engineers. The schemes would satisfy the following criteria.

- The licence would apply to a prescribed area of work.
- Competence would be delivered through occupational standards.
- Competence would be assessed by the Institutions.
- Competence would be reassessed at intervals of no more than five years.

The voluntary licensing proposal is one of a number of measures being considered by the Council to promote the contribution of Registered engineers to society. Voluntary licensing schemes have the potential to become mandatory says the Council when public interests are paramount.

Beefing up the water pressure (more correctly)

CORRECTION In the previous issue of Landwards, Summer 1998 vol 53(2) p 17, the principle of the hydraulic ram mechanism was explained but the article contained two errors. Fig 1 and Fig 3 were switched inadvertently and there was reference to only one manufacturer. We apologise for these errors and are also pleased to include this product information from Green & Carter. Editor

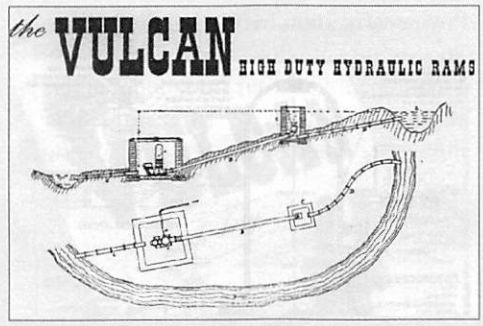
What's the connection between Montgolfier, the Somerset Levels and farmers' water bills? It's the hydraulic ram, a masterpiece of 18th century technology that is enjoying a revival, much to the delight of the oldest company that still makes them. Green and Carter, a family firm in Ashbrittle, which is as close to the Somerset border as you can get without falling into Devon, is currently installing more hydraulic rams than it did when it was laying on water supplies to the great estates and country houses in Victorian times.

Farmers all over Britain are turning back to a low technology answer to their water needs as an alternative to paying ever higher bills for piped mains water. And in the environmentally-conscious 1990s you could hardly hope for a better set of green credentials than the hydraulic ram can display.

Essentially, it is a water-driven pump which uses the force supplied by a head of water from a river or stream to force a smaller quantity of water through a narrower pipe - up to 300 m vertically or over a distance of several kilometres. The mechanism is governed by a pulse valve, whose regular opening and closing creates the rhythmic thumping sound which is all that betrays the ram's presence in a wood or field.

It was Montgolfier, the French hot-air balloonist, who invented the device but, says the current head of the family firm, Charles Doble: "While he was good at inventing things he wasn't terribly good at marketing them."

The result was that the British patent - signed by George III and still in the company's ownership - was bought by Josiah Easton, a surveyor who laid out many of the roads in the West and also designed steam pumps to drain the Somerset Levels. His company was eventually bought out by Green and Carter.



"But it was he who really promoted the concept of the ram," says Charles Doble. "A lot of the large country houses didn't have piped water supplies in the 1800s - they relied on wells. As soon as the big estates began putting them in, the smaller country houses followed and there was a trickle-down effect to farms and smaller properties."

Details of every single, individually numbered ram Green and Carter has ever supplied are recorded in green leather-bound ledgers dating back to 1774. Royalty, dukes and earls, prime ministers and other notable figures, including Lawrence of Arabia are named.

Green and Carter exports hydraulic rams to undeveloped countries where they provide the answer to water supply problems. But now American farmers, faced since the 1970s with soaring water bills, are after them as well. And demand in Britain has never been higher.

"We are now installing 1,000 units a year in this country and that's probably more than the company was doing in Victorian times," says Charles Doble.

Contact: **Charles Doble, Green & Carter, Vulcan Works, Ashbrittle, Nr Wellington, Somerset TA21 0LQ. Tel: 01823 672365**

Low cost, fully automatic filter for incoming water supplies

The EasyClean Auto filter has been introduced by Cross Manufacturing to provide low cost and fully automatic self-cleaning filtration of incoming mains or well water supplies for many industrial and commercial applications. Potential users include photographic and industrial laboratories, market gardens, swimming pools, laundries and any application where filtration at the point of use will prevent the build-up of water-borne debris from causing nozzle blockages or damage to machinery and processes.

