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Landwards

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Landwards

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Front cover: *New Holland Series 60 on the turn.*

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Editorial

Fifty years of publishing

It's time for change. Journals must reflect the current fashions and fortunes of their target readership.

We acknowledge the enterprise of our contributors and the skills of our editors over the past fifty years. Whatever may be the future role assigned to the agricultural industry in the economy of the nation, that period will go down to posterity as the age of the Agricultural Engineer. We can enjoy a sense of pride and satisfaction from being associated with the huge strides in mechanisation, the painstaking innovation, the advances in operator safety, and the progressive design refinements for higher performance and reliability.

But with this issue, we must look forward to the next half century, mostly in the next mystical millennium. Maximum food production is not the flavour of the month. It has been eroded by set-aside. And it is tempered by protection of our natural heritage and recreational access to the countryside. The diversity of the current objectives requires a greater diversity of skills. Many of our members are engineers - agricultural, forestry, environmental, biological, civil, mechanical, electrical, electronic,..... But engineering is not an end in itself, it is a means to an end. Our continuing success depends on teamwork by engineers scientists and practitioners involved with technology, from innovation to application, in *Agriculture, Forestry, Amenity* and *Environment.*

Whilst it is hard - well nigh impossible - to define a simple unique identity, "you'll know one when you see one". So where are all these like-minded enthusiasts? We have not gone to ground, simply broadened our appeal and enhanced our image to meet the needs, not just of agriculture, but also of other expanding markets in the land-based industries. Companies, research institutes, educational establishments have all adapted to conform with public opinion. If we wish to attract interest, generate awareness and invite participation, then our publications must project the right signals.

We have an intrinsic value of living systems, a direct involvement with the open spaces, with the land. Land is not just soil particulates, it is much more. It is a tract of ground and buildings; it is a region; and it is a country encompassing all the natural and biological resources.

We are involved in sustaining green and pleasant lands - productively. We have a common sense of direction and commitment, a common theme and interest in the land. That is why we are looking ***Landwards***.

BDW

The New 'Wor New Holland

New Holland, the world's largest tractor manufacturer following the merger between Ford and Fiatagri, has unveiled a new 'world' tractor range. The new tractors come in a choice of liveries, blue (Ford) and terracotta (Fiat) with different model designations but otherwise identical. In the New Holland Series M/60, there are four models covering the 75-119 kW (100-160 hp) sector. Together with five models in the mid-range Series L/35, and two models in the compact range Series 66S/35, there is comprehensive choice of specification and engine rating from 34 kW (45 hp) upwards. The flagship of the Series M/60 range is the M160/8560, with ample power from the 119 kW (160 hp) turbocharged engine and traction to match for heavy cultivations and for large trailed forage harvesters.

'Constant power', fuel efficient engines

The Series M/60's engines are of an advanced design, based on the same units which power New Holland's high-range Series G/70 tractors. They offer 7.5 litre, 6 cylinder, 'constant power' specification which provides good lugging ability over a wide engine speed band, reducing the need for regular gear shifts. Importantly, these engines comply fully with all the tough new European emission legislation restrictions which come into force at the end of 1996. New engine technology, which includes the use of re-entrant piston bowls, provides for efficient blending of air and fuel. The result is a quiet engine, with clean exhaust, and excellent fuel economy.

Three transmission standards

To maximise the benefit from the advanced engine design, three transmission standards are available. The first alternative is **Shuttle Command**, a fully synchronised, four gear, four range mechanical shuttle transmission, providing 16 forward and 16 reverse speeds for the two-wheel drive models and a maximum road speed of 32 km/h. In the four-wheel drive specification, an extra overdrive gear in each range gives a top speed of 40 km/h. Optional creeper boxes double the choice of operating speeds down as low as 230 m/h at maximum power, ideal for such tasks as precision planting and harvesting operations. Gear selection control is by a three-lever, clutch-controlled mechanical engagement system; gear levers being mounted to the right of the operator, within the main control console.

Dual Command is a four gear, three range, electro-hydraulic transmission with a two-speed powershift in each forward gear, offering a total of 23 forward and 12 reverse speeds for greater versatility in the field. The Dual Command powershift is controlled by two switches, mounted on top of the gear lever, and are used to select a high or low setting with engine braking on both. This enables the operator to reduce forward speed in each gear by 16 % when working through a heavy patch of ground, then increasing forward speed by 20 % again to return to the original speed for the normal conditions - without clutching. The two range and gear levers are mounted on the main console.

The power shuttle between forward and reverse is operated by a lever on the steering column. Modulated control of oil-cooled, multi-plate clutches provides smooth speed and direction changes.

Transmission speeds in Dual Command ensure that there is a full overlap of one gear between each range. This enables the operator to move up a range without compromising machine performance, or overloading implements. A

d' Tractor from

The overall styling is similar to the larger Series G/70 stablemates.

creeper speed option effectively doubles the number of working speeds available.

For maximum potential output, New Holland has developed a brand new, top-of-the-range transmission which enables the operator to extract full engine utilisation through a wide range of working and transport speeds. **Range Command** is an 18 forward and six reverse speed, semi-powershift transmission, providing six powershift speeds in each of three forward and one reverse range. Two switches are operated to control smooth changes of the six powershift speeds under load. Powered synchronisers are used for shifting between ranges. Thus, the operator can select 1st gear, and then select all through the range to 18th gear without clutching. Speed overlap between ranges throughout the fieldwork selection ensures infinite flexibility in choosing the right forward speed for the job in hand.

In standard format, Range Command offers a top road speed of 40 km/h and, with the optional creep speed, as low as 350 m/h at full power. The semi-automatic gear change function not only enhances machine performance but also reduces operator fatigue. In road work or fast top-work, for example, the operator can select top gear at standstill; the tractor will then pull away in first and shift up through each speed in the range when engine speed allows until the preselected gear is reached.

Electrolink
'intelligent' linkage system
Draft/Position/Intermix control
drop speed control
Dynamic Ride Control
wheelslip override control
weight monitor

High-spec front axles

Series M/60 tractors are available in either two or four-wheel drive configuration, the four-wheel drive, front axle providing a fully locking differential and a 55 degree turning angle for excellent manoeuvrability. Also included is **TerraLock**, a system which controls four-wheel drive engagement and front and rear differential locks with two levels of optional specification - basic and automatic.

The basic option provides four-wheel drive and semi automatic locking of the front and rear differentials. The operator selects TerraLock by depressing a side console-mounted touch pad, automatically disengaging the differentials either when the hydraulic linkage raise/lower switch is used or a single brake pedal is pushed, and re-engaging when the implement is returned to work or the brake pedal is released.

The fully automatic option operates in the same way as the basic system but, in addition, controls automatic four-wheel drive engagement. Sensors, mounted within the front axle, monitor steering angle and effect disengagement of the differential locks and four-wheel drive system when manoeuvring.

In either form, TerraLock increases tractive efficiency and removes the repetitiveness of essential operational functions at the headlands, enabling greater concentration on driving routines at higher travel speeds.

High capacity hydraulics

The hydraulic system operates at 190 bar, with an oil flow of 95 litres per minute (slightly higher on the M160/8560). There is a choice between the Open Centre hydraulic facility using gear pumps, and the Closed Centre Load Sensing version which consists of a variable displacement pump design with three pumps in a single unit.

The closed centre system senses the demand when a hydraulic service is activated, only supplying the flow required and so minimising power usage. A low pressure, high flow, charge pump provides oil for the main swash-plate pump. Also within the same unit, a dedicated pump provides a flow of 60 litres per minute for the fully hydrostatic, self-centring steering system functions, uninterrupted by any operation of the lift linkage and external services.

The maximum lift linkage capacity is 6730 kg at 610 mm behind the lift arm ball ends.

Linkage control systems

Two options of hydraulic control are available, the first being a mechanical Draft Control system which senses draught forces through a lower link flexion bar. This flexing sends a signal to the hydraulic servomechanism which automatically adjusts implement depth until the draught matches that set by the operator. Two levers control the linkage setting, one for depth and one for draught.

Included within the mechanical system is **'Lift-O-Matic'**, New Holland's automated linkage control system which effectively allows the operator to maintain constant implement settings, regardless of engagement and disengagement routines at the headlands. With the touch of a control button mounted on the side console, the hydraulics automatically lift the implement out of the ground, then return it to the pre-set level in the working condition.

The second hydraulic control option is **Electrolink**, a fully electronic 'intelligent' Draft Control system, still retaining the traditional quadrant lever controller for positioning the implement, and including a fast raise/ lower switch for fast headland turns. With this system, all the operator needs to set is the draught and depth. Electrolink then monitors implement response and adjusts the preferred implement settings automatically. And there are external control switches to raise and lower the linkage when attaching an implement.

Other hydraulic system features enhance machine performance and operator comfort. Drop speed is infinitely variable, controlling rate of descent relative to implement weight. New Holland's new **Dynamic Ride Control** system enhances the comfort factor when transporting heavy implements by sensing and absorbing the bounces. It is an active suspension system, electro-hydraulically controlling oil flow to and from the three point linkage cylinders to damp the oscillations. There is also an optional 'Wheelslip Override' which can be used in conjunction with draught and position control. By adjusting depth and draught, this feature ensures that the maximum wheelslip value, pre-set by the operator, is not exceeded. When the wheelslip of the tractor is below the pre-set maximum value, the working depth is controlled by the draught/position control lever, the intermix and the quadrant lever.

Good operator environment and ergonomically designed control console.

The 'intelligent' control system integrates the implement with the tractor. As the implement is lifted, Electrolink gauges the weight and adjusts the hydraulic responses accordingly. This allows fast ground engagement because the removal of weight from the linkage, when the implement touches the ground, eliminates the drop speed restriction automatically.

Up to four single or double acting remote control valves are available for optional fitment. Front linkage is a factory fitted option and has a lift capacity of 3200 kg, with lift control, through a height restrictor, from one of the rear remote valves.

Direct drive PTO system

The single speed, 1000 rev/min, front PTO drive comes directly from the engine, via a multi-plate wet clutch, and is controlled from the console to the right of the operator. Rear PTO options include 1000 rev/min, 540 rev/min, and 540E (750 rev/min). Maximum engine power occurs at the most beneficial engine speed setting for efficient PTO use. With electro-hydraulic control of both front and rear PTO drives, there is also no need to interrupt the drive to the tractor wheels.

Productivity potential

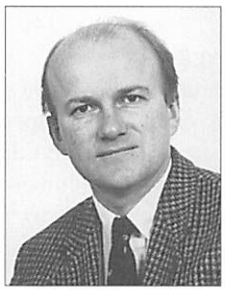
Operator environment is a major factor in the productivity potential of these new tractors and New Holland has paid considerable attention to detail. Operator cabs, with six-post ROPS, combine excellent all-round vision with easy access via large entry doors hinging from the rear. The Series M/60 are available with options on a choice of seating, from mechanical damping to air suspension and, regardless of which seat is specified, there is adjustment for weight, rake swivel and damping. By careful selection of seat position, operators can maximise access to machine controls, improve sightlines and alter seat response to optimise ride comfort even on difficult terrain. The recirculatory air system passes fresh air through roof mounted filters, and into the cab via adjustable outlets.

Externally, the Series M/60 tractors take on a futuristic appeal, with sloped bonnet for greater visibility, and an overall styling similar to their larger Series G/70 stablemates.

Precision farming: the price of imperfection

A case study using fertiliser distribution

Ian J Yule and Edward Crooks



A great deal of interest has been generated in precision farming in recent years. This has primarily been because an accurate location system has become available in the form of a differential global positioning system (DGPS). The cost of such systems has been much reduced and farmers can now begin to seriously consider variable application of inputs, such as fertilisers and sprays, where yield mapping has been performed. While much effort has been concentrated on the positioning aspects of precision farming, there is a need to focus on the present standards of performance of machines we wish to control for variable rate applications.

Initial work in precision farming has shown that there is a great deal of variation in crop yield. This work identifies areas of weakness in a farming system and shows that there is potential to increase overall yields by a combination of better targetting of inputs and improved management standards. All of the benefits of precision farming will be lost, however, if machinery is not maintained to the highest level and calibrated regularly.

Fertiliser is a particular area of concern where much has been made of the opportunities to improve economic performance through matching the fertiliser application to the potential of an area. However, it is evident that there is a requirement for much more rigorous standards in machinery management and maintenance in order to achieve these targets. An actual case study is used to demonstrate the cost implications from having incorrectly set and poorly maintained machines.

Table 1 Coefficient values of a_1, a_2, a_3, and a_4 for ten arable crops, after England (1986).

Crop	Crop yield response coefficients			
	a_1	a_2	a_3	a_4
1st Wheat after break	9.12	6.541	0.9820	0.0131
2nd Wheat after break	8.16	5.796	0.9857	0.0075
3rd Wheat after break	9.43	9.739	0.9881	0.0120
W barley after break	10.89	9.089	0.9908	0.0201
W barley after cereal	9.99	8.936	0.9923	0.0146
S barley after break	11.82	9.286	0.9909	0.0305
S barley after cereal	16.63	15.500	0.9944	0.0364
W oilseed rape	6.39	4.638	0.9910	0.0061
Maincrop potatoes	40.39	12.340	0.9897	0.0103
Sugar beet	38.97	26.630	0.9778	0.0112

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Introduction

The basis for precision application of fertiliser is that each area of land has a potential which can be described by a fertiliser/yield response function and the inputs to that unit can be exactly matched with the requirements, thus reducing waste and improving financial performance. These yield response functions have been established through experimentation at different sites and take the form of quadratic equations, modified exponentials and modified inverse polynomials.

Fertiliser response in arable crops

For winter wheat, quadratic functions have been described by Kling (1986). The following soil specific equation is adapted from that work, where Y is grain yield and N is nitrogen application, both described in kg/ha.

$$Y=5420+27.75N-0.053N^2 \quad [1]$$

Shiles(1989) developed an equation for winter barley where:

$$Y=4421+33.8N-0.11N^2 \quad [2]$$

Based on a wheat price of £124/t and a nitrogen cost of £0.31/kg (N), *Equation [1]* gives an optimum return at approximately 190 kg/ha, while *Equation[2]* indicates the economically optimum application of N to be 140 kg/ha, based on a price of £104/t for feed barley and the same N cost. The cost of deviating from

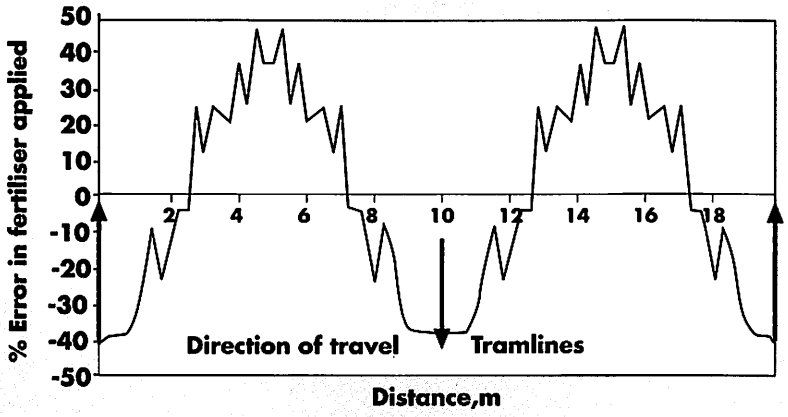

Fig. 1 Lapped spreader pattern

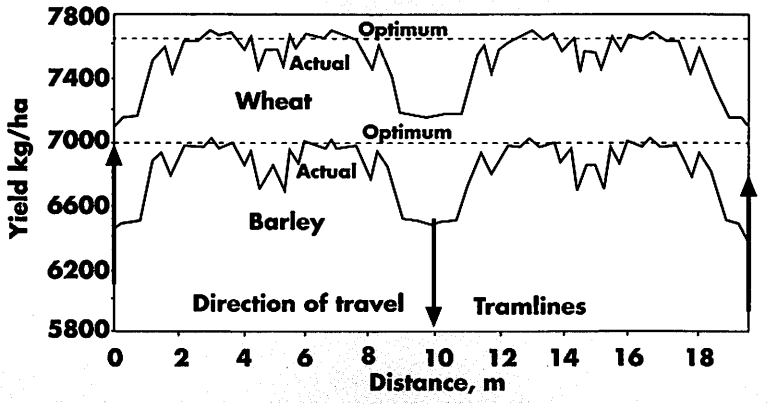

Fig. 2 Yield effect from lapped pattern

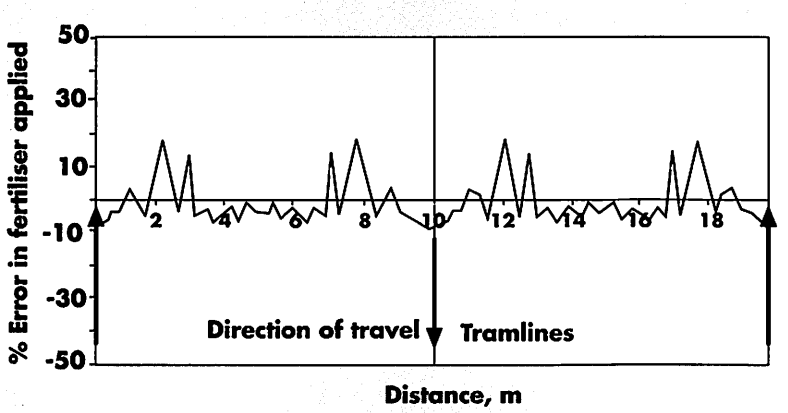

Fig. 3 Lapped spreader pattern after calibration

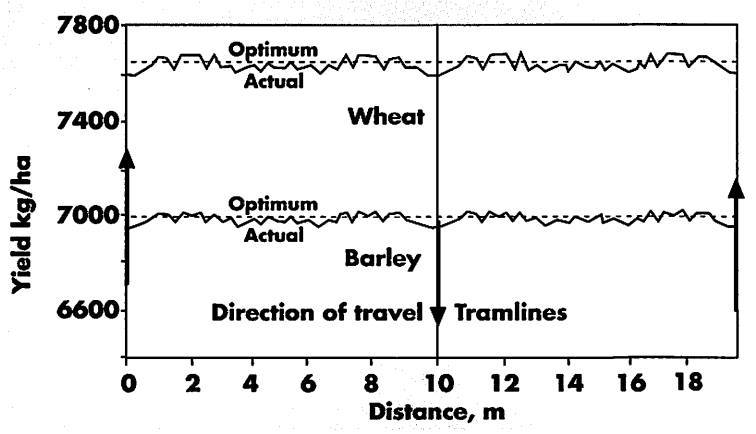

Fig. 4 Yield effect from lapped pattern after calibration

these optima can be readily calculated.

Utilising data from ADAS field trials, England (1986) developed a number of response curves for arable crops *(Table 1)*. The general form of the equation is:

$Y=a_1-a_2(a_3^N)-a_4N$ [3]

Fertiliser response in grassland

Morrison *et al.* (1980) conducted an extensive investigation into the response of perennial ryegrass to N fertiliser in relation to climate and soil. It was found that an inverse polynomial function offered the best fit to the data:

$$Y=\frac{a+bN}{1+cN+dN^2} \quad [4]$$

where Y is given in kg/ha.

The study, conducted over 21 sites in England and Wales, produced site-specific values for constants a, b, c and d. For example, at Cambo in Northumberland, a=5944, b=15.2952, $c=7.443\times10^{-4}$, $d=1.6293\times10^{-6}$.

Spreader performance

Using these same equations and a known spreading pattern, is it possible to calculate the cost of an incorrectly set fertiliser spreader. England and Audsley (1987) describe how the coefficient of variation of the spread pattern can be used to calculate the effect of uneven spreading on crop growth and ultimately on financial loss. The coefficient of variation, C, is given by:

$$C=\frac{s}{\mu}100 \quad [5]$$

where:

s = standard deviation

μ= sample mean.

ISO standard 5690/1 describes the equipment and procedures used in testing the performance of a full width fertiliser distributor.

Figure 1 represents the actual spread pattern from a spreader prior to maintenance and calibration. The figure shows severe problems, with some areas being given 40 % more fertiliser than required while others receive 40 % too little. The coefficient of variation of the spread pattern is 29 %. *Figure 2* represents the effect of this on yield, assuming no lateral movement of fertiliser after spreading. Due to the nature of the fertiliser/yield function, excessive fertiliser can actually cause a yield reduction. No account is taken of the increased likelihood of lodging and it's effect on har-

Table 2. Relationships between financial loss (L,£/ha), crop price (P,£/t) and the coefficient of variation (C,%) of the lapped nitrogen fertiliser spread pattern. Adapted from England and Audsley (1987). Prices: current market price, Farmers Weekly 21/9/95

Crop	Price, £/t	Financial loss coefficients		Loss at C of V of 20%	
		a	b	£/ha	%
1st Wheat after break	124.90	0.000182	1.975	8.43	6.80
2nd Wheat after break	111.20	0.000164	1.978	6.83	7.50
3rd Wheat after break	111,20	0.000273	1.975	11.27	5.90
W barley after break	104.00	0.000210	1.950	7.52	7.10
W barley after cereal	104.00	0.000210	1.955	7.63	7.10
S barley after break	104.00	0.000162	1.931	5.48	8.30
S barley after cereal	104.00	0.000219	1.933	7.45	7.10
W oilseed rape	168.30	0.000062	1.931	3.41	10.60
Maincrop potatoes	171.40	0.000364	1.964	22.40	4.05
Sugar beet	40.00	0.000065	1.995	11.38	6.25

vesting efficiency and drying costs. *Figure 3* represents the spreading pattern from the same machine after it has been fully reset and calibrated, some smaller peaks still exist although the coefficient of variation has been reduced to 7.63 %. A spreader operating to this standard has a minimal influence on the final yield of the crop, as illustrated in *Figure 4*.