Filtration is achieved with the Cross zero-gravity coil, a patented, precision engineered stainless steel element, guaranteed for five years without replacement in normal operation. Raised 'ridges' on the coil surface ensure a precise filtration gap, selectable and interchangeable within the range of 12 to 400 microns. Unlike a conventional coil, the zero gravity coil opens evenly along its entire length during the backwash process, enabling the element to be completely cleaned in seconds with the minimum of water loss.

Backwashing is automatically triggered at user-adjustable intervals. The integral 12 V d.c. electric actuator operates a three-way valve to cut off the inlet supply, enabling the filter to be completely flushed out with water held in a pressure tank. The tank is immediately refilled when the inlet flow is restored following the user-adjustable backwash duration.

EasyClean Auto filters are supplied with ¾ in BSP pipework connections and designed for a maximum recommended flow rate of 1.3 litres/second. Higher flow rates can be handled by connecting individual filters in parallel.

Contact: **William Smith-Haddon, Cross Manufacturing Co. (1938) Ltd, Midford Road Bath, BA2 5RR. Tel: 01225 837000**

Amazone enters the mixer-feeder business

Amazone Ltd has been appointed sole UK distributor of the Strautmann range of Multi-Mix mixer feeder wagons, which will chop and incorporate clamp silage, round and large bales of straw and silage, and root crops such as potatoes and turnips. The range also includes Strautmann Power-Mix models and the Strautmann FVW feeder wagon.

The Multi-Mix range comprises of two models: the Multi-Mix 700 and the Multi-Mix 900. Capacities are 7 cu m and 9 cu m, respectively, and the uncluttered interior design of the hopper enables 90 per cent of the nominal volume to be used. Both models are top loaded and their ability to handle root crops and whole bales comes from the design of the two lower augers, whose flights are fitted with serrated knife sections. These chop material and bring it into the centre of the hopper, to start the mixing cycle, from where it is forced upwards and outwards to be fully incorporated with other ingredients, by two longitudinal mixing augers whose action does not compact the feed.

In standard configuration, discharge is to the right of the machine. A centrally positioned 700 mm wide slatted conveyor ensures a blockage free, uniform flow of material. Rate of output is governed by the combination of a hydraulically operated gate and varying the speed of the conveyor, with both functions activated from the tractor seat through Bowden cables.

A high quality of build comes from the use of 8 mm fine grained steel plate in the manufacture of the hopper. The use of a robust 13 mm chain drive running in an oil bath and splines for all shaft/hub connections are designed for maintenance free operation in the most arduous conditions.

Optional equipment for the Multi-Mix range includes discharge to the left or to both sides of the machine; hydraulic control of discharge conveyor speed; electronic weighing equipment; air brakes; and a hydraulic front jockey wheel. The price of the Multi-Mix 900 in standard specification will be £20,425.

Power-Mix 1000 Mixer Feeder

The Strautmann Power-Mix 1000 model is equipped with four horizontal augers and has a capacity of 10 cu m. Auger flights are fitted with cutting blades to shred materials during mixing and in operation, ingredients are moved to the front of the mixing chamber by the lower pair of augers, forced upwards and moved rearward by the upper pair. This action, and the fact that the pairs of augers operate at different speeds, ensures thorough mixing.

Power requirement for the machine is put at 45 kW and power is transmitted via a heavy duty gearbox and roller chains to the augers. Hydraulic functions are taken from the tractor external hydraulics system.

Model	700	900
Capacity, cu m	7	9
Max payload, kg	3500	4500
Right discharge, mm	2050	2050
Right & left discharge, mm	2440	2440
Overall height, mm	2270	2270
Power requirement, kW	34	38
Unladen weight, kg	3500	3900
Tyre size	235175 R17.5	235/75 R17.5

Strautmann Multi-Mix 700 and 900 technical specification

The mixing chamber is of 8 mm steel and carried on a two-wheeled axle. Its height is 2320 mm and the machine is 2360 mm wide and 5660 mm in length. The price of the Power-Mix 1000 will be £24,160.

Strautmann Feeder Wagon

Amazone Ltd will also be marketing the Strautmann FVW Feeder Wagon which is ideal for store and fattening cattle and sheep fed under cover or in the field.

Discharge is from the front and the design includes a chain and slat mechanism in the floor, feeding to a pair of PTO powered horizontal rollers fitted with aggressive rip tines to loosen up the ration. Material is fed in a continuous even flow via the discharge conveyor, which can discharge to the right or left hand side of the wagon to a height of 800 mm.

Features of the FVW Wagon include recessed floor chains, seals to prevent ingress of material under the conveyor, wide slats to ensure material movement and reversible drive. A mesh panel in the front allows the operator to see when unloading is nearing completion and the design includes single axle and front jacking.

It is anticipated that the full range of Strautmann Wagons will become available; at present the FVW 120 is under trial in the UK with a capacity of 12 cu m and an expected price around £12,655.

Contact: **Rod Baker, Amazone Ltd, Rowse, Pillaton, Saltash, Cornwall PL12 6QU. Tel: 01579 351155**

Multi-pin connectors

Designed specifically for the truck, bus and off-road industry, the Deutsch HDP 20 Series is a heavy duty rated, environmentally sealed, thermoplastic shell, multi-pin connector. The plug features a quick connect-disconnect, bayonet style coupling, and the receptacle is designed for single hole mounting to reduce assembly line time and installation costs.

Silicone wire grommets are an integral part of the connector, reducing wire installed costs while providing complete environmental sealing against moisture and contaminants.

With an operating temperature from -55°C to +125°C, the HDP 20 Series accepts a range of contacts with rating from 7.4 amps to 100 amps. As well as being used in off-road and agricultural industries, applications for the HDP Series include bulkhead mounting and through-cab connections.

Contact: **Richard Wyatt at Deutsch on 01424 852722.**

Largest Multispread yet

Dowdeswell has introduced a 14 tonne, twin auger version of its acclaimed Multispread all-purpose manure spreader.

Complementing the company's existing 8 and 10 tonne models, the new Multispread's 30% greater volume is designed to meet the needs of contractors and large-scale livestock enterprises with substantial quantities of manure to shift and spread. Capacity is 9,700 litres of liquid material or 9.7 cu m of solid farmyard manure. Large diameter, wide tread, 12 ply cleated tyres minimise rolling resistance and sinkage, while steeply-sloping body sides ensure complete emptying of sticky material.

To promote efficient handling and thorough mixing of all types and consistencies of manure, the latest Multispread has twin augers powered by a rugged chain and sprocket transmission. The right hand auger revolves at twice the speed of the left hand auger, producing a churning, boiling action which effectively mixes and breaks down material while simultaneously forcing it towards the discharge expeller located on the offside of the chamber. Shearbolt protection is provided on the augers, the expeller rotor and the PTO drive shaft.

The expeller, which is of overshot design, is fitted with reversible hardened steel blades designed to break up any remaining solid material and withstand impact from stones or stray metal. A hydraulically-controlled vertical sliding door is fitted behind the expeller to control the rate of discharge and retain manure when driving to the field. A slurry 'bib' beneath the outlet prevents loose, sloppy material dripping onto roads or driveways.

Requiring a tractor of at least 75 kW, the Dowdeswell 14 tonne Multispread is priced at £15,872.

Contact: **Michael Alsop, Dowdeswell Engineering Co. Ltd, Blue Lias Works, Stockton, Nr Rugby, Warwickshire CV23 8LD. Tel: 01926 812335**

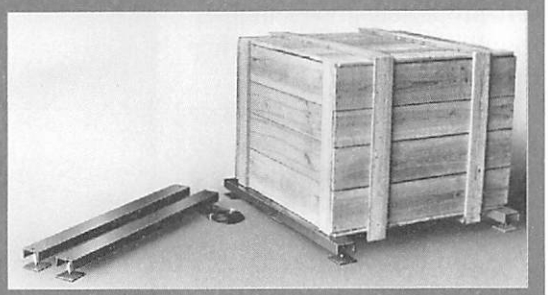
Trade approved Flexi-Beam weighing system

The Griffith Elder Flexi-Beam Weighing System is now available with full EC Trade Approval. This means that the system can be stamped by Trading Standards and used to buy and sell goods over.