England and Audsley (1987) produced an equation to represent the financial loss from uneven spreading and applied it to the ten crops represented in *Table 2*. The equation for financial loss is given as:

$L=aC^bP$ [6]

where:

L = financial loss, £/ha

C = coefficient of variation of the lapped spread pattern

P = selling price of the crop, £/t

a and b = constants for the given crop.

Utilising this analysis it is possible to calculate the financial benefit of calibrating the spreader *(Table 3)*. Maintaining a spreader to a high standard is clearly important in this example. When considering winter wheat, the cost reduction was £16.20/ha; while under winter barley, it was £14.27/ha. This approximates to 22 % of the total nitrogen fertiliser cost.

Machine operation and maintenance

The spinning disc and spout fertiliser distributors rely on a lapped pattern between successive passes of the machine to achieve an even spread pattern. If these machines are being controlled under a variable rate controller for precision work, failure to take account of fertiliser already spread on the crop from the last pass will make the system less accurate. We have to ask ourselves the question: Is this mode of operation suitable for precision farming? There is no doubt that pneumatic spreaders can give just as poor results if improperly maintained but they would appear in principle to give a better opportunity for variable spreading. There is, of course, a trade-off in that these spreaders are generally more expensive than spinning disc or pendulum types. It has further been suggested that liquid nitrogen application may be worth considering for precision application.

As bout widths have increased, headland or border cut-off devices have become more important. Many machines still have little or no provision for this and the farmer must strike a balance between putting excessive amounts of fertiliser into the hedge and leaving a strip of partially fertilised crop around the outside of the field.

Table 4 summarises many of the problems which can occur on fertiliser spreaders. All three types require regular maintenance and inspection. Most of the tasks involved are simple but it is important to check the spread pattern and calibrate the machine regularly.

Fertiliser Quality

The quality of the fertiliser is very important, dusty or soft fertiliser being extremely difficult to spread to wide bout widths. Fertiliser sticking to the vanes, spouts or rotors will cause a change in spreading pattern. Different fertilisers have individual flow characteristics which will again change the spread pattern, and operators need to be aware of this. Fertiliser manufacturers have recognised this and have attempted to rate a fertiliser according to its physical attributes which determine spreading characteristics. This allows each fertiliser to be described in terms of a standard spread pattern rating, 'SP' rating. The main factors affecting the performance of the product were: consistency of particle size, high bulk density, good flow characteristics and good particle strength to reduce crushing. Large particles tend to be thrown further than small particles, a predominance of either reducing the spreading accuracy.

Table 3. Case study example: economic benefit of spreader calibration.

	C of V	Crop loss, £/ha	
		Wheat	Barley
Before calibration	28.91	17.46	15.42
After calibration	7.63	1.26	1.15
Economic benefit		16.20	14.27

Economic model

A spreadsheet programme was developed to calculate the cost inaccurate

Table 4. Common problems encountered with fertiliser spreaders

Problem area	*Spreader type*		
	Disc	***Spout***	***Pneumatic***
Tractor	PTO speed	PTO speed	PTO speed
Mounting	Level spreader Spreader height	Level spreader Spreader height	Level boom Boom height
Feed mechanism	Incorrect agitation Feed gate	Incorrect agitation Feed gate Worn feed pot	Air leaks Feed gates unequal Worn rotor bearings Worn spreader plates
Spreader mechanism	Incorrect disc/vane setting Incorrect discs/vanes Incorrect disc speed Worn vanes	Incorrect spout setting Incorrectly assembled arc adjusters PTO timing Worn spout	Damaged spouts or tubes Damaged/worn boom

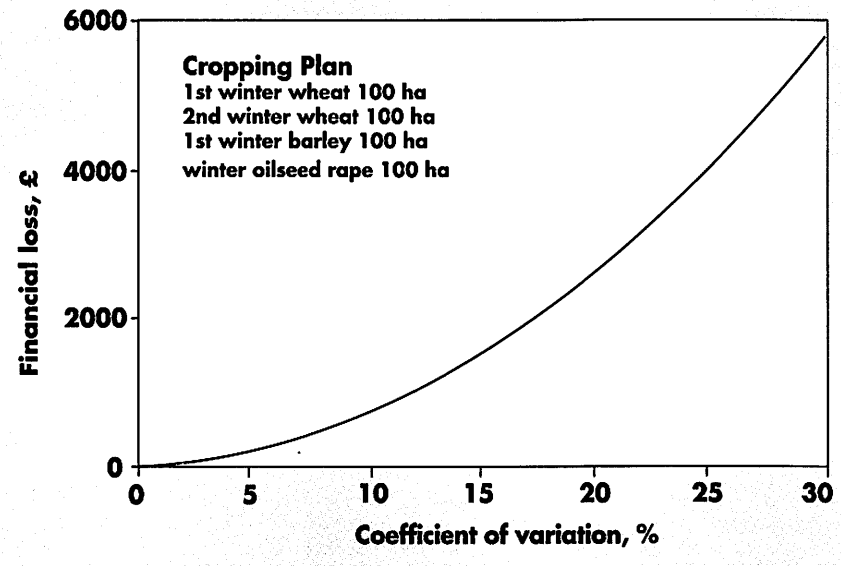

Fig. 5 Financial loss due to inaccurate spreading of N fertiliser.

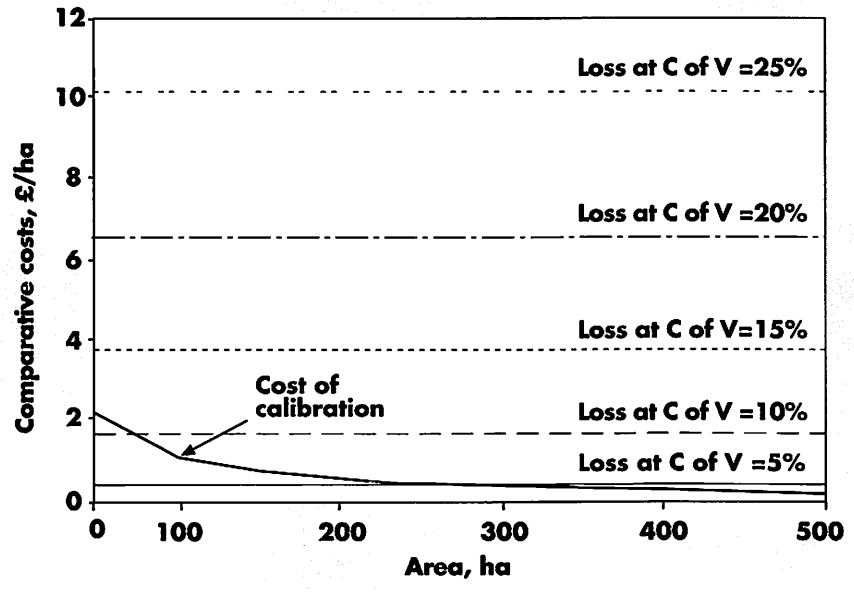

Fig. 6 Cost of calibration: comparison to financial loss at different levels of coefficient of variance for spreader.

spreading. *Figure 5*, indicates the financial loss, from the given cropping plan, when the coefficient of variation is considered. A break-even analysis is illustrated in *Figure 6* which considers the cost of calibration against area, utilising the same rotation as in *Figure 5*. The cost of calibration given in this case is £110. Both figures demonstrate the economic necessity of calibration. If the spreader considered in *Figures 1 & 2* had been used over 400 ha, the financial loss would be in the order of £6000, whereas the cost of calibration is £110. Even after calibration, a small coefficient of variation will remain; in the case illustrated, it was 7.63 %. This, however, does not constitute a significant financial loss.

Figure 5 is not sensitive to changes in fertiliser price as the "loss" is a loss of potential crop and therefore based on the price of each crop commodity. The increase in fertiliser price for the 1996 season to £0.41/kg (N), causes an average reduction in margin for the rotation illustrated in *Figure 5* of £14.27/ha, or a total cost of £5,700 over the 400 ha.

Conclusions

An estimated £56 M is wasted every year in the UK through inaccurate fertiliser application. There is considerable evidence that much of the machinery used for fertiliser application is incorrectly set or poorly maintained. This demonstrates the need for changes in attitude towards machinery operational management, if practices such as precision farming are to be successfully adopted. The case study is intended to demonstrate to the farmer what this lack of care is costing. The environmental impact of inaccurate spreading has not been considered but it is clear that accurate spreading is a requirementin order to reduce nitrogen leaching.

All of this highlights the need for innovation in developing new systems for accurate fertiliser placement, as well as improving the performance and serviceability of existing machine types. The answer does not necessarily lie in developing more mechanically complex machines as market trends would indicate that farmers will tend not to adopt machines where increased sophistication means increased cost. This can be illustrated by the market trend for fertiliser distribution equipment in the UK in the period 1984 - 1994, (AEA Statistics

Dept. 1995). In 1984, pneumatic spreaders accounted for 10% of a total market of 7,600 machines. For 1994, the total market was estimated to be 3,900 machines of which only 4% were pneumatic.

Three parties have considerable influence in trying to improve this situation: the farmer, through better operational and maintenance practices; the engineer, in improving the performance and reliability of existing machinery and developing new systems to meet the requirements of precision farming; and thirdly, the fertiliser manufacturers, by providing a consistent product to meet spreading requirements.

There are definite benefits from precision farming but it is clear that these will be lost if the machinery used to administer the crop inputs is either poorly set or badly maintained. This paper further seeks to demonstrate the high cost of such poorly managed machines even outside the context of precision farming.

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Superplan goes national: the first in the World

Ordnance Survey, Great Britain's National Mapping Agency, is celebrating the national availability of Superplan, using the latest technology to make the 290 000 large scale plans available to commerce, industry, government and the general public. The Superplan plotting system allows access to the latest large scale information from any of Ordnance Survey's Superplan Agents dotted about the country. Using digital communications, map detail from anywhere in the country can be called up and displayed on a computer screen. This information can then be manipulated to fit the customers requirements. A Superplan plot is not restricted by the old constraints of sheet edges or scale. The customer simply identifies the feature of interest and this is moved to the centre of the screen and subsequently plotted out on paper, or film.

Superplan was one of the services that helped gain Ordnance Survey a Citizen's Charter CHARTER MARK. Each year Prime Minister John Major awards up to 100 CHARTER MARKS and he has congratulated Ordnance Survey on the achievement of building a partnership between the public and private sector. His personal commendation was presented at the event by Earl Ferrers, Minister for the Environment & Countryside. Ordnance Survey is proud of its CHARTER MARK, so much so that constant development and improvement of products and services is now indelibly part of the organisation's culture.

For general information on products and services contact: **Steve Yeates, Ordnance Survey. Tel: 01703 792635.**

New mouldboards add versatility to Vogel & Noot ploughs

Two new solid mouldboards are being introduced by Anglia Imports to increase the versatility of Vogel & Noot Euromat 3S reversible ploughs.

The 'MPK430' is a long cylindrical mouldboard designed for heavy, sticky soils reluctant to flow smoothly over conventional 'spiral' shaped mouldboards. it has a deep body profile immediately behind the substantial shin, but the upward taper and lack of curl then discourages soil from sticking, while the long tail ensures complete furrow inversion.

In contrast, the 'UL430' mouldboard has an aggressively rounded and blunt shape designed to move a lot of soil to leave a wide, clean furrow bottom for wider tractor tyres, and a broken but level finish.

The new designs, fitted in combination with hard-wearing shins, shares and reversible chisel points that give a long service life in the most abrasive soils, can take the place of the standard universal mouldboards on new Vogel & Noot Euromat 3S plough at no extra cost. Manure skimmers and plain or serrated rear disc coulters are standard on all Euromat 3S reversible ploughs which range from the light duty 'L' models in two- and three- furrow sizes, to the extra-heavy duty 'S' version in four- to six-furrow configurations.

For more information, contact: **Charlie Dyke, Anglia Imports Ltd, North Walsham, Norfolk, NR28 0AN. Tel: 01692 407233.**

Fitting new roads into the landscape

Simon Bell

There is no doubt that the landscape, that is what we see around us and experience by all our senses, is important to the majority of people. It can be considered as the human habitat. Rural landscapes are often perceived as unchanging, as 'natural', and as places to go to escape the stresses of city life. People care very much about the quality of this kind of landscape and get very worried if changes occur which are to its detriment. A wide range of professions work in the countryside and many of their actions alter the appearance of the landscape. It is important, therefore, for the well-being of the landscape, for the satisfaction of those who love it and for its continual management that all activities - afforestation, buildings, utilities and roads - are well designed to fit into the landscape. Design means developing strategies to convert existing situations into preferred ones and encompasses a wide range of factors besides visual quality.

Successful design needs skill. It requires that those responsible for a development, such as a new road, understand how to evaluate the effect of their proposals on the landscape as well as they can evaluate their cost and functional efficiency. To do this, an ability to 'read' the landscape is necessary. There is now a well recognised way of doing this, using a set of defined visual design principles (Bell, 1993). These principles allow us to analyse and describe the landscape and subsequently to design solutions which fit into it better. There are several major principles which are worth explaining before looking in detail at the methods of fitting roads into the landscape.

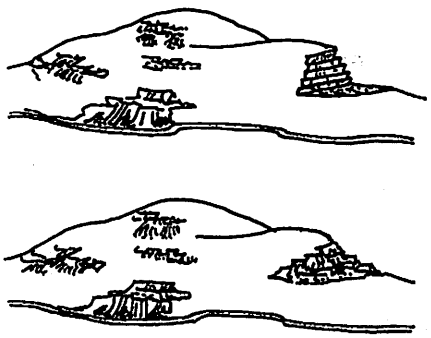


Fig. 1 *Shape.* **The quarry(top) has lots of geometric shapes which stand out as being artificial, whereas the more naturalistic quarry face of organic shapes (bottom) relates visually to the natural rock areas.**

An earlier version of this paper was presented at the IAgrE conference entitled: "Low cost, unsurfaced roads", organised by the Forestry Engineering Group and held at Heriot Watt University, Edinburgh on 22 March 1993. ***Simon Bell is Chief Landscape Architect based at Forestry Authority, 231 Corstorphine Road, Edinburgh, EH12 7AT.***

Basic design principles

a. Shape

This has a very powerful influence on what we see. We pick out shapes in the landscape often on the slightest evidence. Some shapes can be categorised as geometric, regular, artificial and man-made, while others are organic, irregular or natural. There are plenty of examples of geometric shapes in the landscape - early forests planted on hillsides, the surveyed grids used in field layouts, straight roads cutting across topography *(Figure 1)*. By comparison organic shapes, such as irregular natural woodland or sinuous curving roads, seem to stand out less and be perceived as more compatible with the landscape around them.

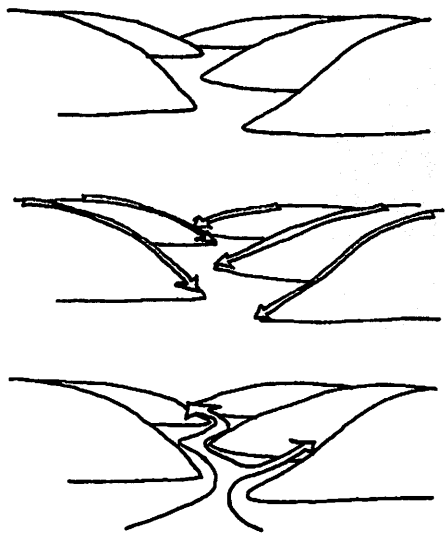


Fig. 2 *Visual force.* **Using a sketch (top) of a landform and a lake, visual forces lead our eyes down the ridges (middle), and up into the valleys (bottom).**

b. Visual force

When we look at a landscape, our eyes are sub-consciously led around different parts of it in a pre-ordained way. It has been found that our eyes tend to be led up valleys, hollows and concavities and down ridges, spurs and convexities *(Figure 2)*. Shapes which cut across or interrupt these flows or lines of visual force can produce unresolved, jarring effects which reduce the compatibility of that shape. For example, a road cutting across a contour may fit less well than a more winding alignment.

c. Scale

The relative dimensions of the landscape in relation to our own size and the amounts we can take in at one view determine its scale. Small elements can

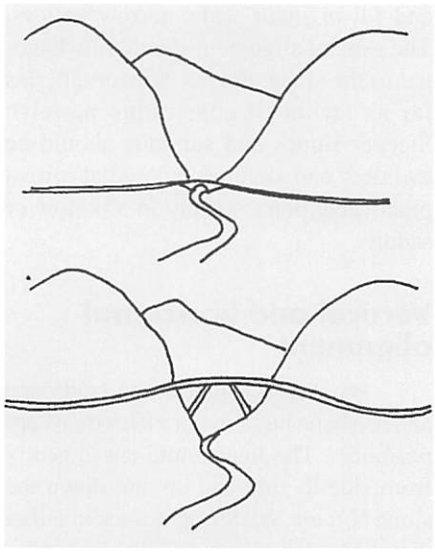


Fig. 3 *Scale.* **A small bridge (top) fits the scale of the landscape, whereas the larger bridge (bottom) tends to dominate the view.**

seem lost in large scale landscapes, while large elements can dominate over small scale ones *(Figure 3)*. Therefore, it is important to work at the correct scale.

The *Spirit of Place* is an intangible, elusive quality, easy to damage and difficult to repair

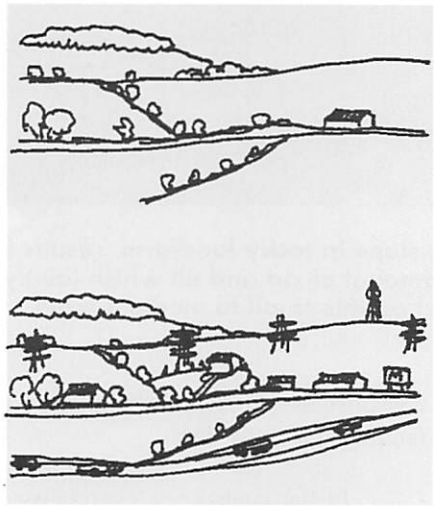


Fig. 4 *Diversity.* **A pleasant landscape (top),with some diversity provided by woods, trees and a house, becomes too diverse and chaotic (bottom) when many other features are introduced.**

This is complicated by the effect of different observer distances and between internal and external views, especially in forests.

d. Diversity

We respond positively to landscapes which contain certain amounts of variety. A landscape with very little diversity can be boring, while one containing too much can be confusing *(Figure 4)*. Additional elements can tip a landscape which is already very diverse into chaos.

e. Unity

Diversity has to be balanced against the need for unity in a landscape, where all the parts belong to the whole. An incompatible shape or an element creating a lot of contrast can fail to achieve unity with its surroundings and so look distinctly unhappy and out of place *(Figure 5)*.

f. *Genius loci* or the Spirit of Place

All landscapes are different although there might be general similarities amongst some of them. The sense of place is important to us in that it helps to identify a particular location and make it special. It is an intangible elusive quality easy to damage and difficult to repair. New elements introduced into a landscape should avoid damaging the *genius loci* and ideally should complement it *(Figure 6)*.

Landscape design

Landscape design has been defined as: "the organisation of a place in a way which reconciles the conflicting requirements of use while ensuring an attractive appearance" (Lucas, 1991).

It is fundamental to recognise that a good design is one which fulfils the three criteria of *BEAUTY, UTILITY* and *EFFICIENCY*. Each of these can be measured or defined to some extent. In the rural situation, *BEAUTY* usually means adhering to the main principles outlined above, achieving unity, diversity and responding to the *genius loci* in order to blend new features into the existing landscape or by respecting its character. Landscape design is, therefore, neither a cosmetic application to prettify something, nor screening or otherwise mitigating the worst effects of an ill-considered development.

The rest of this paper will deal with the visual quality part of the equation described above. It must be stressed that the three aspects are not normally

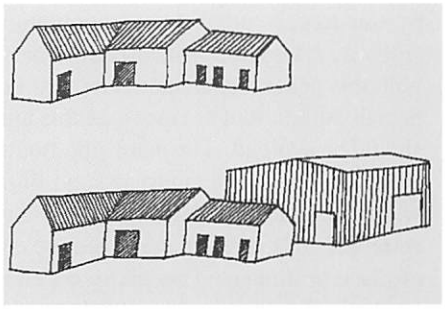


Fig. 5 *Unity.* **The buildings (top) all comprise a unified composition due to their shapes, sizes and colours being similar, contrasting with the disharmony generated by the addition of a mismatched building (bottom).**

considered separately but are integrated: this is really what design is all about. It is a process, starting with the objective of the development and the landscape

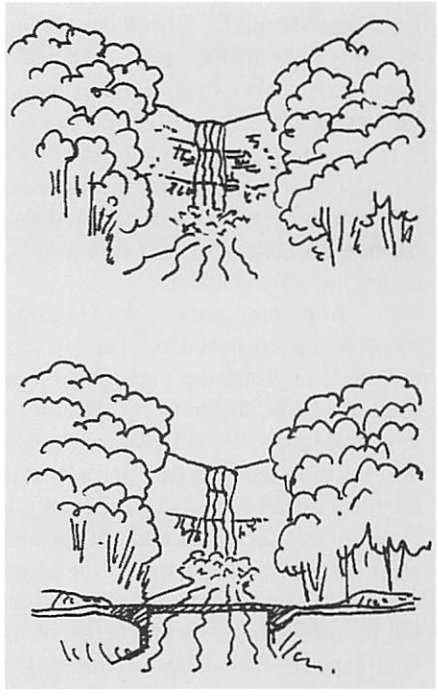


Fig. 6 *Genius loci.* **The view of a dramatic waterfall and tree lined gorge (top) is disrupted by incorrectly locating the road and bridge (bottom), an artificial intrusion which detracts from a landscape feature with a strong sense of place.**

within which it is to be placed, of achieving a mutually compatible solution.