Designed and manufactured by the company in Bury St Edmunds, the Flexi-Beam System consists of two free standing beams and an electronic indicator. Each beam is 1250 mm long, 100 mm wide, 90 mm high and has a weight of 20 kg. Each beam incorporates two precision shear beam load cells. The typical set uses four 500 kg load cells to give a total capacity of 2 tonnes. Over this range, the system can weigh accurately to 0.5 kg. The indicator which operates from a 12 volt battery shows the weight on a digital display. Systems are also available for 4 tonne and 8 tonne capacity.

Typical uses for the Flexi-Beams include potato box weighing, pallet weighing, sack weighing, weighing feedstuffs and livestock weighing. The beams can also be built into a permanent installation such as a mill and mix plant or a weighing platform.

A wide range of electronic indicators can also be used with the Flexi-Beams. These include printers, batch control facilities, totalising facilities and computer interfaces. The cost of the Flexi-Beam System is £1550 for the standard set, and £1856 for a Trade Approved System.



Contact: **Alan Valentine, Griffith Elder and Co Ltd, 2A Cavendish Rd, Bury St Edmunds, Suffolk IP33 3TE. Tel: 01284 763616.**

New heavy duty gear pumps & motors

Rugged design, a multiplicity of options and high efficiency mark Salami's new pulsar range of heavy duty external gear pumps and motors. These spheroidal cast iron units are available in eight displacements from 33.4 to 90 cm^3/rev. They are suitable for use with fire resistant fluids and are not over sensitive to fluid contamination.

Salami have produced aluminium external gear pumps and motors and versions of the same design with cast iron bodies for many years but their new 'Pulsar' range is an entirely new design. The body, flange/front and back segments are designed for the most arduous conditions; for applications where considerations as to weight are less important than the survival of the pump or motor, these units are ideal. Internally, they are also designed for demanding use: the 12 tooth, one piece gear sets run either on DU bearings, giving excellent high pressure capability, or on needle roller bearings for use in exceptionally heavy duty operation and for use with fire resistant fluids. Higher volumetric efficiencies are achieved by innovative design and accurate control of machining tolerances in manufacture. Axially floating bushes give pressure and wear compensation, providing high efficiency over the complete pressure range and life of the pump or motor.

Versatility of application is achieved by the availability of the common SAE standard mounting flanges, shaft and ports options. Working pressures range from 280 bar for the smallest units to 160 bar for the largest (these figures are down rated when used with fire resistant fluids). Peak pressures, sustainable for eight seconds, range from 325 bar to 200 bar. Both pumps and motors are suitable for shaft speeds ranging from 3000 to 1800 rpm. Motors are available for uni- or bi-directional service and pumps are available as multiple units with either common or separate inlet ports.

Contact: **Paul Hensman, Berendsen Fluid Power Ltd, Sandy Way, Amington Industrial Estate, Tamworth, Staffordshire, B77 4DS. Tel: 0182769369.**

New self-propelled gravel hopper for land drainage specialists

Working in conjunction with one of the country's leading sports field and golf course drainage specialists, White Horse Contractors, based at Abingdon near Oxford, self-propelled power unit and crop sprayer manufacturers, Househams of Leadenham, near Lincoln, have developed a new self-propelled gravel hopper, based on their well proven Imp chassis.

"Laying drainage systems on established golf courses has become an important part of our business," says White Horse Contractors' Managing Director, Mr. Robert Donald. "However, greenkeepers expect us to do as little surface damage as possible during the operation, so we need specialised equipment to achieve this aim. We use laser-guided tracked trenching machines to lay the drainage pipes and the trenches are then back-filled with gravel and topped-off with either lytag or a sand and soil mixture, using a specially designed gravel hopper."