At this stage, we need to consider what the visual design objectives are likely to be when considering a new road development. In the countryside and particularly in wilder, mountainous areas, the qualities of naturalness are highly valued by our largely urban based population *(Figure 7)*. Developments which contrast with this general character and more especially urbanise it are incompatible and should be avoided. The main aim should be to blend with the landscape and fit in with its character. That is not to say that certain engineering structures need be out of place or hidden. This partly depends on the scale, allowing the landscape to dominate, not the engineering structure. Sometimes the landscape quality can be enhanced by the contrast of a bridge spanning a ravine, for example some Swiss or Italian bridges in mountainous landscapes.

Road location

The first major decision which needs to be taken is the location of the road and the general route corridor to be followed. When choosing a road line and surveying potential routes, an appraisal of the landscape should be carried out *(Figure 8)*. This may involve using sketches or photographs taken from significant public viewpoints and testing the impact of various general options. Computer analyses based on digital terrain models can also be used for this. The appraisal should include all factors to be taken into account, not only visual ones.

Important parts of a road alignment include: those points where the road crosses a skyline; the geometry of the road at bends, hairpins and junctions; large scale cuts, fills, culverts and bridges, all of which can increase the artificial qualities of the landscape, especially in close views. Natural qualities of the landscape should be reflected in the alignment. The aim is not to disguise the road but to reflect the scale and forms of the landscape in their design. If these factors are taken into account at an early stage the additional costs can be minimal with little or no effect on functional efficiency, yet the environmental benefits can be substantial.

The general location of roads should be planned to avoid important habitats and appear unobtrusive in the landscape. In agricultural landscapes, access roads can be hidden behind hedgerows, dykes and walls or hollows amongst landform. Landscapes of particular quality or *genius loci* should be avoided, for example, focal views, water edges and waterfalls.

Beauty, utility and efficiency are the hallmarks of good design

Watercourses of particular quality should be crossed at the least visible point. High standards of design and construction must be achieved in these sensitive locations.

The visible parts of the road should be in scale with the landscape, for example by not running close to the skyline for long stretches and avoiding routes which will result in large amounts of cut and fill in small scale, narrow valleys. The general alignment should run diagonal to the slope and not horizontally (as far as technical constraints permit). Steeper slopes and summits should be avoided and skylines crossed at lowest practicable point, ideally in a hollow or saddle.

Vertical and horizontal alignment

A road is a line in the landscape and its shape has a major effect on its appearance. The line should curve gently from side to side and up and down the slope *(Figure 9)*. Straight lines in either direction tend to cut awkwardly across landform, especially where they conflict with lines of visual force. In order to blend with landform, roads should be deflected downwards on convex slopes and rise slightly in hollows and valleys. The degree of inflexion depends on the scale of the landform. Where this is large, generous curves are needed which will appear as simple engineering on the ground. In small scale landscapes, over-simple construction will obliterate landform detail if not carefully done.

In flat landscapes, especially in forests, roads have tended to be straight in the past. These can look artificial away from the built environment and can be daunting to walkers or cyclists. Curving alignments look more natural, taking advantage of any landform present.

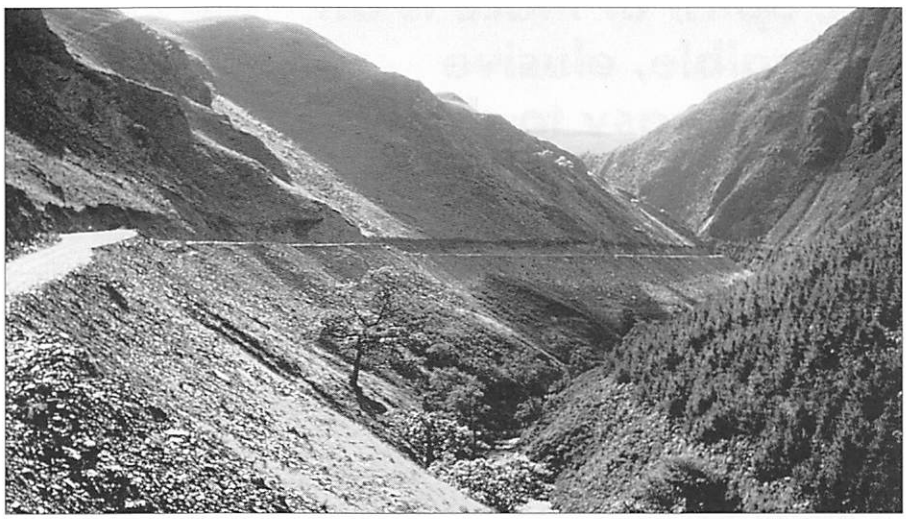
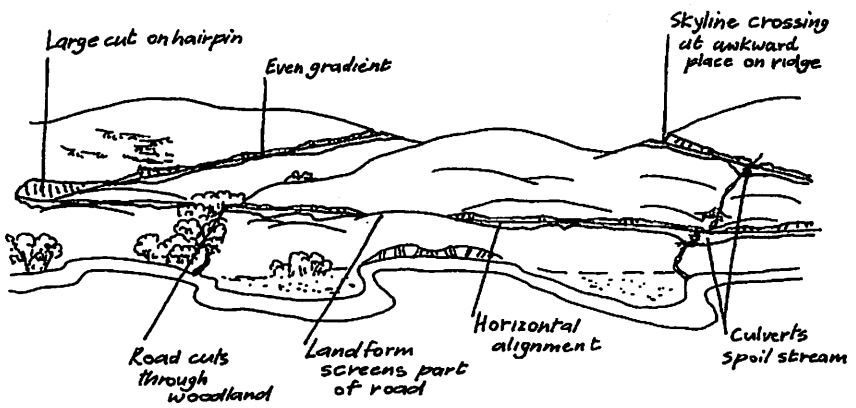
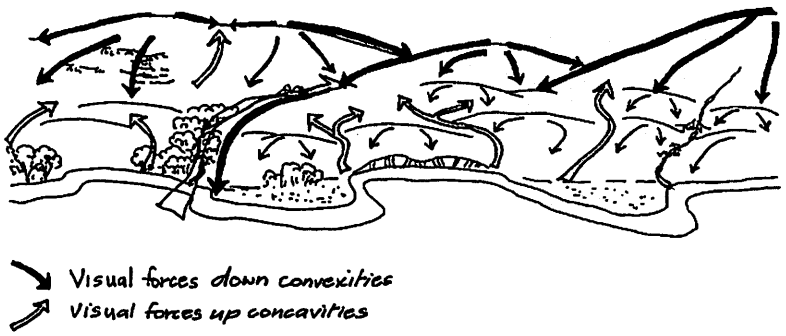


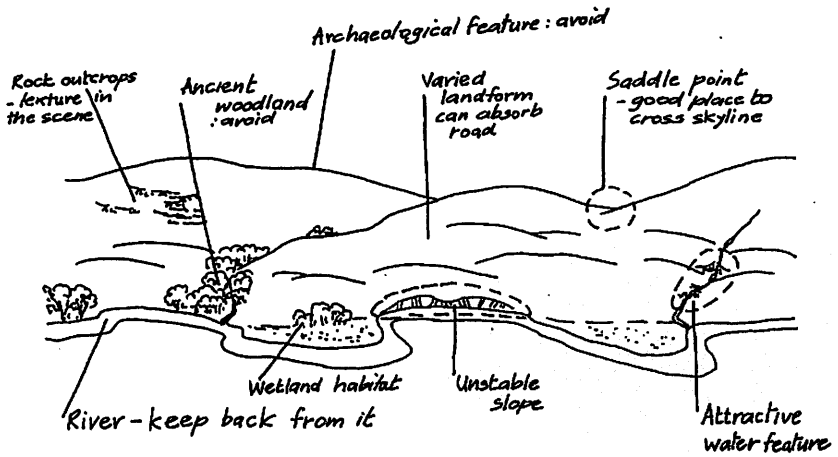
Fig. 7 This road, traversing a severe slope in rocky landform, results in a straight horizontal line and large amount of cut and fill which jointly contribute to its highly intrusive effect on this small to medium scale landscape.



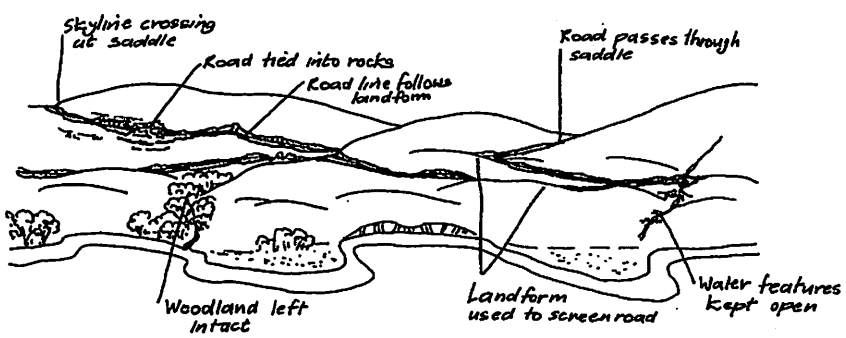
(a) Illustrating potential problems, such as horizontal alignment, skyline crossing points and disturbance of sensitive sites.



(b) Using the concept of visual force to analyse the landform and to plan a road line with a more harmonious effect.



(c) Identifying various elements or factors to guide what, or what not, to do with the road line in this landscape.



(d) Proposing an alternative route to take account of the landform and factors above, but prior to considering technical, financial and functional aspects.

Fig. 8 Stages in choosing a better road line in the landscape.

The standard of the road determines the flexibility of the alignment. If the terrain is difficult yet the landscape is sensitive, a lower standard may be the solution, for example, reducing to a road capable of taking a Land Rover instead of a van, or a forwarder instead of a 38 tonne lorry. This is where a balance between all the objectives, environmental as well as functional, is necessary at the design stage.

Landings and turning points which require additional space should be located as far as possible where natural gradients provide more scope. Avoid prominent ridges. Hairpin bends and zigzag alignments on prominent slopes can look especially intrusive, made worse by large areas of cut and fill.

The road line scar

Cuttings and areas of spoil produced by road construction on steep slopes add further to the potential landscape impact unless dealt with sensitively *(Figure 10)*. Geometric shapes, light, raw colours and their scale are the main factors to consider. Alignments should firstly be planned to avoid them if possible.

In soft rocks, areas of cut should be excavated into more rounded banks to reduce the engineered profile, blend into the contours and allow vegetation cover to develop faster. In hard rock, it is better to imitate natural crags with ledges and shelves capable of holding vegetation produced at construction. Occasionally an irregular combination of these two treatments can be used to break the artificial line of a long cut.

Vegetation cover is not always necessary, but in open and prominent landscapes may be important to the extent of employing hydraseeding or turfing to accelerate its establishment. The right choice of seed and turf is critical, in case a bright green line replaces a grey one in a landscape of subdued colour. In landscapes of more varied vegetation, extending the existing pattern on to the cut and fill will help. Material such as turf and bracken rhizomes can be saved at construction and relaid afterwards if thought is given to the method of construction and there is room for storage.

In severely limited topography the impact of cut and fill together is so great that it may be better to remove all fill from the site. The cut is left but is probably more stable and easier to deal with than

Fig. 9 Varying the road line in its horizontal and vertical dimensions achieves a sinuous, organic shape appropriate to this rounded, flowing landform

the loose, erodible fill in such circumstances. Obviously costs will rise in these cases.

Road materials

Wherever possible, road materials should be of local origin, ideally from the same location. This ensures that the colour and texture blend into the surrounding landscape. Brightly coloured or white stone can look very intrusive in many landscapes. Where the local stone is not suitable for the road, then imported stone should be chosen for similarity of colour as well as for its cost and strength.

Culverts

Where the road crosses a stream and a culvert is an appropriate method, then the design will depend on its scale. A small concrete pipe can be set into the fill and collect the water while the slopes above are vegetated. Larger culverts, perhaps those constructed from Armco or similar material, often require retaining walls. Gabions are one solution which can work well if arranged so as to emulate natural rock formations and filled with local stone. If stepped back, vegetation can grow on the ledges which further help to blend them into the surroundings.

Bridges

Where a stream has to be crossed by a bridge then further factors need to be taken into account.

a. Location

Siting a bridge should be very carefully thought out so that visual intrusion is avoided and genius loci protected. As a bridge can be a substantial engineering structure in a fairly wild and remote location, it should be sited away from rapids or waterfalls while providing a vantage point from which visitors may view them. A bridge can be a positive element in the sequence of experiences walkers may enjoy.

The alignment of the bridge to the river and the road leading to and from it should be designed so that there is a flow to it, across it and away from it. Cut and fill on the approach should be minimised and natural ground contours used wherever possible. The cut or fill around the bridge abutments should blend into the adjacent contours so that the bridge seems to grow out of the surrounding landscape rather than being placed upon it.

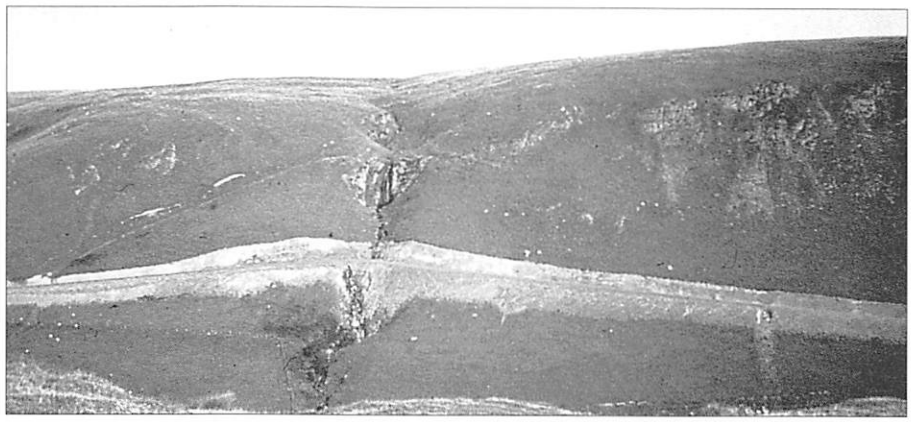


Fig. 10 Where roads cross open terrain in highly visible landscapes, avoid excessive excavations for cut and fill in light coloured materials which contrast strongly with surrounding vegetation

b. Bridge design

The structure of the bridge itself needs careful thought. Concrete and steel can have a strongly urban feel, while natural stone and timber relate more to the countryside.

Concrete is often a choice for cost and strength but smooth cast, light coloured abutments and wing walls are not compatible in colour or texture with natural settings. Alternatives include exposing the aggregate where local material is incorporated; using shuttering to give texture and coloured cement to darken the concrete. Coarse vertical textures are most appropriate. Stone can be used to clad the concrete. One method is to build a stone face inside the shuttering and to pour the concrete in behind it. Large stones at the bottom grading to smaller at the top complete the effect.

Using gabions instead of concrete can be cheaper and more flexible, especially for the wing walls. The same considerations apply as for culverts. Timber abutments are widely used in other parts of the world and may have a place here.

The decking, its detail, finish and the way it fits the abutments needs care. Steel and concrete need the same thought as described for abutments. Steel beams should be painted in recessive earth tones. Timber decking is a good material. It weathers to a natural colour and is coarse in texture.

Handrails are to be avoided if possible. Where they are necessary for safety reasons, their design should be simple and in scale with the bridge and the landscape. Chunky timber rails are likely to be the best. Tubular steel, especially with wire mesh infill looks urban, crude and fussy and should be avoided.

Conclusions

Many roads and their associated features have been put into the countryside in a careless and crude fashion. This has led to public concern. The advantage of low cost, unsurfaced roads is that they are flexible in their alignment and choice of materials in a way in which most public highways are not. There is no reason why, with care and sensitivity, it should not be possible to design roads to fit comfortably into any rural landscape where a road is appropriate and necessary.

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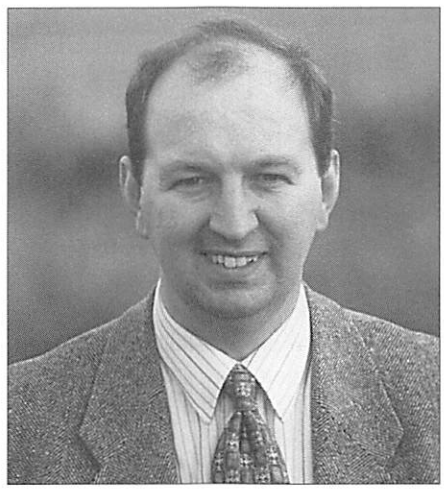
Sludge recycling to land - present and future

Brian J. Chambers

Sludge (biosolids) is a valuable source of plant available nutrients and organic matter which has been recycled to agricultural land in the UK for many decades. Applications need to comply with legislation controlling heavy metal loadings to land and the MAFF Codes of Good Agricultural Practice for the Protection of Soil, Water and Air. The Water Code recommends that the annual total nitrogen (N) applications should not exceed 250 kg(N)/ha and within proposed Nitrate Vulnerable Zones an annual limit of 210 kg(N)/ha is likely to apply initially. Farmers need to be reassured that sludge is a safe, acceptable and agronomically beneficial material. Good quality technical information needs to be provided to enable farmers to fully utilise the fertiliser value of sludge, whilst minimising nutrient losses to the wider environment.

Land application

Land application is recognised as the Best Practical Environmental Option (BPEO) for utilising the properties of sludge, enabling its nutrient and organic matter content to be used in supplying crop nutrient requirements, and maintaining soil fertility. Sludge provides a useful source of plant available nitrogen (N) and phosphorus (P), and as a result of some conditioning processes has value as a liming material. The organic matter content also has value as a soil conditioner, improving the structural stability and water holding capacity of soils, especially where applied as a cake.



As a result of the impending ban on sewage sludge disposal at sea which has to cease by the end of year 1998 and Implementation of the Urban Waste Water Treatment (England and Wales) Regulations 1994 (SI, 1994a) and the Urban Waste Water Treatment (Scotland) Regulations 1994 (SI, 1994b) on direct discharges of sewage, more sludge is likely to be recycled to agricultural land. In 1990/91, an estimated 465,000 tonnes of sewage sludge dry solids per year [t(ds)/yr] were applied to agricultural land, which is equivalent to 42% of UK sludge production (DoE, 1993), *Table 1*. The total area of land receiving sludge in 1990/91 was 56,000 hectares which represents an average application rate of 8 t(ds)/yr. Only 0.3% of agricultural land received sludge in 1990/91.

In 1990/91, the total UK sludge production was approximately 1.11 Mt(ds)/yr, by the year 2006 sludge production is predicted to double to 2.16 Mt(ds)/yr (DoE, 1993). Reuse to agricultural land is predicted to remain the principal outlet, with the estimated quantity doubling to 926,000 t(ds)/yr by 2006.

Sludge applications to land are regulated by European Community Directive 86/278/EEC (CEC, 1986) which has been implemented in England, Scotland and Wales by The Sludge (Use in Agriculture) Regulations 1989 (SI, 1989) and as amended by The Sludge (Use in Agriculture) Amendment Regulations 1990 (SI, 1990). However, in the short term sludge applications to land will be influenced more by the need to comply with the Ministry of Agriculture, Fisheries and Food (MAFF) Code of Good Agricultural Practice for the Protection of

Table 1 Present and predicted future UK sludge production, reuse and disposal.

Use	Dry solids, kt		
	1990/91	1999	2006
Agriculture	465	777	926
Dedicated	25	30	30
Sea disposal	334	-	-
Landfill	88	35	46
Incineration	77	382	405
Other beneficial uses	68	137	161
Within curtilage	50	91	146
Uncertain	-	294	441
Total	1107	1746	2155

Source: DoE (1993)

This paper was presented at the IAgrE conference entitled: "Sewage sludge and water resources - present and future", organised by the Soil and Water Specialist Group and held at ADAS Land Research Centre, Gleadthorpe on 29 November 1995.
Dr Brian J Chambers is a Soil Scientist, based at ADAS Land Research Centre, Gleadthorpe, Meden Vale, Mansfield, NG20 9PF.

Liquid sludge about to be injected.

Water, and competition from other organic materials (farm manures and industrial by-products) for the available land spreading area.

Codes of Good Agricultural Practice

In addition to the Code of Practice for Agricultural Use of Sewage Sludge in the UK (DoE, 1989), the MAFF Codes of Good Agricultural Practice are of particular relevance to the recycling of sludge to agricultural land, viz:

- Water Code (MAFF, 1991)
- Air Code (MAFF, 1992)
- Soil Code (MAFF, 1993)

The Water Code

To minimise the risk of water pollution following the recycling of organic manures to agricultural land the code advises that the following four steps are followed.

(a) Identify any land where organic manures should *not* be applied at any time, e.g. within 50 m of a spring, well or borehole that supplies water for human consumption, or within 10 m of a watercourse.

(b) Identify land where organic manures should *not* be applied at certain times, e.g. frozen ground, fields with flooding risk, steeply sloping land at field capacity.

(c) Match the nitrogen content of the organic manure to the land spreading area; annual total applied should not exceed *250 kg(total N)/ha.*

(d) Ensure that storage facilities are secure, with adequate storage capacity.

In terms of sludge recycling to land, the most important single guideline in the Code is likely to be the need to ensure that annual applications do not supply more than *250 kg(N)/ha* (see *Table 2*).

The Air Code

The Code provides guidance on avoiding air pollution from odours, ammonia and smoke. In general, the factors affecting odour nuisance from farm manures are equally applicable to sludge.

The Soil Code

The Code provides guidance on avoiding long-term damage to soils, with specific sections dedicated to the land recycling of sludge.

Nitrogen

Sludge is a useful source of plant available nitrogen and this is one of the major reasons why farmers accept sludge onto their land. Where efficiently recycled sludge can result in major savings on inorganic fertiliser nitrogen costs, whilst still maintaining crop yields and quality. Typical quantities of plant available N supplied by a spring application of sewage sludge supplying 250 kg(N)/ha (WRc, 1986; MAFF, 1987) and its potential financial fertiliser N value are shown in *Table 3*.

The MAFF Fertiliser Recommendations reference booklet 209 (MAFF, 1994) provides further guidance on the availability of nitrogen from liquid digested sludge and digested sludge cake, taking into account application timing and soil type. These guidelines have largely been derived from experimental work with pig slurry and farmyard manures, to provide soil type/excess rainfall leaching factors applicable to digested sludges. However, guidance is not provided (due to a lack of appropriate information) on *ammonia volatilisation losses* following surface applications of sludge, compared with injection/rapid incorporation. In the case of surface applied farmyard manures/slurries that have not been rapidly incorporated, losses can vary between 20 and 80% of the ammonium N applied.

Table 2 Typical sludge application rates to comply with an annual loading of 250 kg(total N)/ha.

Sludge type	*Dry matter, %*	*Total N analysis, kg/t fresh weight*	*"Limit" annual application rate, m^3/ha or t/ha*
Liquid:			
Digested	4	2.0	125
Undigested	5	1.8	140
Cake:			
Digested	25	7.5	33
Undigested	25	7.5	33

Phosphorus

Sludge is a valuable source of plant available phosphate (P_2O_5), which can be integrated into farm fertiliser policies on a rotational basis. Typical quantities of high quality *technical information* to be

Table 3 Plant available nitrogen supplied by a spring sludge dressing providing 250 kg total N.

Sludge type	Nitrogen availability, %	Plant available N, kg/ha	Potential financial N value*, £/ha
Liquid:			
Digested	60	150	45
Undigested	35	88	26
Cake:			
Digested	15	37	11
Undigested	20	50	15

** Based on a nitrogen fertiliser value of £0.30/kg*

plant available and total P_2O_5 supplied by sludge dressings providing 250 kg(total N)/ha are shown in *Table 4*.

Where the inorganic farm fertiliser policy is geared to maintain the soil phosphorus (P) status at a satisfactory level, i.e. ADAS Index 2 for combinable crops and grassland (MAFF, 1994), sludge applications in accordance with the Water Code would provide enough phosphate to balance the offtake requirements of 3 to 5 wheat crops yielding 8 t/ha, or upto 5 years of a grass silage system - *c.* annual offtake of 60 kg(P_2O_5)/ha.

Heavy metals

Heavy metal issues (real and perceived) are probably the key factor concerning farmers in the recycling of sludge to agricultural land. Maximum permitted total soil heavy metal concentrations are laid down in The Sludge (Use in Agriculture) Regulations (SI, 1989 and 1990). Recently changes have been made to the advisory limit for total zinc concentrations in agricultural soils, which has been reduced from 300 (pH range 6.0-7.0) to 200 mg/kg with no distinction for soil pH in the range 5.0-7.0 (*Table 5*). Also, the advisory limit for cadmium concentrations in grassland soils has been reduced from 5 to 3 mg/kg. These changes have been made on the basis of recommendations by the Independent Scientific Committee Reviewing Rules on Sludge Application to Agricultural Land (DoE, 1995). The advisory limit changes will be detailed a future revision of the DoE Code of Practice for Agricultural Use of Sewage Sludge (DoE, 1989), which complements the UK Regulations.

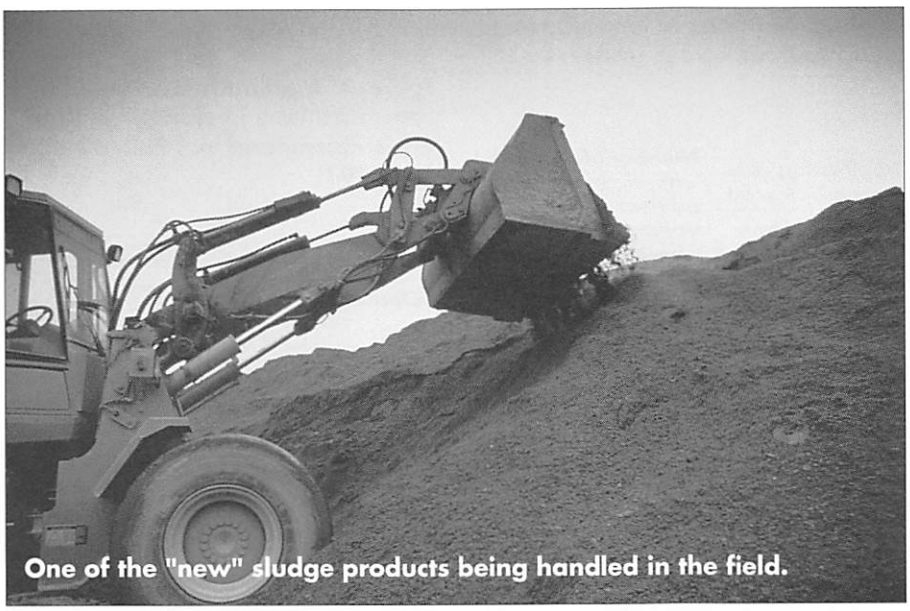
What is often not fully appreciated is the amount of heavy metals typically applied in a sludge dressing supplying 250 kg(total N)/ha, and that to raise soil metal concentrations from typical background levels to limit values is a long-term process (*Table 6*).

Heavy metal concentrations in sewage sludge have decreased in recent years (*Table 7*), with Zn, Cu, Ni and Cr median sludge concentrations being reduced by around a third, Pb by half and Cd by two-thirds (DoE, 1993). These and future reductions in metal concentrations will help to sustain land recycling as a viable route for sludge utilisation.

Table 4 Plant available and total phosphate supplied by a sludge dressing providing 250 kg(total N)/ha.

Sludge type	Dry matter, %	Plant available P_2O_5, kg/ha	Total P_2O_5, kg/ha	Potential P_2O_5 value*, £/ha
Liquid:				
Digested	4	95	190	49
Undigested	5	105	210	55
Cake:				
Digested	25	150	300	78
Undigested	25	110	215	56

** Based on a phosphate fertiliser value of £0.26/kg*



One of the "new" sludge products being handled in the field.

Farmer utilisation

In terms of utilising the N and P content of sludge on farms, there is a need for

made available to farmers, to enable them to utilise sludge efficiently as a source of N and P. Provision of *analysis information* (principally plant available and total N, and total P content) for the applied sludge is of critical importance in this area, along with actual application rate data. This will enable farmers to maximise financial savings on fertiliser inputs whilst still maintaining crop yields and avoiding potential quality problems, e.g. excess N supply causing lodging in cereals/oilseed rape, poor fermentation in grass silage and high amino-N levels in sugar beet.

The routine soil sampling requirements of The Sludge (Use in Agriculture) Regulations (SI, 1989) provide the farmer with a *soil metal baseline* which can be used to assess the rate at which soil metals are accumulating.


Field spreading a "new" sludge product.

Table 5 Maximum permitted total heavy metal concentrations in soils and maximum annual metal application rates.

Element	Maximum permitted concentrations in agricultural soils, mg/kg				Maximum av. annual rate of addition over 10 years, kg/ha**
	pH 5.0<5.5	pH 5.5<6.0	pH 6.0<7.0	pH >7.0	
Zinc(Zn)	200	200	200	300	15
Copper(Cu)	80	100	135	200	7.5
Nickel(Ni)	50	60	75	110	3
	For pH 5.0 and above				
Cadmium(Cd)	3				0.15
Lead(Pb)	300				15
Mercury(Hg)	1				0.1
Chromium(Cr)	400				15***

** The increased concentration limits in soils>pH 7.0 only apply to soils containing more than 5% $CaCO_3$*
*** Sludge applications must match crop N and P requirements (DoE, 1989)*
**** Provisional*

Table 6 Typical quantities of heavy metals applied in sludge supplying 250 kg(total N)/ha and typical number of applications to elevate total soil metal concentrations from background to limit values (MAFF/DoE, 1993).

Element	Typical background total soil heavy metal concentrations, mg/kg	Annual application rate of heavy metals, kg/ha		Number of annual applications to advisory soil limit values *** on 250 kg(N)/ha basis
		Statutory basis*	Nitrogen basis**	
Zinc	80	15	7.65	51
Copper	20	7.5	4.76	78
Nickel	25	3	0.54	332
Cadmium	0.5	0.15	0.04	179
Lead	50	15	1.67	491
Chromium	50	15	1.73	686
Mercury	0.1	0.1	0.03	98

** As laid down in SI (1989)*
*** Based on 250kg(N) ha^{-1} $annum^{-1}$*
**** Soil limits based on pH6-7 values*

Odour emissions from sludge products, and recycling strategies are an important consideration to many farmers. Solid products which have low odour emissions, are easy to handle and can be applied by conventional farm machinery are generally attractive to farmers e.g. Biogran, N-Viro. *Biogran* is essentially thermally dried sludge, whose major agronomic benefit is as a source of plant available phosphate and slow release nitrogen. *N-Viro* is a mixture of digested sludge cake and alkali admixtures, which has value as a liming material and additionally as a source of nitrogen, phosphate, potash and sulphur. Both products have a high dry matter content, are easily handled/stored and can be spread by farm

(continued on p19)

Table. 7 Median heavy metal concentrations in sludge used on agricultural land in 1982/83 and 1990/91.

Element	Concentration, mg/kg dry solids	
	1982/83	1990/91
Zinc	1205	889
Copper	625	473
Nickel	59	37
Cadmium	9	32
Lead	418	217
Mercury	3	32
Chromium	124	86

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Spring 1996

Planning IAgrE strategy

"The Institution will promote the professional status and career development of those supplying the engineering needs of the agricultural, land and associated industries."

This is the Mission Statement which was agreed by the 27 members, drawn mainly from Council and the Branches, attending the Strategic Planning meeting at Silsoe College on 20th July 1995. The group not only produced the Mission Statement with reference to our main stakeholders, but also went on to specify an Implementation Plan to enhance our future prospects.

The main stakeholders are: the members, the voluntary officers, the industry, the educational establishments & students, and the research institutes. The aims of the Institution will be achieved by:

- *raising the image and profile of the profession,*
- *providing and facilitating professional recognition,*
- *providing technical and professional services,*
- *maintaining professional standards by accrediting courses and promoting continuing professional development.*

Undoubtedly, key strengths of the Institution are the members' skills and experience, and the diversity of membership, tapped through the regional structure and the specialist groups. Added to this, we have close affiliation with Engineering Council and information transfer through our publications. There are opportunities, however, to broaden our membership base, to attract corporate affiliation, and to promote higher profile, better publicity.

The critical success factors on which the future of the Institution depends are:

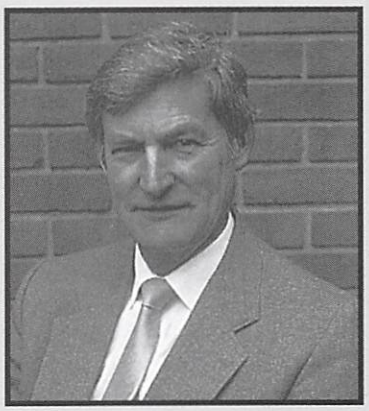
1) increasing membership numbers;
2) providing high quality goods and services targeted at members and potential members;
3) improving the profile and image.

"The Institution will promote the professional status and career development of those supplying the engineering needs of the agricultural, land and associated industries."

Although the present voluntary activities are fully acknowledged, there was consensus that members had little time in reserve to devote more to the Institution activities. Endorsement of a comprehensive Implementation Plan, therefore, would require an increase in bought-in services and staff involvement, and it was tacitly accepted that an increase in fees may be necessary to pay for it. Meanwhile, a number of guiding principles were recommended.

Ensure the journal is of high quality and professional standard.
Encourage specialist groups to convene more conferences and publish the papers.
Provide more support for recruitment and include recruitment advertisements in the journal.
Develop a presence on the Internet.
Ascertain the needs of young engineers in industry.
Foster specialist links with Rural Buildings.
Commission Branch review of local members' needs.
Consult membership on relevance of organisation title and logo.
Seek Branch assistance for specific projects.
Upgrade publicity and careers material.
Improve public image and response to current issues.
Consider staff implications of these proposals.

BDW



Professor R W Hill, CIAgrE

Professor Roy Hill who retired last year joined Silsoe College in 1977 at the time when Marketing was first introduced into the College's education, training, research and consultancy work. The subject of Project Management was borne as the result of Roy's pioneering initiative. He quickly demonstrated the need and opportunity to expand the marketing and product development aspects of the College's activities well beyond their application to the agricultural engineering industry, into the rural sector more generally.

The Department of Marketing and Business Management, with Roy at its head, thus developed to offer programmes of study to students with a great diversity of backgrounds. This not only enriched the life of the College, but those students continue to be ambassadors for Silsoe worldwide.

BCS

Membership movements

November 1995 to January 1996

Mem No	*Name*	*From*	*To*
5258	P W Ashenden	Beds	Herts
5540	J M Brook	Gwent	Saudi Arabia
5730	D A Cotterell	Northants	Lincs
3468	P Edwards	Devon	Ghana
6370	J A J Gander	Netherlands	India
6408	A T Glazebrook	Dorset	Beds
5113	J P Grindey	Hampshire	Thailand
6025	D M Hall	Beds	Kent
6362	A Kaminski	Warwicks	Beds
6148	H M Lockwood	Pakistan	Essex
4505	R L Lodge	Beds	Tanzania
6356	N J Pigott	Yorks	Warwicks
6010	N P Reed	Oxon	Bucks
6435	L N Storey	Essex	Shropshire
6433	R J van Bentum	WiltsThailand	
5992	G A Walker	Cambs	Suffolk
5196	J W G Young	WiltsWorcs	

Gone Away

Name	*Last known address*	*Date*
C R Blessley	43 Grange Road, Ealing, London W5 5BU	30/10/95
S Haresign	57 High Street, Powton, Sleaford, Lincs NG34 0LY	21/11/95

Institution membership changes

November 1995 to January 1996

Admissions - a warm welcome to the following new members

Member: J K Adewumi (Nigeria), S M I Elazhari (Gloucs)

Associate Member: P W Amos (Scotland), S N Fonebi (Berks), S A Moore (Dorset), D L Sandars (Herts)

Associate: A J Parrish (Beds), A Tcherbi-Narteh (London)

Student: N J Handy (Wilts), E Lusambo (Tyne & Wear),
A S Nyirenda (Gloucs), M P Osborne (Essex), K R Scrivens (Worcs), G R Tulloch (Wilts)

Transfers - congratulations on achieving a further phase of professional development

Member: U B Bindir (Papua New Guinea)

Associate Member: A Cooper (Bucks), L Mwale (Zambia), A G Robbins (Scotland), A Tcherbi-Narteh (London)

Death - with regret we record the death of:

P F Mundell (Cambs)

Engineering Council registrations

CEng: D A Cotterell (Cambs), C T Pratt (Warwicks), D W Seccombe (Cambs)

IEng: R Chilvers (Cambs), S D Evans (Derby), J C Salisbury (Clwyd), J Shewring (Norfolk)

Personal Career Development

The PCD focus and the work of Branches

The Personal Career Development (PCD) focus is now well and truly launched within the Institution. Perhaps the most important and successful component to emerge so far is the Continuing Professional Development (CPD) initiative. Several members have registered and the numbers are expected to rise. For greatest benefit to individual members and to the profession as a whole, we clearly need the greatest possible participation. This is where the Branches can play a vital role by regularly bringing the scheme to the attention of members at local meetings and through personal contact. It would be especially helpful if the more experienced members of the Institution would speak out in favour of the scheme, doing every thing possible to encourage the younger members of the Institution to take part. After all, it is those at the earlier stages of their careers that may have most to gain from participation.

Do remember the four main benefits of the scheme when speaking to members and when encouraging others to join. These are:

- *ensuring that professionals remain up-to-date in a changing world*
- *ensuring that the reputation of those qualified in the profession is enhanced*
- *encouraging professionals to aspire to improved performance*
- *facilitating committed learning as an integral part of work and to manage learning methods that are appropriate to the needs of the members' circumstances.*

BAM

All change at SAC

Whilst past achievements at the Scottish Centre of Agricultural Engineering (SCAE) and at the Centre for Rural Building (CRB) will march on, the organisations are slipping gracefully into history through corporate restructuring. After **Professor Brian Witney** relinquished his post as Director of SCAE last year and started his own consultancy and publishing company Land Technology Ltd, **Tom Copland** has been appointed as Head of the *Resource Engineering Department* comprising staff formerly in Mechanisation, Engineering Systems and Technical Services. Once building alterations are completed, the new department will shortly transfer to the Pentland Building at the same location. The Crop Handling staff have been transferred to the Crop Systems Department at the same address.

The Head of CRB, Dr Jim Bruce, has been promoted to Vice-Dean (Education) at SAC Aberdeen and other CRB research staff are being transferred according to commodity specialisms to other departments. **Bob Pringle** and **Rod McGovern** are transferring with their Crop Storage Unit to become part of the Engineering & Mechanisation Department at SAC Aberdeen. **Dr Mike Kelly**, Head of Buildings Department at SAC Auchincruive now also has administrative responsibility for the consultancy work undertaken through the Farm Building Units at SAC Aberdeen as well as at SAC Edinburgh. It has also been intimated that the publication of the CRB journal: "*Farm Buildings Progress*" has been discontinued.

Long Service Certificates

25 years

Name	*Grade*	*Date of Anniversary*
David G Bedingfeld	CEng MIAgrE	23.7.95
Robin Blackford	IEng MIAgrE	23.7.95
Guy E R Blakely	IEng MIAgrE	23.7.95
Alan J Brewer	IEng MIAgrE	27.7.95
Rodney Brice Baker	IEng MIAgrE	13.7.95
Peter John Hubert	EngTech AMIAgrE	15.10.95
Eugen Kramer	AIAgrE	23.7.95
Harry N Lalsa	AIAgrE	15.10.95
David Long	CIAgrE	23.7.95
Devathasan Paul	AMIAgrE	24.9.95
Richard Eady Robinson	IEng MIAgrE	15.10.95
Christopher Rees Whetnall	IEng MIAgrE	23.7.95
John Malcolm Wilkes	MIAgrE	23.7.95

35 Years

Name	*Grade*	*Date of Anniversary*
Robert Cowen	IEng MIAgrE	22.11.95
William Davidson	IEng MIAgrE	22.11.95
David J Evans	FIAgrE	21.11.95
Robert R Gladden	EngTech AMIAgrE	22.11.95
Geoffrey D Senior	IEng MIAgrE	13.9.95
Robert J Sims	IEng MIAgrE	22.11.95
Brian D Witney	Eur Ing CEng FIAgrE	22.11.95

No more Hospital Engineers

After years of debate within The Institute of Hospital Engineering, the decision has been taken to change its title to: "The Institute of Healthcare Engineering and Estate Management (IHEEM)". This decision has been taken in recognition of the fact that engineering can no longer stand alone as an isolated discipline, and that it forms a crucial inter-related part of the total built environment. The new title more accurately reflects the current work and interests of their membership, and is a better description of their expertise to those outside their Institute.

Over recent years, the Institute has been expanding its work in estate management and is currently setting up an accredited Diploma course in Healthcare Estate Management.

The Institute is in College A Institution Group of Engineering Council, the same as the IAgrE.

Engineering Council regional affairs

The new Engineering Council has set up a High Level Working Group on Regional Affairs in conjunction with the Engineering Institutions. The aim is to develop a policy for the future of regional activities, including consideration of proposals for the Institutions to work together more closely at branch level.

Although the IAgrE is not directly represented on the Working Group, it has made a written submission and will take a close interest. If any members have views they would like to have conveyed to the Working Group, please let me know.

Michael Hurst, Secretary

News of *Members*

Brennan P Weston is currently working at Ramu Sugar which is a sugar estate situated in the Ramu Valley of Papua New Guinea where he is involved in workshop and machinery management. Current workshop activities revolve around the out of crop maintenance programme, which this year is to be prepared using Project Management techniques learned recently at courses held at Ramu Sugar. It is hoped that improved cost and time expenditure will be achieved by this form of management control. If any members require information on sugar cane production or its machinery management, Brennan can be contacted at Ramu Sugar Ltd., P O 2183, Lae, Papua New Guinea.