Powered by a 94 kW, turbo-charged, diesel engine with hydrostatic four wheel drive and two or four wheel steering, the new machine is equipped with a moving floor hopper and a hydraulically operated gravel placement shoe. An important requirement was to make the machine suitable for one-man operation and this was achieved by designing a rear mounted platform, fitted with a remote control panel which duplicates the cab controls. This enables the operator to steer and control the machine from the rear platform, whilst at the same time controlling the flow of gravel from the hopper into the placement shoe. Wide, flotation tyres reduce ground pressure to eliminate rutting and four-wheel drive prevents wheel slip.

Contact: **Robert Willey, Managing Director, L W Household Ltd. Tel: 01400 272519.**

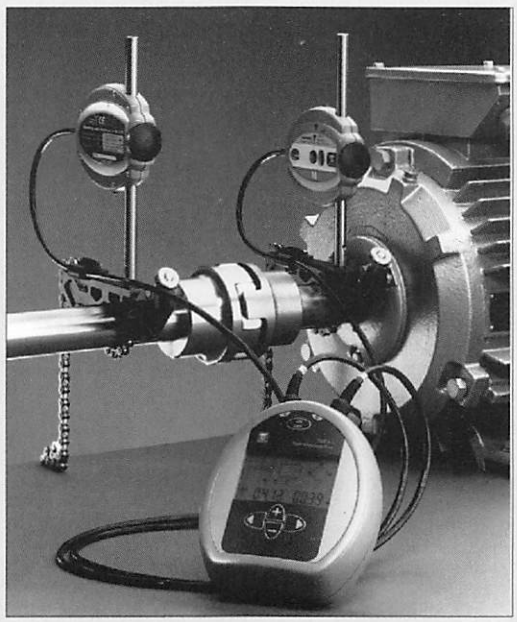
Shaft alignment made simple by SKF

By combining laser diodes and positioning detectors in two measuring units, SKF has developed a simple, accurate and very effective method of aligning horizontal shafts in rotating machinery.

Designated Shaft Alignment Tool TMEA1, the new device can be used without prior training and is ideal for service, maintenance and quality control departments across a wide array of industries. By perfecting alignment, engineers will be able to improve reliability, prevent vibration in shafting which, in turn, extends bearing and seal life, eliminates shaft fatigue, reduces energy consumption and problems associated with heat generation.

The ready to use TMEA1 kit comprises two measuring units consisting of a transmitter and detector, two shaft chain clamping fixtures, an LED calculator and display, a measuring tape and a set of pre-cut machinery shims.

In use, the measuring units are attached to each shaft and the on-screen display provides step by step instructions to guide the operator through the alignment procedure. The machinery can then be correctly positioned using the shim set according to the calculated 'real time' values determined by the diode l mV laser and single axis PSD detectors. Operation of the unit is by just four buttons with a clear LCD display on the 55 mm by 77 mm screen.



The TMEA1 unit can be used on shafts between 30 mm and 500 mm diameter and the maximum distance between the measuring units is one metre. Battery driven, the displayed error is better than two per cent and linearity better than one per cent. The unit is operable between 0° and 50°C. The TMEA1 kit is supplied in sturdy carrying case just 425 mm by 330 mm by 115 mm and weighs just 4.5 kg.

Contact: **Mr Chris Haywood, Marketing Services Manager, SKF Industrial Sales Division, Sundon Park Road, Luton, Bedfordshire LU3 3BL. Tel: 01582 490049**

Drain cleaning

Studies indicate that, in many parts of the UK, blockages occur in drainage, due to the formation of ochre. Clearing by rodding has limitations, therefore to overcome this, jetting is necessary. Generally drainage schemes installed in soils with a large proportion of fine sand or silt suffers sedimentation problems which require jetting of drains.

Well installed and maintained subsurface drainage systems help plant growth and ease the task of tillage. Crops grown on poorly drained land often have poor germination levels (wet soils warm slowly), poor responses to fertilisers, inferior root development and high incidence of diseases. The removal of water from the soil profile by drainage reduce harvesting problems, such as for instance helping the clean lifting of potatoes and improved movement over the ground.

The Homburg drain jetter fits on the tractor 3-point linkage. The hose guiding system is operated through two hydraulic motors and is remote controlled. The 5-chamber diaphragm piston pump is PTO driven. To make sure that no damage is caused to soil structure, working pressure is limited to 12-15 bar at the nozzle.

Drain jetters are now an essential tool in Dutch agriculture, with other European countries also recognising the importance of systematic cleaning of underground drains. Homburg the Dutch manufacturers have now established a base in Suffolk to serve the UK market. Four models are offered in the UK, with prices ranging from £5,300.

Contact: **John Colman, Salters House, Salters Hall Mews, Sudbury, Suffolk, C010 6DU. Tel: 01787 372233**

More big-lift telehandlers from Massey Ferguson

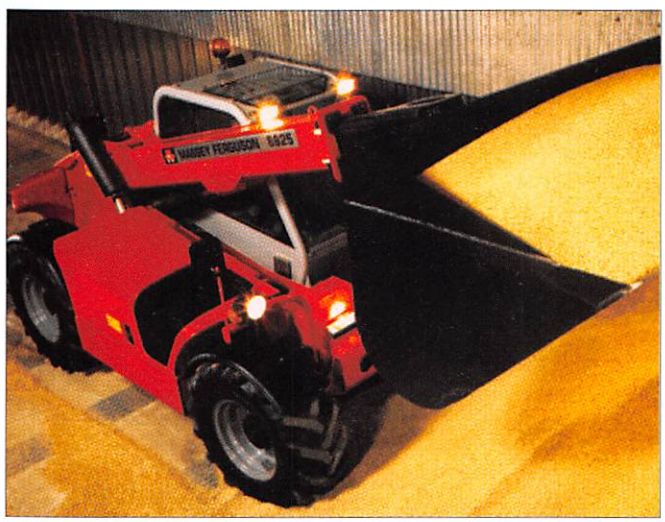
AGCO has given a big lift to its Massey Ferguson telescopic handler range with the introduction of three new models. Making a four-model line-up in total, all with hydrostatic transmissions, users now have a choice of load capacity and lift heights to suit most farm needs, combined with the leading features of the MF design for high output and easy, reliable operation.

The new machines join the existing MF8937, which was launched last year offering a 3 tonne lift capacity to a height of 7.11 m. This is now partnered in the extended MF telehandler range by the new MF8939. It will lift 1.9 tonnes up to 9.46 m, which is one of the best lift heights in its market sector, as well as providing the 3 tonne lift capacity of its sister model at heights of up to nearly 6 m.

Both of the other new models, the MF8925 and 8926, have been developed to combine more compact dimensions while still offering outstanding performance. The former will lift 2.5 tonnes to a full height of 5.56 m, and the latter has the same maximum capacity but will also handle 2 tonnes at its maximum lift height of 6.45m.

Maximum reach ranges from the MF8925's 3.05 m to 6.47m on the MF8939. All models feature rear pivot booms, and engines are mid-mounted for the enhanced stability this provides. The power plant is a 4-cylinder Perkins 1000 Series diesel, available across the range either naturally aspirated or turbocharged to give operators a choice of 60 kW or 78 kW.

Electronic control of the hydrostatic transmission gives smooth automatic changes between ratios in both the field and road speed ranges. It also provides 'aggressive' or 'gentle' control to suit the differing requirements of such jobs as grain loading or pallet handling. Maximum speed is up to 30 km/h depending on tyre specification.



Hydraulic power is supplied by a 91 l/min gear pump at 220 bar. Features include automatic levelling of attachments as the boom is lifted. All-wheel steering, crab steering or two-wheel steering modes, selected from the cab, ensure optimum manoeuvrability in wide-ranging conditions and situations

Noise- and vibration-isolating rubber mounts for the cab contribute to the comfortable environment for the operator. Tinted glass is fitted, and the cab also includes heating and fresh air ventilation, tilting steering column, adjustable spring suspension seat, full instrumentation and 4-function joystick boom control. Air-conditioning, roof and rear screen wipers and windscreen grille are among optional equipment.

The more compact dimensions of the MF8925 for working in tighter spaces include an overall length of 4.31 m, a width of 1.99 m and a height on 50 cm tyres of 2.09 m.