At the beginning of October last year **D S Elsworth** started working for Loven & Co. which is a firm of Chartered Patent Agents, European Patent Attorneys and Registered Trade Mark Agents based in Lincoln. He moved to this position from the European Patent Office, where he was a Patent Examiner, examining application for patents on agricultural machinery and food processing equipment. He started working at the European Patent Office soon after graduating from the University of Newcastle upon Tyne with a BEng (Hons) in Agricultural Engineering. He says that the Lincoln office already handles a substantial amount of work based on agricultural machinery and therefore they are well equipped to handle patent work for any member of the Institution.

J N Short who has worked for Wardell Armstrong since 1991 has recently moved to Sheffield to co-ordinate and take responsibility for the company's work in Environmental Assessment, Audit and management systems. He graduated from Silsoe College in 1980 where his final year specialism was soil and water engineering. Initially he worked in irrigation and drainage both in the UK and overseas. He then joined MAFF in 1984 and became involved in land restoration following mineral extraction (as a statutory consultant in the planning system). He later pursued this line whilst working for a consultancy in Cambridgeshire where he specialised in mineral site development and became involved both in the planning system and all aspects of Environmental Assessment for such development. He says that he still retains his specialist role where he occasionally advises on soils and agricultural issues, drainage and irrigation but not as often as he once did and therefore he is now somewhat removed from mainstream agricultural engineering. However, he is aware of environmental issues which are affecting the agricultural engineering industry and suggests than many will have engineering solutions.

Russell Ashley-Smith who was at one time *Secretary of the Yorkshire Branch* of the Institution and also former *Editor of the Newsletter* has resigned from the Institution. He says that he left agricultural engineering 13 years ago and joined FEBA radio which is an international radio mission communicating the Gospel of Jesus Christ. Russell and his wife Gill have in recent years visited India, Pakistan, Philippines and Ecuador, returning home on each occasion to talk to church and other groups about the countries and their people. Russell and Gill are now looking forward to going to South Africa for two to three years to set up FEBA's Radio South Africa where they will also be supporting FEBA's ministry in general, but especially elsewhere is Africa. Russell say that there is considerable interest already in South Africa in FEBA's work and the idea is that within 2 to 3 years they will have worked themselves out of a job leaving South Africans to develop the work.

AAWC

Consultancy opportunities

Landell Mills Ltd is a UK company which specialises in providing management consultancy services in Central and Eastern Europe and the CIS, with particular emphasis on:

- food production, processing and distribution
- agriculture
- post-harvest technology
- marketing and trade
- economic analysis and institutional strengthening
- banking and rural credit evaluation
- SME development.

They are currently seeking to augment their resources of expertise in order to meet the growing demand for short and long term technical assistance in these regions, and wish to hear from experienced specialists (preferably with a higher degree) in the following areas.

Technical specialists:
land reform; environmental assessment; farm production; storage and distribution; wholesaling and retailing; rural infrastructure; food processing and agro industry; fisheries and forestry; privatisation of enterprises; export market development; banking and credit management; training and human resources development.

Economists:
macroeconomic analysis: financial, regulatory, trade, and enterprise economics; project management.

Managers:
enterprise management; team leadership; public sector management; aid management; co-ordination and investment management for joint ventures.

For further information and registration on their database, contact: **Charles Duff, Landell Mills Ltd. Tel: 01225 462891.**

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(from p18) machinery. A potential "advantage" of both products is their low plant available N supply, which means they are not likely to result in substantial nitrate leaching losses when applied in the autumn-early winter to freely draining soils. It is likely that these 'new' products will be produced in increasing quantities by the Water Companies as more sludge is recycled to land over the next decade.

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Rules, Regulations & Codes

Final HSE list of approved respiratory protective equipment

The fourth and final edition of the Health & Safety Executive (HSE) list of approved respiratory protective equipment (RPE) was published recently. It is the last to be issued by HSE because any further revisions have been made unnecessary by a new legal framework implementing a European Directive and administered by the Department of Trade and Industry (DTI). The new edition lists all the equipment which has been submitted to and approved by HSE up to 30 June 1995.

Until 1 July this year, health and safety legislation required employers to ensure that respiratory protective equipment when used as protection against substances which can damage workers' health, was suitable for the purpose, and either CE-marked or approved by HSE. In the latter case, approval was gained either type-approval testing by HSE, or by conforming to a Standard approved by HSE.

Since 1 July this year, all new personal protective equipment (PPE) - including RPE - sold or supplied to industry has had to be CE-marked in accordance with the PPE (EC Directive) Regulations 1992, and their subsequent amendments, which are the responsibility of the DTI. The CE-mark signifies to enforcement authorities that the manufacturer believes the product complies with all the requirements of the relevant EC Directives. HSE is no longer directly responsible for the approval of such equipment. Under the new system, respiratory protective equipment carrying the CE-mark is approved for the purposes of health and safety legislation. It is till the employer's duty to select equipment that is suitable for the purpose for which is to be used.

However, there is still a considerable quantity of HSE-approved but non-CE-marked respiratory protective equipment in use in industry, or in the supply chain before the 1 July 1995 deadline. This final list of HSE-approved respiratory protective equipment (RPE) and the Certificates of Approval reproduced in it - allow industry to continue to use this equipment as it is suitable for the intended use and is properly maintained in good condition. Manufacturers' instructions for maintenance procedures should be followed, and at a frequency commensurate with the usage of the equipment.

Guidance on the selection and use of respiratory protective equipment (RPE) is contained in the HSE booklet *"Respiratory Protective Equipment - A Practical Guide for Users"*, ISBN 0 7176 0493 4, price £4. The final HSE list of approved RPE is published under the title *"Respiratory Protective Equipment: Legislative Requirements and Lists of HSE Approved Standards and Type-Approved Equipment - Fourth Edition"*, ISBN 0 7176 1036 5, price £5.50. Contact: **HSE Books. Tel: 01787 881165.**

The Disability Discrimination Act could affect *you*

Are you aware that the Disability Discrimination Act has become law? Taking the time now to find out more about the Act could be important to many of your members.

The new Act brings in laws and measures aimed at ending the discrimination many disabled people face everyday. The first measure will be introduced around the end of 1996. Under the Act, disabled people will have new rights in the areas of employment, getting goods and services, buying or renting land and property, together with new measures concerning access to education and using public transport. It will also become unlawful to treat a disabled customer less favourably than a non-disabled one when providing goods or services to the public.

A booklet about the Act has just been published. It's called: *A Brief guide to the Disability Discrimination Act'*. This booklet gives you information about the Act, what it will do, the new rights for disabled people and outlines when the new measures will begin.

You can get FREE copies of the booklet and receive further information when it becomes available, by calling anytime on **0345 622 633 (local rate) or by writing to (quoting reference TA1) : Disability on the Agenda, FREEPOST, Bristol, BS38 7DE.**

ERA Technolog launches Supe

Precision radar imaging equipm surface detection

ERA Technology has launched Superscan, the company's new, enhanced, precision radar instrumentation for sub-surface detection and imaging. This equipment uses the surface penetrating radar technology, pioneered by ERA Technology in the UK, which has now been refined into a compact, lightweight, easily portable and highly user-friendly unit that can be used by just one operator.

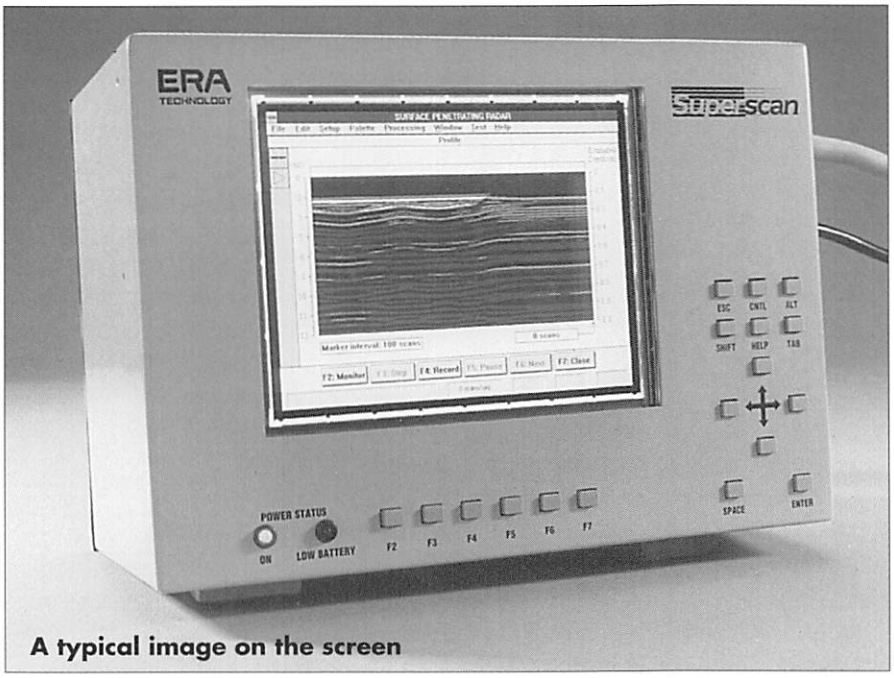
Applications

The new Superscan unit has many applications in situations where it is necessary to search or non-destructively investigate beneath the surface of the ground or of a solid structure. These include: surveying, civil engineering, mining, tunnelling, road construction, pipe and cable laying, military, police, security and archaeology.

A major advantage of the radar over other non-destructive testing methods, such as ultrasound, is that it is possible to use an antenna that is not in physical contact with the material being tested. Superscan is therefore able to scan areas of interest extremely quickly.

Background

ERA Technology first achieved international fame for its work on surface penetrating radar when it was called upon by the Ministry of Defence to develop a means of detecting plastic mines left buried after the Falklands conflict. Last year, the company again hit the headlines when a team from ERA Technology used its surface penetrating radar to assist the Gloucestershire Constabulary in detecting the location of human remains in the notorious police investigation conducted in that county.



A typical image on the screen

General description

Surface penetrating radar is a non-destructive testing technique that uses electromagnetic waves to investigate the internal structure of non-conducting materials. A typical radar transmits a short pulse of 1 ns time duration from a transmit antenna into the material. Energy reflected from dielectric interfaces is received by means of a receive antenna and then suitably processed and displayed by a radar receiver and display unit.

In principle, the technique is similar to ultrasonic imaging, but uses electromagnetic rather than acoustic waves. If the transmit and receive antennas are moved at a constant velocity along a linear path, a cross-sectional image of the material can be generated. Alternatively, if the antennas are scanned in a regular grid pattern, a three-dimensional image of the target can be derived.

Hardware

At the core of the equipment are two main components: the radar head unit, which comprises a pair of special antennas, a transmitter/receiver and a separate radar controller unit. They are powered jointly by a single portable, compact, rugged battery pack.

Superscan's state-of-the-art radar head unit achieves outstandingly high speed and fidelity of data. This is thanks to its advanced antenna design and transmitter-receiver performance. The standard version of Superscan is fitted with a pair of 500 MHz shielded parallel dipole transmit/receive antennas. Other antenna variants are also available, to order, to suit differing applications.

The main radar controller unit features a colour TFT display, 486 DX computer and 260 Mbyte hard disk - all housed in a rugged case designed to withstand field use - and is also usable as a stand-alone portable PC. The more advanced controller features a 550 Mbyte hard disk, high-speed digital signal processor and area scan software.

The various units comprising Superscan can be configured in a number of ways, allowing the user maximum flexibility. The radar controller unit may

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be positioned at some distance from the rest of the equipment and connected to it by a cable; it may also be carried by the operator, wearing a special harness; the controller and antenna head may be mounted together in a basic wheeled arrangement; or they can be mounted in a full purpose-built, glass fibre trolley.

Software

The radar controller unit is driven by advanced, specially developed software, running under MS-DOS 6.22 and Windows for Workgroups V3.11 and delivering real time signal processing. The menu operation makes it very easy to use and enables extremely productive data gathering and processing.

In addition to presenting the data as a cross-section of the material, Superscan is able to build up an area scan, by taking a grid of correctly registered line scans. Selected depths of the area may also be viewed.

Superscan sub-surface detector

Signal generation

As the signal from Superscan is transmitted during the scanning process, it is attenuated by the ground or material under investigation and this causes the range in depth to be limited by the type of material or ground being scanned. There is an optimum choice of bandwidth of operation to achieve best performance in terms of depth and ability to see detail in the target structure. This choice lies in the 50 MHz to 5 GHz range and several octaves of bandwidth are used. Low ranges of frequency are normally used for deep probing (more than 50 m) and high ranges of frequency are used for shallow, highly detailed probing (approximately 25 cm). The standard Superscan unit uses a centre frequency of 500 MHz which corresponds to a wavelength of 20 cm in typical soil.

The wavelength of the transmission decreases as the velocity of propagation slows within the material - a process governed by the relative permittivity or relative dielectric constant of the material. If the propagation velocity can be measured or derived, an absolute measurement of depth or thickness is possible.

Signal processing

Once the signal has been received, it is necessary to process it from its raw state into a form more suitable for the operator. With any radar, the initial transmitted impulse becomes convolved with a series of responses, due to the antenna, the ground, etc. The only part of the signal that is of interest is the target impulse response.

However, this cannot be measured directly and a successful radar design is one which minimises all impulse responses under the control of the designer. For example, in Superscan the antenna time responses have been optimised by careful design and, within noise limits, compensation for ground response is carried out both by amplification and by means of a special compression of the received signal.

Signal processing for any application can be carried out in software at a rate appropriate to the complexity of the signal processing and the power of the

computing. The use of the Windows environment allows ready access to additional signal processing software which can be used for image processing or intelligent pattern recognition.

Evolution of surface penetrating radar
ERA Technology first produced its surface penetrating radar following work it undertook for the UK's Ministry of Defence, to evaluate the different means available of detecting plastic mines **left** buried in the ground after the Falklands conflict. ERA proposed that Surface Penetrating Radar was the most effective method. The company subsequently received a contract from the MoD to build a surface penetrating radar unit and to trial the equipment on behalf of the Ministry in the Falklands.

The company then went on to develop the surface penetrating radar technology for other non-destructive testing applications. These include: archaeology, for detecting the sites of ancient burials and artefacts; civil engineering, for assessing the condition of roads, for inspecting tunnel linings, for searching for voids in certain types of reinforced concrete and for locating pipes and cables underground; as well as for searching for avalanche victims.

In 1987, ERA Technology first proposed to the Home Office that radar could be used to detect buried bodies and carried out a special research project. Because of this experience, the Gloucestershire Constabulary last year used surface penetrating radar equipment, operated by a specialist team from ERA Technology, to help identify the possible locations of buried human remains, in what is regarded as possibly the UK's biggest police investigation of its kind, to date.

ERA Technology has subsequently continued to assist various UK police forces with similar requirements in criminal investigations, as part of its survey service.

Superscan is now on sale at a starting price of £29,500.

Contact: **Keith Cheshire, Markets Development Manager, ERA Technology Ltd, Cleeve Road, Leatherhead, Surrey KT22 7SA. Tel: 01372 367069.**

The WHO (Europe) Risk Communication Network

In modern society, the rapid developments in communication technology have enabled more and more information to be transferred at a faster and faster rate. It sometimes seems as if there is no time to reflect upon the real benefits of these so-called advances. However, despite all of the apparent advantages of the fax machine, the internet and the video phone there is no doubt that some major communications challenges lies ahead. One of the most important and pressing of these challenges concerns communication about risk information. Public concern, often intensifying into widespread outrage, appears increasingly commonplace in many areas ranging from local disputes about siting hazardous industries and developing new roads to regional and national concerns about the development and implementation of social and environmental policies.

The Centre for Environmental and Risk Management (CERM) is a research group within the School of Environmental Sciences at the University of East Anglia. It has significant expertise in environmental policy related matters, particularly in the integration of technical and non-technical perceptions of risk. Much of this work has involved the development of practical mechanisms for improving the effectiveness of decision making through the incorporation of non-technical views from interest groups and the public in general into the policy development process.

For the past two years, CERM has been busy establishing a risk communication network on behalf of WHO (Europe). Risk communication encompasses a very broad range of communicative aspects. It is central to the management of risks which involves both scientific and non-technical considerations. By responding to changes in technical innovation, legislation, economic climate, and public mood, risk management can act as a balancing mechanism ensuring the optimum allocation of society's resources.

The Risk Communication Network newsletter - RISKOM - is now available. It provides one mechanism by which the risk communication debate van progress throughout Europe and beyond. To date, over 100 members receive RISKOM, the first issue of which contains articles by some of Europe's leading risk communications experts. Membership of the Risk Communication Network is free to individuals. Subsequent issues of RISKOM will be available electronically, either through email or on the Internet.

For application forms or further information contact: **Simon Gerrard, Risk Communication Network Co-ordinator, Centre for Environmental and Risk Management, University of East Anglia, Norwich, NR4 7TJ.**

More action needs to be taken in order to reduce the amount of pesticides entering the aquatic environment, the national Rivers Authority (NRA) said in a report published recently. According to *Pesticides in the Aquatic Environment*, the first comprehensive report ever published on the presence of pesticides in the aquatics environment in England and Wales, low levels of a number of pesticides are commonly found in both surface and groundwaters. Although these levels are, on the whole, unlikely to cause immediate damage to the water environment, the effects of cumulative long term exposure are difficult to predict. A number of actions have, therefore, been identified in the report which, if implemented, would help to minimise the impact of pesticides in the future.

John Seager, Head of Environmental Quality at the NRA, said: "The NRA's report shows that, except in a few specific cases, the levels of pesticides found in the water environment are generally low and, where applicable, meet established environmental quality standards. However, the significance of long-term exposure to pesticides and their combined effects on the environment are not fully understood. The NRA believes that further action needs to be taken now to minimise the risk of pesticide pollution and avoid potential problems for the future."

"It is important to remember that pesticides are used by a whole range of people in many different ways. Protecting the aquatic environment from pesticide pollution is not purely the responsibility of one particular group of people, such as farmers, but of everyone involved in the manufacture, supply, use and regulation of pesticides. Active support from all these different groups is essential if the recommendations outlined in the NRA's report are going to be achieved".

The NRA will be seeking support from other relevant organisations with an interest in pesticides to help produce and implement a National 'Pesticides in Water' Strategy which will incorporate the recommendations outlined in *Pesticides in the Aquatic Environment* including:
•Government examining the case for "no spray" zones of a minimum of 6 metres adjacent to watercourses and seeking changes in the rules on set-aside (a European Community scheme where a proportion of farmland is taken out of production in order to reduce surpluses or con-

NRA seeks concerted action on pesticides

trol prices) which would help offset the cost to farmers;

•the NRA, Government and the water companies assessing the economic case for Water Protection Zones which can restrict or prohibit the use of specified pesticides in order that the cost of treating water to remove pesticides can be compared against the cost of controlling inputs of pesticides within public water supply catchments;

•a notification procedure for the siting of sheep dips and disposal of any spent solution, the development of an effective treatment process to make spent sheep dip solution harmless being a priority for the industry;

•the NRA seeking further improvement in the level of treatment of effluent discharges from wool processing and textile industries, and the water companies;

•pesticide regulators and manufacturers proactively targeting users, distributors and suppliers on pollution prevention measures;

•more research on predicting pollution risk, less intensive farming practices including integrated crop management, and new analytical techniques to aid the detection of pesticides in water.

The NRA will also be feeding these recommendations into the Government's Action Plan on Pesticide Minimisation which was announced in the recent Rural White Paper.

Pesticides in the Aquatic Environment outlines the results from the NRA's two-year monitoring programme (1992-93) which involved over 450,000 analyses from around 3,500 sites.

Over 99 % of the monitored sites complied with the Environmental Quality Standard (EQS) set for those pesticides (about 450 substances) included on List I of the EC Dangerous Substances Directive. An EQS is the concentration of a substance which must not be exceeded in order to protect the aquatic environment. The standards are specific to individual pesticides and depend on their toxicity, persistence and potential to accumulate in fish, plants and animals. Pesticides included in List I of the EC Dangerous Substance Directive have statutory EQSs. Other pesticides have EQSs set by the DoE which it proposes to make statutory. In addition, the NRA has set operational EQSs for additional pesticides. The development of EQSs is both time consuming and costly. The NRA is, therefore, concentrating on those that are the most frequently detected in, and potentially the most damaging to, the environment in its on-going programme of EQS development.

"the significance of long-term exposure to pesticides and their combined effects on the environment are not fully understood"

Over 96 % of the monitored sites complied with all EQSs set for approximately 20 pesticides in 1993. Examination of the data indicates that there are very few breaches of operational EQSs for a further 25 pesticides set by the NRA since 1993.

In surface waters, the uron, triazine and phenoxy acid herbicides are the most predominant. In drinking water supply catchments, the presence of these and other pesticides has resulted in the need for substantial investment in treatment plants by the water industry.

For groundwater (where treatment facilities for pesticide removal are not generally in use), comparison of the data against Drinking Water Standard indicate that triazine and uron herbicides breach this figure the most.

Agriculture is not the only source of pesticides. Significant inputs of pesticides into the water environment also originate from use on roads and railways, in the amenity sector such as controlling weeds on paved areas, and from point source discharges from the wool processing and textile industries.

The NRA is required to carry out monitoring of pesticides which have been set statutory EQSs in UK legislation. It also, however, carries out non-statutory monitoring for other pesticides which it considers may be present in the aquatic environment to ensure that no environmental damage is occurring. This monitoring is tailored to the particular problems associated with the local use of pesticides. In intensive arable farming areas, for example, monitoring is carried out for some of the most widely used agricultural pesticides. In contrast, the amenity pesticides used on roads and railways are monitored most frequently in urban areas.