Recommended retail prices, with the 78 kW engine as standard, are from £36,000 to £44,400.

Contact : **John Briscoe, AGCO Ltd, P.O. Box 62 Banner Lane, Coventry. Tel: 01203 851221**

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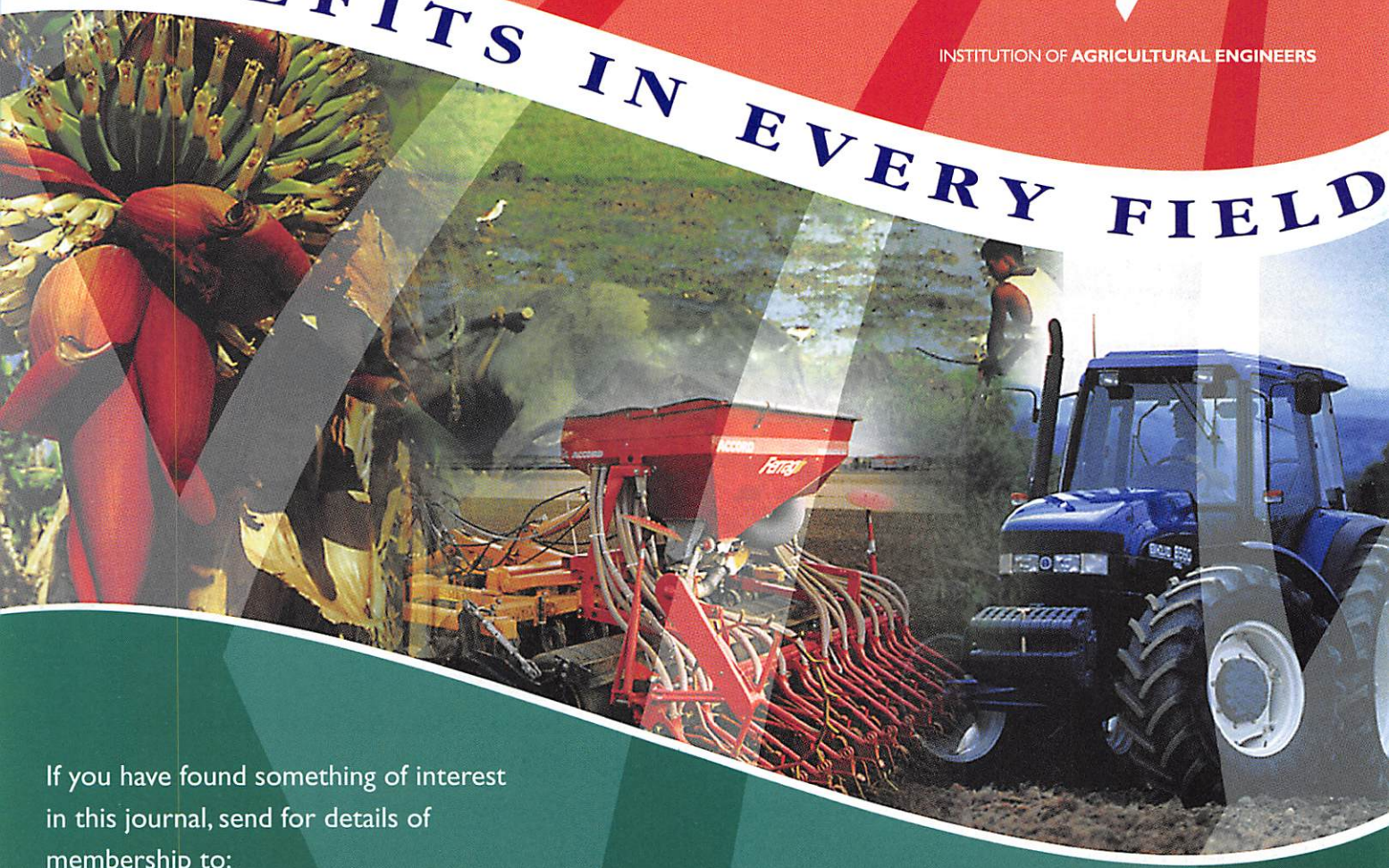

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