Serious pesticide pollution incidents are rare, comprising less that 0.2% of all substantiated pollution incidents. However, when they do occur, they can cause serious environmental damage.

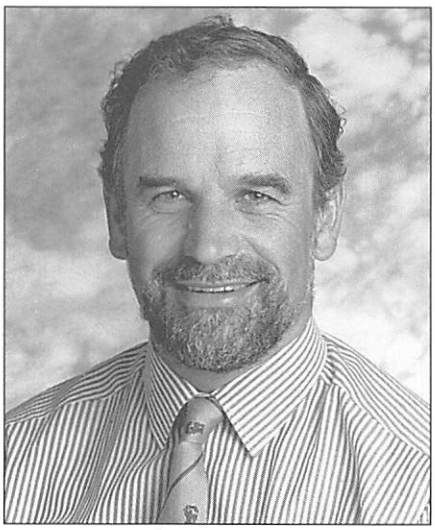
The NRA is currently developing a computer based modelling tool, **POPPIE** (Prediction Of Pesticide Pollution In the Environment), which will assist is assessing the risk of pesticide pollution to ground and surface waters across England and Wales. This will help target national pesticide monitoring programmes and assess the environmental impact of individual pesticides.

Pesticides in the Aquatic Environment published for the NRA by HMSO, price £25, ISBM 0113101015 has been produced by the NRA's Toxic and Persistent Substance (TAPS) centre - a National Centre of expertise covering four key areas of work: pesticides and other toxic substances; toxic algae/eutrophication; the North Sea; and environmental toxicology.

The functions of the NRA will be transferred to the **Environment Agency** on 1 April 1996 which will have responsibility not only for the environmental protection of water, but also of land and air.

Potential pollutio

Geoffrey J H Freedman



This paper is about designing, constructing and maintaining environmentally friendly, small bridge structures over water without polluting the stream or the aesthetics of the area. That is avoiding dropping things into the water and disturbing the visual harmony. The obvious mistake is spilling paint or cement into the water but it is extremely important to leave the natural bed undisturbed. This means no excavators in the river and no round culverts or Irish bridges. The countryside usually looks best totally undisturbed and a bridge added to it can upset it. The secret is to introduce it as sympathetically as possible, create harmony, add interest and avoid bold statements *(Figure 1)* **The ground rules are really very simple - leave things as near to the way you found them as possible and do not touch the stream bed.**

This paper was presented at the IAgrE conference entitled: "Prevention of pollution during forest engineering operations", organised by the Forest Engineering Group and held at Newton Rigg College on 31 August 1995. Geoffrey Freedman BSc, CEng, MICE, FIAgrE, is Design Engineer Forest Enterprise, 231 Corstorphine Rd, Edinburgh, EH12 7AT.

Introduction

It is not very long ago that small estate and forestry bridges were thrown together using gravel from the river bed and water from the stream for concrete, and casting a deck with no real quality control and little consideration for the fish. Pipes, often used in a natural water course, increase the velocity and may change the gradient, causing a barrier to migrating fish. Fords were common and the vehicles using them are a constant source of pollutants, introducing sediments from the roads and washed off oil from their undercarriages. Things are different now that we have legislation to control us, water guidelines to help us, and a conscience to bother us so we think before we act.

Design

The big mistakes that are made here are choosing too short a span or deciding to build a structure on the bed. However, great care is needed to pick a structure type which is appropriate to the situation. In a really sensitive area, for example, try to avoid using materials which if spilt could cause a major incident. At the same time, economics and structural sense need to be considered. Here I am thinking of gabion abutments, timber decks and as little in-situ concrete in complex shutters as possible. When choosing a design, the aesthetics are important because an ugly lump of streaky, off-white concrete in the wrong place is every bit an act of pollution as is dropping cement and killing the fish.

Choosing a site

When looking for a site, there is usually some choice. Always seek out a place with ground which will provide a good foundation. Look for rock outcrops. Look for some elevation which will help with the waterway area when designing for the maximum flood. Try to avoid bends where the river may change it's course in the future. While considering these points, the functional position has obviously to remain a prime factor.

Choosing a span

The waterway for a 1 in 50 year flood should be calculated to show the minimum requirement. The other criteria are the width of the river and the height of the banks relative to the road. Never build a bridge in the river. The natural bed should be left undisturbed. If possible, make the span wider and use bank seats. If the river is narrowed its increased velocity causes the bed profile to change.

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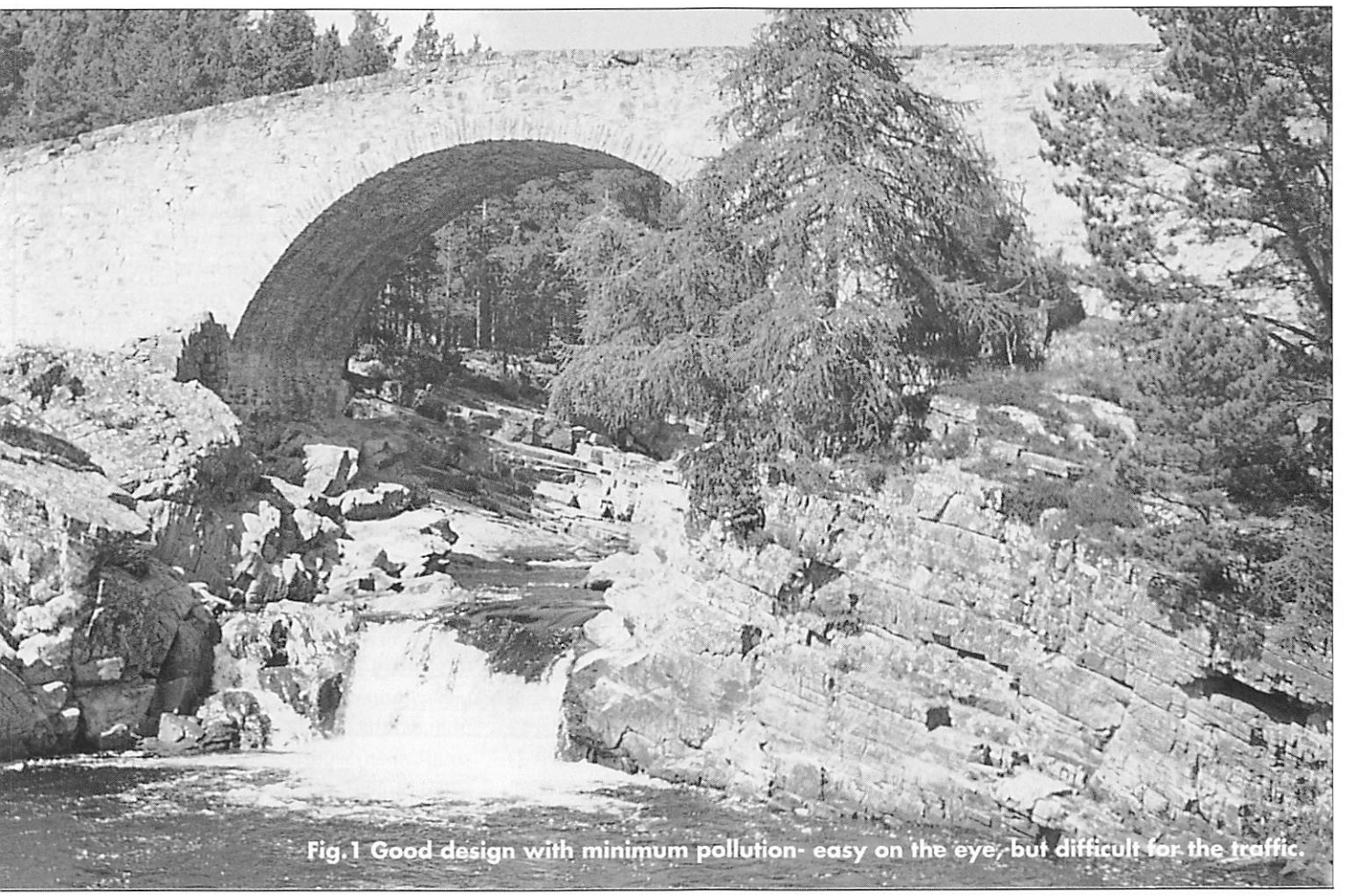


Fig.1 Good design with minimum pollution- easy on the eye, but difficult for the traffic.

In fragile gravels, a hole will appear just downstream from the narrowing. In time, this hole will move back towards the structure and eventually undercut it, causing collapse. This sort of irresponsible design can also be the start of banks eroding upstream during flood. This kills plant life and introduces sediment which is bad for fish.

"The ground rules are really very simple - leave things as near to the way you found them as possible and do not touch the stream bed"

Choosing a bridge type

Having decided on the site, there will be a number of structure types which will do the job. The secret of good design is choosing the one which looks right, costs least and is easily built. I have narrowed down the field on mainly economic grounds and the full range can be seen in my paper "Low cost bridges and culverts" from a previous symposium (Freedman, 1993). Each solution is best suited to a particular span but different decisions may be made when the environmental factor is thrown in. If the site is elevated and can be seen from afar, there is a good case for spending a bit more money to make it look good. If, for example, the site is at the top of a waterfall, great care is required to avoid an environmental blotch on the landscape. After all, you start from a position of weakness because the bridge is an addition to the scene and generally the landscape always looks better undisturbed. At this stage, it is usually worth consulting the opinions of others, for example, a landscape architect. There is nothing worse than ending up with the wrong structure in the wrong place and no one to blame it on.

Concrete abutments

The first thing that springs to mind is whether concrete is really necessary. There is always the risk of cement leaking into the water, increasing the alkalin-

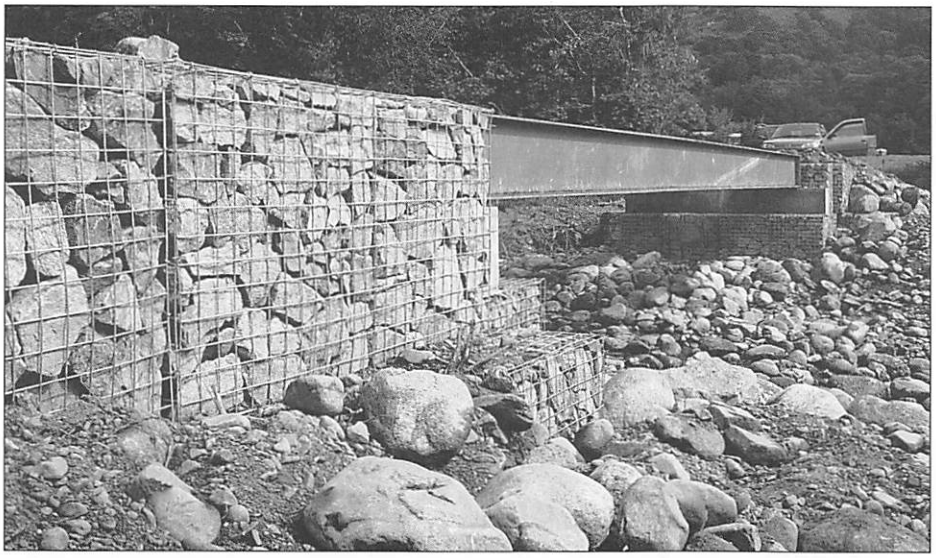


Fig. 2 Gabion abutments avoid pollution.

ity and killing fish if the concentration is high enough. The particles or cement grains are also of a size which are dangerous to fish because they can coat and clog gills. If the deck is concrete, the abutments will have to be concrete but for a steel and timber deck consider an alternative. If you are stuck with concrete, consider the economics of increasing the span in order to take the dangerous material as far away from the water as possible. Make provision for the inevitable stains on the face from rainwater flowing onto the top of the abutment. It is a good idea to construct a channel along the top to take the rainwater to vertical slots which will guide it to the ground, thus concentrating the staining in two places. It is worth considering a feature finish using a profiled shutter. This can be done with vertical slots or, more easily, with a plastic moulding which can be purchased readily with many interesting patterns. The final touch will be added by including a nesting box under the deck centrally located on the face of the abutment. This is one of the few opportunities to improve the environment.

Gabion abutments

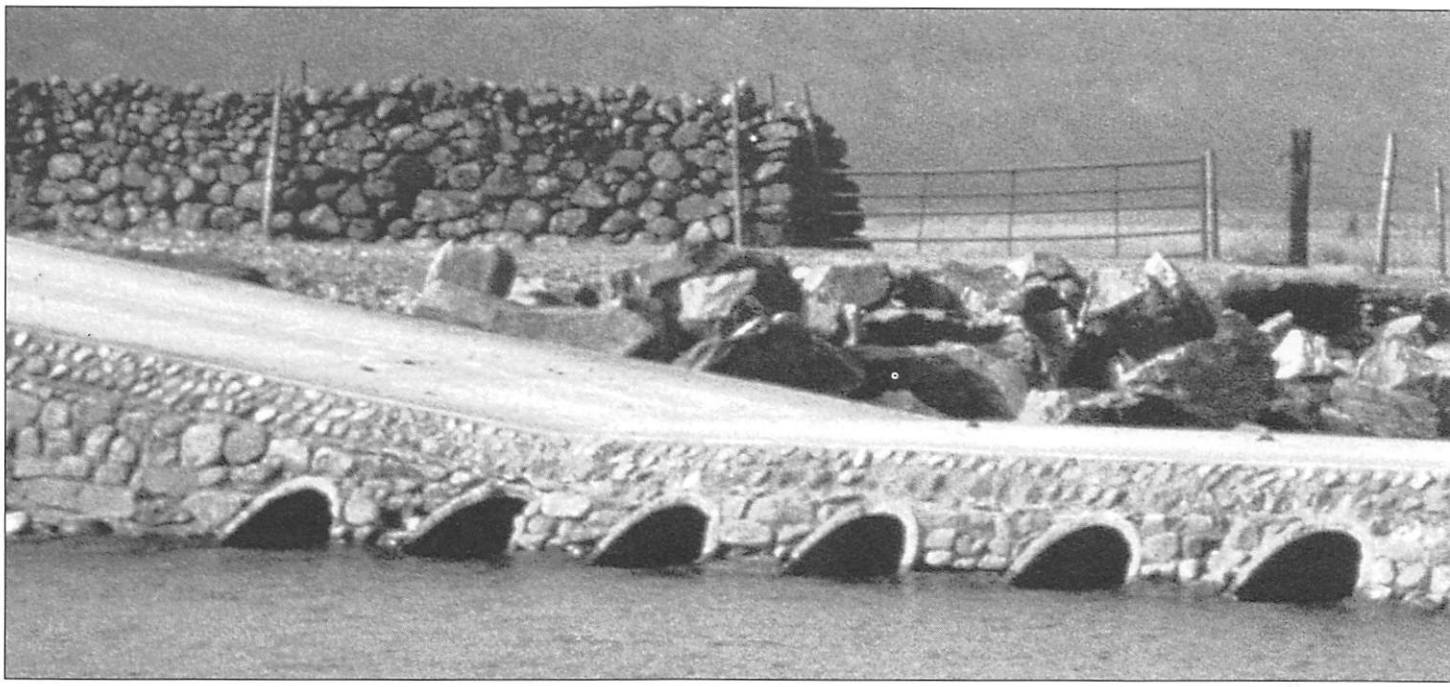
For all footbridges and road bridges up to 15 metre spans with flexible decks, gabions are the first choice *(Figure 2)*. They should always be the geometrically stable weldmesh type as opposed to the slumpy ones. The latter would be alright for an extremely big gabion structure but abutments for small bridges are generally only 2 or 3 metres high. They should be hand filled using local stone carefully placed on the outer faces. For road bridges, a substantial sill beam is necessary to spread the load and even the settlement. Gabions fit well with the surroundings and carry very little risk of pollution when being filled. Given time, some vegetation can take root in them and wildlife can make homes for themselves.

Bank seats

These are always the first choice. They are well away from the water which leaves the natural bank and reduces the risk of pollution during construction. It is more often the best choice for a footbridge because it is cheaper to extend the span of a light deck than that for a heavy road bridge. Although traditional materials are usually used, a timber sleeper is often good enough as a foundation for a stable footbridge, eg 'Aerial Mast' type.

Concrete decks

For small spans, up to 6 metres, the normal choice would have been an in situ RC slab. I have reservations now about this solution because of the risk of pollution and the ease of alternatives. Such a small span would normally be over a small stream, the scaffold would be on the bed and operatives would be in and out of the water disturbing the bed. For the 6 - 16 metre span range for main road



bridges with a lot of traffic, the inverted "T" beam concrete bridge is still the best solution. A recent development of the original design has greatly improved it's pollution risk factor and reduced costs. The old design required in-situ edge beams to be cast to anchor the lateral reinforcement. These required elaborate shutters, much operative to-ing and fro-ing and concrete poured next to the river. These have been replaced by an extra beam and kerbs cast onto the outer "T" beams in the factory. These outer beams have sockets cast in to take threaded reinforcement anchorage bars. The infill concrete requires no shuttering and none is poured near the edge, so the risk of any dropping into the water is greatly reduced. For spans above 16 metres, there is probably no alternative to concrete being poured in-situ. Usually at this span, bridges would be concrete, acting compositely with steel beams. For this type of construction, I would strongly recommend a shuttering system suspended from the main beams in order to reduce bed disturbance. Use proprietary shuttering which will give the best seal and reduce the risk of leakage at the joints. It is very difficult to put a handrail onto a concrete bridge and make it look right. If it is near the county road, a DoT type can be used successfully but in a sensitive more rural location usually timber is used and it often looks odd. If the location is very sensitive, however, a concrete deck may not be chosen.

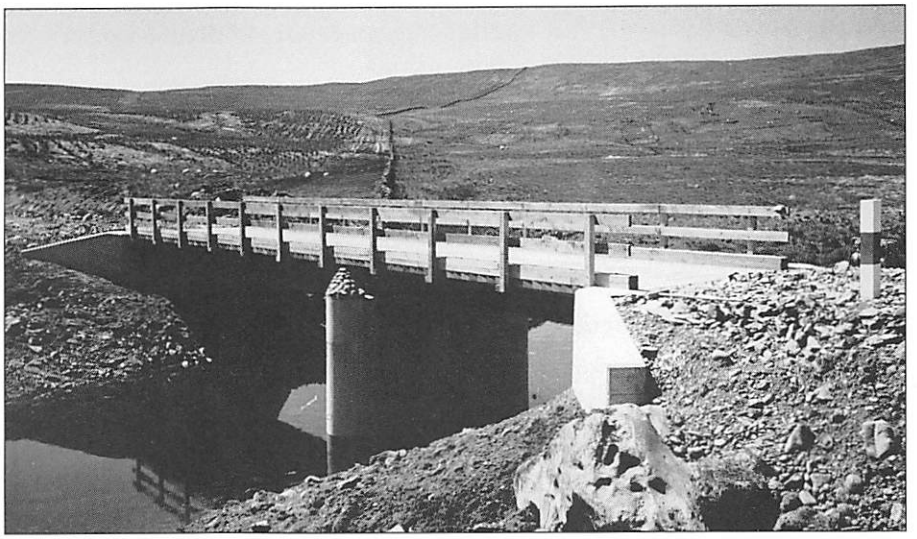


Fig. 3 Pollution free construction by means of a steel beam/timber deck bridge.

Steel beam with timber boards

This is an old idea and a new one *(Figure 3)*. For the first half of the century, most estate bridges were built using RSJs and timber decks. The design fell into disrepute with rotting and loose deck boards and corroding beams. Today, there has been a revival with the help of good detailing, pressure treatments and galvanising. This has been first choice in forestry for the last 10 years except on busy entrance roads. They are quick and cheap to build, the decks are flexible and removable and they will last a tree cycle with two or three changes of deck. They are usually built with a handrail which enhances the appearance and improves safety, both anti pollution factors. The steel beams are usually painted black to put them into shadow and the environmentally friendly timber looks to be the only bridge construction. A criticism which I have sidestepped as a promoter of the steel and timber deck is the material which falls through the gaps between the boards. It is my contention that the amount is negligible, given that these bridges are built on the less trafficked routes.

Culverts

Culverts should be used for drainage only unless extra special care is taken. If used on a natural watercourse, they could easily interfere with fish migration. If they

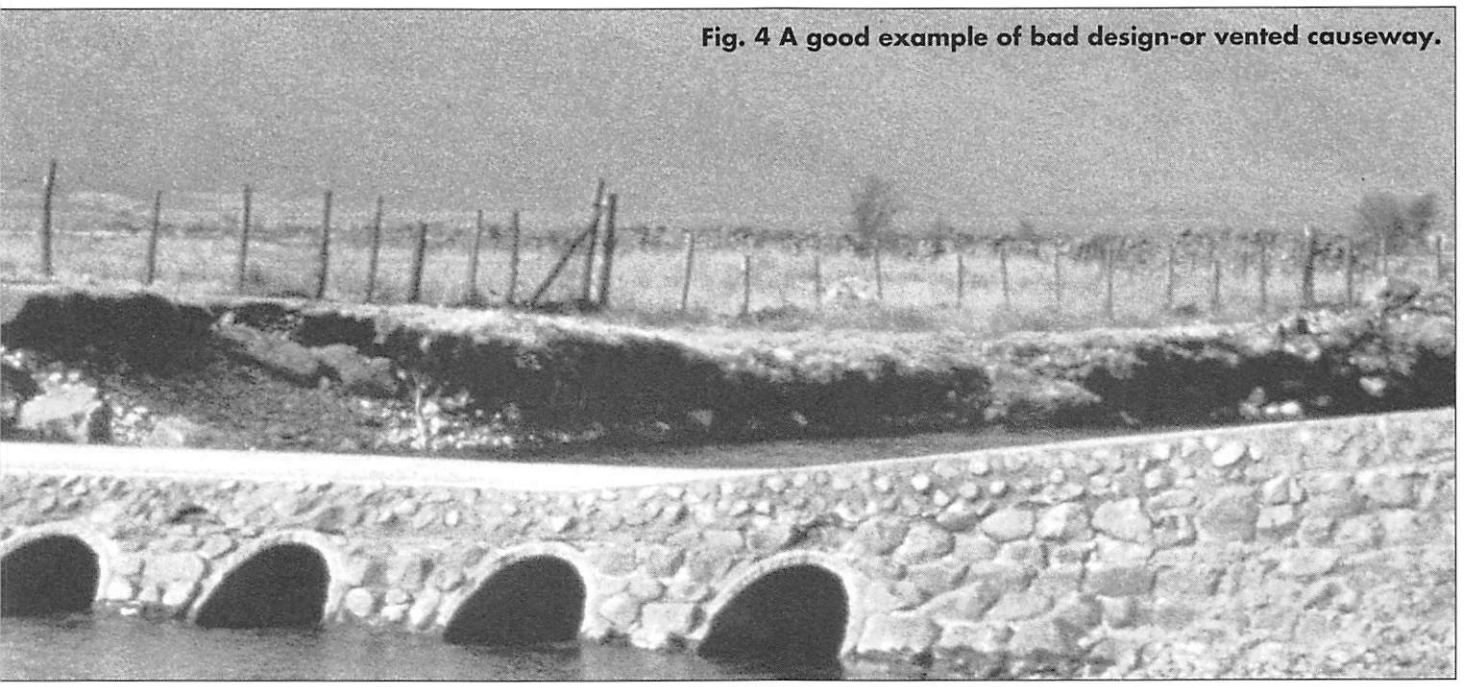


Fig. 4 A good example of bad design-or vented causeway.

are to be used, they should be sunk into the bed and follow the gradient exactly. This will mean that the velocity of flow will not be changed in normal conditions as the water runs in the culvert. A dreadful mistake, often made, is having the discharge end above the bed level which would require a fish to jump to swim upstream

Irish bridges and fords

These types of construction are to be avoided *(Figure 4)*. They allow pollutants to enter the water. They create obstacles to fish. They interfere with the flow and cause scour. They are dangerous in flood and have been the cause of many deaths through people attempting to cross when the water is too high. They permit everything I endeavour to avoid. They are cheap but should only be allowed where vehicle use is likely to amount to one per day.

Wetland walkways

When specifying coatings and treatments to increase the durability of the construction materials try to pick the least dangerous. The odd fact is that performance is directly proportional to contamination power. For new construction, carry out all painting and treatment off site and touch up carefully later. Sometimes deck boards are cut on site. If this is done, catch any sawdust which has been pre-treated with creosote or something equally nasty.

Construction

Having made all the correct design decisions, the risk of polluting the watercourse during construction will have been minimised. Here we are only concerned with dropping harmful materials into the water. The responsibility is not only with the contractor. Some lies with the planning supervisor who approves the method statement and risk assessment in the Health and Safety Plan. This written plan of action must ensure that all work is carried out in accordance with current legislation controlling pollution. Contractors are usually very conscientious nowadays because it is usually easy to pinpoint blame if fish die and, although the fine can be up to £20,000, his removal from a contractors's list may prove more financially crippling. There is no magic formula here just a lot of common sense procedures.

Legislation

Today, it is very fashionable to be seen to be looking after the environment. As a result, guidelines are often enough for effective control without the need for primary legislation. The Forest and Water Guidelines by the Forestry Commission are a perfect example. Most environmental legislation is not primary, however, the legal requirements to be upheld being found in the following official documentation:

The Control of Pollution Act 1974 Amended 1990
Environmental Protection Act 1990
The Water Act 1989
The Water Industry Act 1991
The Water Resources Act 1991
Water (Scotland) Act 1980
Food and Environment Protection Act 1985
E C Directives

It is a fair overall assumption that, if you drop a foreign body capable of altering a stream's environment, you will be committing an offence with a penalty of up to £20,000.

It is easy to build bridges without polluting the environment or stream; it just needs a little consideration, consultation, common sense and a little money

Basic common sense practice

'If it can be done remote from the stream - do it.' If a bridge can be prefabricated elsewhere, it avoids extra activity on site where the damage can be done. The site compound should be a minimum of 10 metres from the watercourse. This compound will be the store for oils, paints, fuels, and preservatives - the most dangerous polluters. Security is important. The River Purification Boards have produced some excellent guidance for contractors advising on good practice (Anon, 1995). They have also drafted standard contract conditions which are designed to keep contractors within the law and thus avoiding pollution. The following are some important tips for constructing bridges over water.

'Build a temporary bridge'
Preferably provide one for both plant and personnel. It avoids bed disturbance and oil wash into the river.

'Carry out work May - September'
Rivers are low and easier to divert and work around. Coincidentally, it is the time when least damage can be done to fish eggs and alevins.

'Construct substantial working platforms'
Poor temporary works will lead to more spillages through a feeling of insecurity. The poor construction will permit more leakages.

'Use proper cranage'
Too often, an excavator will sit in the river to carry out a lift to save money on a crane. All lifting should be from a hardstanding adjacent to the bridge using a crane of suitable capacity.

'Avoid the results of vandalism'
Keep all toxic or dangerous liquids locked up in a secure module in the compound. Padlock fuel bowser taps. Avoid too large a store on site of anything that may pollute.

'Have emergency procedures in place'
All operators and staff must be aware of the emergency plan for mopping up after the accident which it is hoped will not happen (Jardine *et al.*, 1995).

Maintenance

This is probably the keenest area of interest. Very often it appears too difficult or expensive to completely avoid some pollution. It is for those reasons that the River Purification Board or NRA are consulted at an **early** stage. I have found the officers helpful and reasonable as long as you are taking the sensible action. They will permit calculated pollution if the economic case is undeniable. During a recent stone arch demolition, for example, the central portion of masonry was allowed to fall into the water, provided that suitable weirs were constructed to catch sediment. Good consultation leads to understanding compromises. The key words are :-

- safe materials'
- safe working practices'
- belts and braces'
- 'consultation'

Good practice may cost a bit more but will serve as a valuable low cost insur-

ance premium.

'Safe materials'

I carried out extensive trials using water based paints for bridge beams. Even after giving it every chance, it was found only to be effective if applied in factory conditions. It would have been a very useful material because when dropped in the water it disappeared. There would still be some toxins in the residue but with the base safe it was a step in the correct direction. Corrosion set in after one winter in most cases and it was difficult to apply in cold weather. I carried out extensive tests using wax to cover only partly prepared paintwork on steel beams. The material produced varying results but even the good results were not pursued because of the pollution potential. It was sprayed to ensure penetration of the coating into all crevices but overspray shrouded the entire vicinity in a waxy cloud, resulting in an oily film on water and vegetation. The use of sprayers should be monitored carefully. Where paints are concerned, the nasty toxic ones provide the best protection, so reliance has to be put on the working practice for repainting. Concrete can be made safe with the introduction of a gelling agent; we have successfully used 'Conplast UW' and 'Cormix'. Their use would normally be limited to underpinning where the water is in contact with the shutter or the concrete because it costs £35 per cubic metre, an additional 70% onto the cost of the concrete.

'Safe working practices'

Where part or all of a bridge can be removed, say for repainting, this must be done. When work is being done directly over water, a full close boarded scaffold with tarpaulin covers will be required. Only simple isolated repair jobs can utilise a cherry picker or the like. Concrete shutters are to be as near watertight as possible. There are now polystyrene packers to help in this way. Plan ahead and consult with the River Authority.

'Belts and braces'

When it comes to looking after the environment, "If it can be done it must be done" is a good rule of thumb. Obviously, there must be a sensible economic balance of scale but if doubling up of safety precautions only costs a little more it is a good idea.

'Consultation'

Others often have good advice and extra information. Authorities can give guidance on their interpretation of legislation. When everyone knows what is about to happen, better preparations can be made. When work is planned, everyone with an interest must be informed in good time and be prepared to change and improve the proposals.

Building materials and wildlife

In upstream zones where most Forestry bridges are sited, the water is not constantly deep enough for major fish. Therefore, pollution of nesting zones, invertebrates and plants is usually of concern. The young fish will need food and oxygenated water to survive. Although there are no large fish, do not be complacent; the whole downstream ecosystem will suffer if there is an upstream event, albeit in a diluted form.

Most substances can be dangerous, it only depends on the concentration. The EC Directive (76/464/EEC) covers discharges to surface waters and lists 129 substances to be toxic, persistent or bio-accumulative. For maintenance and construction of bridges, most of these troublesome substances are irrelevant and others are natural or inert, eg timber and steel. However, there are three very common materials involved in construction and it is worth knowing something of their dangerous concentrations. They are:

- cement
- oil-based paint and preservatives
- silt

Each has a different chemical or physical polluting action.

Cement

Cement increases the alkalinity or the pH of the water. Fresh water fish require a pH of 5-9 (pure water is 7). The pollution concentrations are totally dependent on stream flow and velocity. In forest areas, it is likely that the pH is acidic and low and "a bit of cement could improve things". However, the low flows when bridges are built result in high concentrations. The actual particles of cement and the resultant paste will damage bed life by a physical action of clogging gills. Cement will also remove some oxygen from the water but this will only be significant at high concentrations. Because of large variations in flow, it is almost impossible to say how much cement will cause major damage. It is sufficient to say that concrete with a gelling agent and in a good shutter will not cause damage but a bag of raw cement in a small stream will kill everything.

Oil-based paint and preservatives

They form a film on the water surface which "chokes" fish through their gills. The film, from drips or mist from a spray gun, will wash onto the banks and coat the plant life, killing everything. In turbulent waters, the liquids will mix and the toxic contents, sometimes even heavy metals, will go into suspension. In this way, they will enter the food chain and in the worst bio-accumulative cases can cause poisoning in humans to varying degrees.

Silt

The gravel bed of a river is a haven for breeding young fish. Eggs are laid in the spaces where oxygenated water and algae can reach to feed and nourish them. If foreign silt is introduced from say, indiscriminate excavation of an abutment, it can clog these "nests" and kill the new life. In suspension, silt of the wrong size and proportion will clog a fish's gills and cause suffocation.

Conclusions

The environment is man's greatest asset. It is his home, the sights he sees, the air he breathes and the water he drinks. He shares this asset with the rest of mankind, his fellow beings and the plant life. Pollution is interfering with this asset to a degree where it adversely affects others. Surely such action is a social crime. Legislation exists to regulate the social criminals but hopefully a stigma will evolve to shame them as with alcohol and driving, then big improvements will be seen. It is quite easy to design, build and maintain bridges without polluting the environment or the stream; it just needs consideration, consultation, common sense and a little money.

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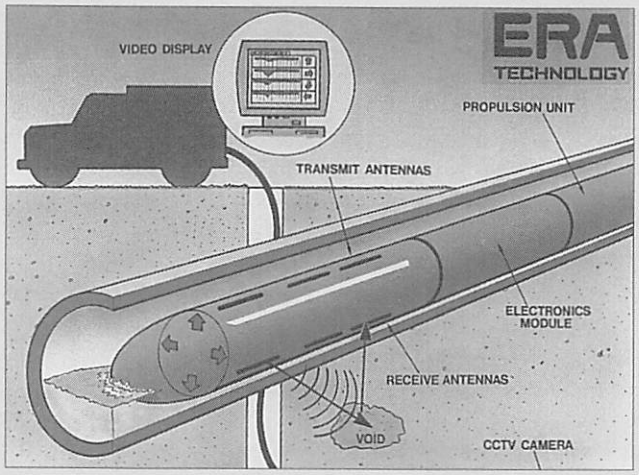
Sewer and pipe inspection by impulse radar

Working as part of a European consortium, ERA Technology has now successfully completed the feasibility stage of development of an advanced radar system for the internal inspection of 200 mm internal diameter, non-metallic sewers and pipes. The results from various tests have shown the capability of the prototype system and the technique is currently the subject of a patent application. The system detects whether the soil around a pipe contains voids, resulting from leaks which cause the surrounding soil to leach into the pipe. It allows voids of this type to be located before they increase to such a size that the ground collapses.

The unit consists of an electronically scanned, four quadrant array, capable of detecting voids 360° around a pipe. The antennas and rf electronics are propelled through the pipe by a motor drive unit, with digital data being relayed to the surface via an umbilical link. ERA Technology is now in a position to progress to the next phase of the project in order to expand the technical and commercial potential of the technology. The objectives of this second phase are:

- to establish an international project group consisting of a number of partners who will be able under licence to use or market the radar system in their own national territory or territories, subject to more detailed discussions at a later date;
- to design, manufacture and supply, under licence, a pre-production prototype system to each partner for trials and assessment in their own national territory;
- to work with each partner to further develop a range of radar systems for the inspection of different internal diameter sewers and pipes;
- to integrate the radar with other inspection methods such as CCTV or ultrasonic.



Schematic diagram of pipe inspection by radar

The company will provide interested parties with a formal invitation to participate, setting out in detail the objectives, programme of work, deliverables, timescales and costs of participation. While the ultimate cost to partners will depend on the overall number of participants, it is expected that the cost of participation will prove to be in the order of £50,000 per partner, staged over a period of two years.

Readers requiring more details of this programme should contact: **Keith Cheshire, ERA Technology Ltd. Tel: 01372 367069.**

ALLMI training course

To cater for increased industry demand for Health & Safety, recognised lorry loader training T H White Ltd, England and Wales distributor of the Palfinger range of lorry loaders, and Epsilon timber cranes, are now offering courses based on H&S approved Association of Lorry Loader Manufacturers and Importers (ALLMI) Code of Practice for the Safe Application and Operation of Lorry Loaders.

All courses, taken by David Ottoway, a qualified engineer and T H White's full time ALLMI certified trainer, take into account the need to comply with the recently introduced manual handling regulations, and current proposals regarding bridge bashing legislation. Having, for the past few years, successfully carried out basic training/familiarisation, when a machine is delivered to site, the updated training methodology caters for more intensive training which leads to the certification of the successful operator. Lorry loader training courses are split into theory and practice; during which time trainees are taken through the mechanical aspects, as well as legislation, machine safety features, component names and safe operating practice. A two hour theoretical aspect of the course is followed by questions and an examination. Up to four candidates can be accepted on each course which provides certification and can be held either at T H White's depot or at the customers location.

Contact: **T H White Ltd, Nursteed Road, Devizes, Wilts.**

Market potential for amenity grassland

The downturn in the agricultural markets for inputs such as pesticides and fertilisers has encouraged manufacturers of these products to explore the market potential presented by amenity grassland. The amenity grassland market, characterised by its complex and highly fragmented nature, has no single source of information to provide an up-to-date analysis of the market potential, the scale of opportunity, and the factors which influence purchasing behaviour.

A report entitled: *"The Market Potential for Amenity Grassland in Great Britain"* aims to address some of these issues. The report covers an overview of amenity grassland, golf courses and Local Authorities and is currently available at a cost of £1500 + VAT. For more information, contact: **Miss Lesley Parry, Produce Studies Ltd. Tel: 01635 46112.**

RASE Machinery Award Scheme Silver Medallists

The Royal Agricultural Society of England has announced the medal winners for the first part of the RASE Machinery Award Scheme, sponsored by TSB. The list of Silver Medallists in the Scheme is as follows:

Premier Livestock Handling - *Unistock Cattle Headgate*

Bonhill Engineering - *Fendt Favorit Series 500/800 tractor* with hydropneumatic front axle suspension

Protimeter plc - *Grainmaster 900 Series moisture meter*

Harvest Installations - *Harvest Maxi Stirrer* (floor store model)

Vredestein (UK) Ltd - *'Flotation+'* implement tyre

The RASE Machinery Awards Scheme is run in two parts. Judging of seasonal machines for spring, summer and early autumn use takes place in November, while machines used in late autumn, winter and early spring are judged in May. Further Awards will be announced after the second judges meeting in May 1996. Presentation of the first and second set of Award winners will take place at the Royal Show on Monday 1 July 1996.

The *Unistock Cattle Headgate* is designed so that an animal locks itself into a yoke automatically as it walks in. Spring-loaded neck bars prevent choking if it should go down whilst being held. A poll bar is provided and can be lowered to restrict excessive head movement. Simply-made adjustments allow all stock from calves to bulls to be handled. Safe one-man operation and a high degree of animal welfare generally have been major considerations in the development of the gate.

All the users contacted were extremely please and praised the rugged construction of the Headgate, its effectiveness and reliability, ready adaptability to different sizes of animal, the quick release and operational safety features, and the ease of one-man operation.

The judges were in no doubt that the Unistock Cattle Headgate represents a major advance in the field of animal handling and welfare, and that its novel feature and advantages should be recognised with the award of a Silver Medal.

Contact: **George Clark, Premier Livestock Handling. Tel: 01556 660449.**

The *Fendt Favorit 500 Series* of tractors comprises 5 models having 4- and 6- cylinder, water-cooled diesel engines providing 70 to 103 kW. The *800 Series* had 4 models with 6-cylinder, water-cooled diesel engines providing 121 to 169 kW. All have electronically monitors and controlled turboshift shuttle gear boxes giving 44 forward and reverse speeds.

The novel common feature is a *hydropneumatic front axle suspension system* which comprises essentially a swing axle and spring-loaded, nitrogen filled reservoirs, to absorb shock loads and provide an automatic self-levelling effect. Position sensors determine the mean position of the axle relative to the tractor. Pressure compensation via a hydraulic cylinder ensures that the usable range of suspension is retained even under a full load. Swing compensation of the front axle is maintained independently. If necessary, the suspension can be locked out, as for example when ploughing or using front loaders.

Users left visiting judges in no doubt about the good performance and exceptional reliability of their tractors. They also reported that incorporation of the front axle suspension system into the two well-proven ranges has brought significant benefits, including a smoother ride, greater operator comfort generally, higher and more consistent speeds and work rates, safer transportation of heavy implements on the road, reduced strain on spray booms and implements in work, better grip on rough ground, and fuel savings.

The Fendt 500 and 800 Series tractors were regarding by the judges as very well engineered; with their hydropneumatic front axle suspension they represent an important step forward in tractor design, especially in terms of versatility, operator comfort, output and road safety.

Contact: **Paul Bassett, Bonhill Engineering. Tel: 01430 423388.**

The *Protimeter Grainmaster 900 Series* moisture meter is designed for ease and speed of use and simplicity of cleaning and maintenance. It employs the well-proven resistance method of measurement and provides automatic temperature correction. In one operation, grain or seed samples are ground and pressed into a cell. Then, from the ten crop calibrations programmed as standard the appropriate one is selected; and the sample moisture content appears in the display. To meet local standards, the calibration can be adjusted. The instrument housing is ergonomically designed, and a hard carrying case is provided. A 2-year warranty applies. A printer is available optionally.

Users praised the simplicity of the instrument. They found it faster and more convenient to use than previous meters of the same and other makes. Most had checked the accuracy of measurement and found it to be of a very high order.

By the award of a Silver Medal, the judges wished to acknowledge the sound design, accuracy and user friendliness of the Grainmaster 900 Series moisture meter.

Contact: **Chris Rawwell, Protimeter plc. Tel: 01628 472722.**

The *Harvest Maxi Stirrer* is designed for the in-store mixing of harvested cereals and seed crops, to promote uniform conditioning and drying. It comprises a box-section main beam spanning the store, pairs of electrically driven friction wheels which propel the beam at each end along a fixed track, and two drive carriages from each of which is suspended a pair of open augers so that they run in the

stored crop, reaching down to within about 50 mm of the floor. The carriages are also electrically driven in alternate directions along the main beam so that all the crop bulk is moved with the minimum number of passes. After setting up, the system operates automatically. Facility for remote control is available.

Users were enthusiastic about the system and reported very good results; a range of combinable crops, including grass seeds and oilseed rape, were effectively and thoroughly mixed or cooled, and in conjunction with ambient or heated air ventilation - with or without a constant humidity controller - surprisingly fast, even and energy efficient drying was achieved, sometimes from moisture levels well above 20 %. The simplicity of construction, operation and maintenance were specifically praised.

The judges were favourably impressed by this simple, effective and automatically operating system for grain and seed conditioning and drying. They believed that its suitability for installation also in existing stores could be of benefit to many grain and seed growers.

Contact: **Colin Hales, Harvest Installations. Tel: 01795 533903.**

'Flotation+' low-pressure flotation tyres are designed to provide a wide profile and large ground contact area, to reduce soil compaction, rutting and grass marking. Depending on tyre size, new section width varies between 418 mm and 720 mm. Load carrying capacity ranges from 3015 kg to 5000 kg. Inflation pressures depend on tyre size and maximum road speeds.

Users interviewed regarded the tyres as an advance on other designs. Claims by the manufacturers of improved performance characteristics were confirmed in a variety of applications and operating conditions.

In making the award of Silver Medal, the judges took account of the importance of minimising soil compaction and surface damage and of the economic advantages of extending the periods in the farming calendar when implementing traffic on the land is possible.

Contact: **Peter Bryett, Vredestein (UK) Ltd. Tel: 01933 677770.**

Midland Agriculture publishes planning booklet for farmers

Midland Bank has published its 22nd annual practical guide for farmers. *Forward Planning 1996*, produced by bank's agricultural division, provides forecasts of income, variable costs and gross margins for arable crops and livestock.

The booklet is free to farmers, agricultural advisers, students and anyone else with an interest agriculture and is available from Midland branches. For farmers, the timing is intended to coincide with the period in which they are reviewing their 1995 performance and preparing their plans for 1996.

Norman Coward, Midland's agricultural director, comments: "In 1995, the prices of most agricultural commodities were up to the levels we had predicted. In some cases, they were higher due to favourable European or world supply and demand balances. The result was that farming profits were generally reasonable for all of the crops and livestock supported by the Common Agricultural Policy."

Mr Coward foresees similar levels of prices and support in 1996. He continues: "We do not anticipate major changes in the value of the green pound. The UK government is likely to continue its policy of seeking strongly to restrain inflation but, even so, farmers' costs are already rising faster than the general rate of inflation - especially fertilisers, sprays feeds and rents. This aspect must be borne in mind by farmers because there is no possibility of increasing compensatory payments like area aid, ewe premia, beef premia, etc. to allow for inflation. Inflation is a major threat for all small businesses - but more so for farmers than others because of the rigidity in their payment system, which arose from the CAP Reform and the GATT Uruguay Round Agreement. Nevertheless we still anticipate reasonable levels of profit for agriculture overall".

Good plans and forecasts continue to be essential for the efficient management of farming businesses. *Forward Planning 1996* gives Midland's estimates for returns and variable costs for the coming year. But, it is only a guide and its format allows farmers to adjust the figures to suit their own circumstances.

Zinc alloy electrodeposits for better steel protection

Developments in zinc alloy electrodeposition will be reviewed at a one day symposium to be held on Wednesday, 15th May 1996 at Aston University, Birmingham and arranged by the Midland Branch of the Institute of Metal Finishing.

The alloying of a small percentage of another metal (eg nickel, cobalt, iron or manganese) in zinc electrodeposited coatings gives a major improvement in resistance to corrosion. Used initially in the motor industry as pre-plated strip for body pressings and on under-bonnet and other steel components, zinc alloy coatings are now being applied to a wide range of steel components.

Papers to be presented will include:

Zinc alloy coatings - A European prospective *by Ethone OMI Ltd*
Zinc iron deposition *by Tong & Taylor Ltd*
Measurement & composition of alloy coatings *by CMI International USA*
Zinc cobalt deposition *by Dunlop Hiflex Limited*
Zinc-manganese deposition *by Loughborough University of Technology*
Zinc nickel deposition *by Bristol Bending Ltd*
Post passivate treatments for zinc alloys *by Atotech UK Ltd*

For further details contact: **Ron Read, Hon. Sec., IMF Midland Branch, 165 Hill Village Road, Four Oaks, Birmingham, B75 5JQ. Tel: 0121 308 0777.**

Book Reviews

Design and Construction Guidelines for Farm Waste Storage

Edited by Dr Mike Kelly
Publisher: SAC, Edinburgh
ISBN 1-85482-481-3
Price: £11.75

These guidelines bring together the recent legislation on farm waste storage. They are aimed at giving direct help to all involved in assessing, planning, and constructing farm waste storage facilities. It must be pointed out, however, that the guidelines relate specifically to Scotland in terms of regulatory requirements. Although there is much similarity between the legislation for Scotland and for the rest of the UK, it does mean that the work (as was intended) is very "Scotland specific". This is something of a pity, as this is an excellent piece of work, and of great use to farmers, landowners, builders and consultants, as well as to River and Local Authorities, educators and students. It does raise an interesting question as to why such a document is not available for the legislative areas of England, Wales and Northern Ireland. Perhaps, we have government policy to thank for that!

To the work itself, as I have suggested, it is of a very high quality. It aims to interpret current legislation so that the reader is able to relate them to specific cases. This it does by a series of excellent worked examples and accompanying explanatory text. The prime interests of the guidelines are transfer and storage of slurry and silage effluent but it does also deal with sheep dipping facilities and the storage of agricultural fuel oils.

To conclude, this is a first class guide to the design and construction of farm waste storage. It is a must for anyone involved in wastes management, even if they have to take account of variation in the legislation within different areas.

MJH

More Years on the Tractor Seat

by Arthur Battelle
Publisher: Farming Press Books
Price: £4.95 (paperback)

The rural sector has produced many 'characters'. Their greatest ability is to take a funny event/situation, exaggerate it and turn it into one of their "and then there was the time".

Most simply entertain friends and perhaps the rest of the pub (well, it does get you free beer). Others attract small crowds at shows etc where they perform to the delight of those present. A very small group put pen to paper and share their "experiences" with a wider audience. Arthur Batelle is one of that small group, and his book - the second in the series - reflects the entertainment value expected of one of life's characters.

The book opens in 1949 and covers events which occurred during the next decade. Packed with "and there was the time" it is an easy and funny read. Buy it, enjoy it if you have any rural farming or machinery connections, you are bound to relate to some of the stories and see the humour in them.

MJH

Machinery for Horticulture

by Brian Bell and Stewart Cousins
Publisher: Farming Press Books
ISBN 085236 2315

It is always a pleasure to review a work in which Brian Bell has been involved. A common feature of his books is the well written text and the excellently presented supporting illustrations. I have suggested before that the discipline of developing lecture programmes on the subjects in his books has stood him in good stead. This is once again very much the case with *Machinery for Horticulture*. True, it is aimed at beginners, such as National Vocational Qualification (NVQ) students, but it will prove a useful reference work for anyone interested in learning more about the basis of modern horticultural equipment.

There are sections on tractors, cultivation, drilling, planting and crop protection equipment. Glasshouse, turf care, and irrigation equipment, together with machinery for estate and ground maintenance are also given good coverage. Finally, workshop and sources of power are considered. One thing I particularly liked was that each chapter includes suggestions for students' further reading and practical work.

It seems to me that the subject of horticultural machinery had limited reference texts. Brian Bell's work is therefore most welcome as it provides an excellent text for the college student and others looking for an introduction to the subject.

MJH

George Constantinesco His Torque Converter and Other Inventions

by Ian Constantinesco
Publisher: M W Models, 4 Greys Road, Henley on Thames

In 1926 the Graphic published its "1900-1925 Leaders in the march of Progress" which included such illustrious names as Einstein, Kelvin, Bell, Rutherford and Mme Curie. Also appearing in this group of 17 is George Constantinesco and perhaps, like myself, you are not well aquainted with the name or his work. This book, written by his son Ian, will certainly make you more familiar with his life and work. I, in fact, borrowed the "Leaders in the March of Progress" through reading this text so if you would like know who the other 11 eminent characters were, buy the book!

George Constantinesco (1881-1965), the work informs us, was best known during World War I and its aftermath as the man who invented the hydraulic wave transmission synchronising gear (the C.C.Gear). (This enabled machine guns to fire forward between the

revolving propeller blades of fighter aircraft). Post war, he invented a mechanical torque converter for cars and railway locomotives. In total, George Constantinesco had more the 133 inventions credited to him.

Ian has put together the work from conversations with his father. It is not only an important reference work of a remarkable inventor, but also an amazing insight into the many difficulties he has faced, like many others, in bringing work to fruition.

The format of the book is A4 softback, and it is 60 pages of well written and documented history, both technical and personal. There are 60 illustrations, many of which must be very rare and are certainly a joy to see.

The work is available directly from the publishers at £19.95. An economy edition is also available with illustrations in computer enhanced mode on plain paper at £12.50. In whichever form you prefer, may I encourage you to consider purchasing it if you have any interest in engineering history and the work of one of its greats, you will find this book fascinating.

MJH

Tractors at Work Vol II

by Stuart Gibbard
Publisher: Farming Press Books
ISBN 085236 3168
Price: £14.95 (hardback)

The first volume of *Tractors at Work* was reviewed about a year ago. It was a book of archive photographs illustrating tractors at work over the past 90 years.

The second volume is a further outstanding composition of photographs depicting the role of the tractor in the workplace. The work features 191 illustrations from a wide range of sources. They are not only extremely well produced but also carefully selected and catagorised in such a way as to be informative as well as enjoyable. As with many other books of this type, they are most attractive to the "enthusiast" to whom I recommend this as highly as I did the original volume. In this case, however, I am able to suggest that this work should meet a wider market. Anyone interested in the recent social history of farming or the development of its prime mover will find this book most valuable.

MJH

World Harvesters

by Bill Huxley
Publisher: Farming Press Books
ISBN 0852363028
Price: £14.95 (hardback)

This book follows Bill Huxley's earlier work which traced the development of combine harvesters. In this work, he has broadened the scope to include equipment for harvesting a range of crops including soft fruit, tea, pears, aquatic weeds, sugar cane and potatoes. The development of various types of powered equipment throughout the world is covered from the earliest up to present day "high tech" offerings.

The book is predominantly a photographic and illustrative record with the focus on the period from the late 1930s to the 1970s. Accompanying this excellent artwork is the author's comments which include details of the manufacturers and technical aspects of the models presented.

The book is undoubtedly aimed at the "enthusiast" and for them I am sure it is a good buy. For others it may occasionally act as a reference or as a pleasing half an hour "flicking through the pictures". Its strength is the photographic record; as a history or reference it is rambling and lacks organisation.

MJH

Video Reviews

Classic Farm Machinery Volume I 1940-1970

Selected by Brian Bell
Narrator: Chris Opperman
Producer: Farming Press Videos
Price: £14.95

There is no doubting the quality of Farming Press videos. They are very clear and well shot. In this case, they have brought together a superb range of archive film. It features, as the title suggests, farm machinery, horse, tractor and self-propelled from 1940 to 1970. Brian Bell had selected a very comprehensive range of tillage, planting, crop protection and harvesting machinery. Further, he has produced an interesting and informative script which is well narrated by Chris Opperman. The video should be of interest to those who wish to know more about how equipment has changed over the period selected. It must be said that it is rather a catalogue of machines, there is very limited technical information or much to suggest reasons for engineering developments that took place. However, as a pictorial of history of machines at work, it is finely crafted and well presented. It should prove attractive to those who enjoy watching old machines and horses at work.

MJH

Classic Farm Machinery Volume II 1970-1995

Selected and Sampled by Brian Bell
Narrator: Chris Opperman
Producer: Farming Press Videos
Price - £14.95

A review of Volume I of the above video series appears separately. This second volume continues from the 1970s through to the present day. It again makes use of archive film from most of the well known manufacturers. The range of equipment is much as in the first issue, starting with tractors and ploughs and moving through cultivation, planting, spraying and harvesting equipment.

As with my first review, I cannot fault the quality of presentation either in the filming or the narrative. I will again, however, make the point that this work is very much a catalogue. True, a very well made catalogue and if that is what you require then fine. If you are looking for any engineering/technology, it is thin on the ground. Some of the footage, particularly of demonstrations, is little more than a picture gallery, even becoming quite tedious at some points. It is, therefore, a product for the beginner who wants to know more about who made what and when and what it looked like in work. It does that particularly well.

MJH

Homburg drain cleaner

The Netherlands based originators of the Homburg agricultural drain cleaners have announced their intention to enter the British market. Their tractor mounted jetter system first patented in 1985, has gained momentum. It is now an essential tool in Dutch agriculture and is equally appropriate for use in this country. Well installed and maintained subsurface drainage systems help plant growth and ease the task of tillage.

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

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 reduces harvesting problems, helps the clean lifting of potatoes, and improves 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 remotely 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.

Johannes de Boer Homburg's managing director announcing the intention to enter the UK market says: "We export to many markets, including the Far East. I believe our success is due to our readiness to provide technical advice, which we now hope to make available to farmers and contractors in the UK". Four models will be offered in the UK, with prices ranging from £5,300.

Contact: **John Colman. Tel: 01787 372233.**

New demount sprayers

2000 litre demount units for both the JCB Fastrac and Fendt Xylon have been added to the range of conventional and air-assisted sprayers manufactured by RAU GmbH.

Much of the initial preparation for the Fastrac was undertaken in the UK by Ferrag Ltd, of St Helens working closely with JCB. The sprayer was then shipped to Germany for testing to ensure compliance with the strictest plant protection laws in Europe regarding uniform tank mixing, minimal residues and internal and external cleaning.

The integral 2000 litre tank and boom can be quickly removed allowing the tractor unit to carry out other duties.

German sprayer manufacturers have joined forces to develop a 2000 litre demount tank for the Fendt Xylon. Fendt have produced a sub-frame with a hydraulic tilt ram making it suitable for both sprayers and bulk tanks to top up the farmer's existing drills and fertiliser spreaders.

RAU have utilised this common 2000 litre spray tank, equipping it with their own spray system. Both units can be fitted with either 18 m or 24 m booms. RAU Airflow booms can be supplied as extra cost options.

The Xylon sub-frame is available from Fendt dealers.

Contact: **G Randles, Ferrag Ltd, PO Box 90, Haydock Lane, Haydock Ind. Est., St Helens, Merseyside, WA11 9UU. Tel: 01942 272777.**

Hydraulic tube couplings

Berendsen Fluid Power have produced a NEW catalogue covering their KR high pressure tube couplings. For tube from 6 mm to 125 mm and +" to 5" O/D, they are capable of operating at high pressures, are resistant to extremely severe pressure pulsation, vibration and temperature cycling.

KR couplings use an 'O' ring seal and a split collect to retain the tube. They are extremely quick to assemble, reliable, leak free and give long trouble free service. The catalogue covers Berendsen's complete range of carbon steel, stainless steel and cupro-nickel couplings as well as their complimentary products; tube, tube clamps, in line valves and gauges.

KR tube couplings are approved by Lloyds Register of Shipping, Germanischer Lloyd and Det Norske-Veritax.

Contact: **Paul Hensman, Berendsen Fluid Power Ltd, Sandy Way, Amington Ind. Est.,Tamworth, Staffs, B77 4DS. Tel: 01827 69369.**

Kverneland buys 100% of Accord

In August 1994, Kverneland entered into a strategic alliance with Accord, the German manufacturer of seeding machines. This alliance gave Kverneland a 26% proprietary interest in Accord and an option to take over the rest of the company. Kverneland's Board of Directors has now resolved to realise this option and to increase the Company's interest to 100% with effect from 2 January 1996.

Accord is Europe's leading company in the area of pneumatic seeding machines. This technology is particularly well suited to wide working widths and for use with new integrated tools for soil preparation and seeding in one operation. The development and integration of the revolutionary plough and drill combination unit, Kverneland Packomat Seeder, is an example of this.

In 1995, Accord had a turnover of approximately DM55 M and profit before tax was perfectly in line with the best results of the Kverneland companies.

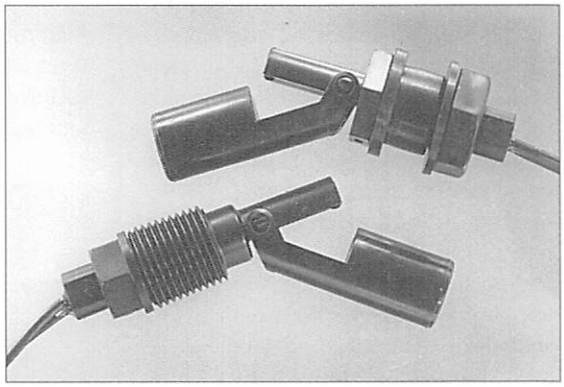
The realisation of this option will help to strengthen Kverneland's total product range in the area of soil preparation. It will also lead to further efforts to develop new, integrated machine systems and to a stronger position in relation to competitors and the dealer network.

The Managing Director and principal shareholder of Accord, Mr Helmut Weiste, as well as the other Accord shareholders are to re-invest part of the income on the sale in Kverneland shares.

Kverneland will finance the acquisition of Accord through its cash reserves. Kverneland believe the acquisition of Accord will lead to an increase in earnings per share.

"Obviously this very good new for the Kverneland stockholder (its employees, dealers and customer) and completes a further piece in our long term strategy. So far as the UK is concerned", said Mr A A Hird, Managing Director; Kverneland (UK) Ltd, "I do not see any immediate changes to the distribution of Accord products."

Side-mounted float switches



A new range of side-mounted float switches work on the crocodile jaw principle, with a float section which closes as the fluid level rises or falls.

The housing of the switch can be specified in either nylon or polypropylene depending on the chemical made-up of the liquid being monitored.

Rotating the mounting by 180 degrees during fitting enables the new switches to detect falling fluid levels so making them suitable for a wide range of usages such as measuring the amount of oil in an engine sump. The switches can be fitted internally or externally with a switching capability up to 3 A, 220 V a.c.

Contact: **John Curd, Assemtech Europe Limited, Rice Bridge Ind. Est., Thorpe-le-Soken, Essex, CO16 0HH. Tel: 01255 862236.**

Nylon threadsealing and locking patches

Standard bolts and nuts are normally made with a clearance between them to ensure easy assembly and it is this fine clearance that allows fasteners to work loose. The most effective method of filling this gap is to use a liquid thread locker or sealer, depending on the application. It is not always acceptable to use liquid threadlocking, and as a result pre-applied dry materials have been developed.

Alston Engineers can apply ANU-LOK to fasteners up to and including M30, and in lengths up to 18". The process is compatible with most plating and fastener pretreatments.

Patched bolts are re-usable, and by increasing or reducing the volume of nylon the torque values can be controlled. The new ANU-LOK patch provides a low in-place cost compared to locking washers and eliminates the need for secondary mechanical, adhesive or sealing tapes.

Contact: **Kevin Taylor, Alston Engineers (Preston) Ltd, 108 Holme Slack Lane, Preston, Lancs, PR1 6HA. Tel: 01772 795721.**

UK tractor registrations up 4.8% in 1995

The AEA reports that the number of agricultural tractors (over 30 kW) registered in 1995 was exactly 19,000, an increase of 4.8% on the previous year. The total power sold into the market rose 8.4% last year to 1,456,000 kW, the highest level for 10 years. The average power per unit also continues to rise and, for the first year ever, has now exceeded 75 kW.

This has been a further year of very satisfactory trading levels, underpinned by the favourable situation in British farming. Sales have been particularly boosted by good returns in the arable sector. Prospects for the farming community appear reasonable and so the trade is expecting that tractor sales may hold at firm levels for the first part of 1996, whilst the prospects for the second half of the year will very much depend on weather conditions, particularly for the cereal crops.

Electric actuators

Electric linear actuators are now being successfully used in agriculture. P J Parmiter & Sons have incorporated an actuator from Linak-UK into a range of bale wrappers being sold worldwide. The actuators form an integral part of a fully automated procedure controlled by an operative with an electric control 'manager' located in the cab of the tractor. The actuator operates the vital 'cut and clamp' mechanism which governs the supply of the plastic film to each bale as it rotates on the table.

An expected life cycle would exceed 50,000 actuations, with up to 15,000 bales wrapped in a short weather window any year. Reliability of all components is therefore paramount.

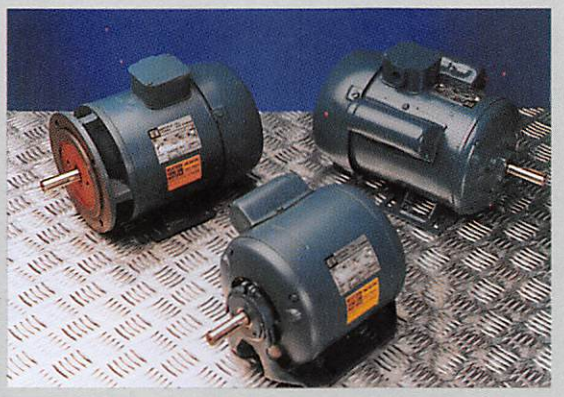
Linak Director, Mike Byrne, said: "Our LA30-15 is the ideal piece of equipment for this job. It is strong, dustproof, waterproof, and has a proven record of operation which meets the demanding requirements of a company such as Parmiter".

Contact: **Mike Palmer, Linak-UK Ltd, 6 Elm Court, Sandwell Business Park, Smethwick, B66 1RB. Tel: 0121 544 2211.**

FHP motors

The new BFM range of fractional hp motors are now available from Beatson and Co (Electrical) Ltd of Sheffield.

The motors conform to BS5000 Pt II for performance and BS 2048 Pt I for dimensions. They are claimed to make an ideal choice for all general engineering replacements, as well as applications in the catering, woodworking and modelmaking industries and many other specialised small machine markets.



Standard frame motors available in 4 mounting and supply options.

Totally enclosed fan cooled or drip-proof motors can be supplied in foot, flange and resilient mountings for 240 V single phase and 415 V three phase operation. Ratings from 1/4 up to 2 hp (180 to 1500 W) can be supplied, covering speeds from 960 to 2800 rev/min.

These fractional hp machines augment an extensive range of industrial motors that can be supplied. Further information is available in a 52 page catalogue supplied free on request.

Beatson & Co (Electrical) Ltd, Hope Works, Mobray St, Sheffield, S Yorks, S3 8EN. Tel: 0114 276 8088.

TurboCAD 2D/3D release

Free evaluation copy of *TurboCAD 3.0* is now available to download from IMSI world wide web site:
http://www/imsisoft.com

IMSI has announced the release of ***TurboCAD 3.0*** for Windows 95 and 3.1, a major new upgrade which is set to revolutionise the concept of desktop CAD. *TurboCAD 3.0* has been designed to compete directly with AutoCAD LT - but at almost one fifth of the price. A combination of increased functionality and exceptional value-for-money is expected to attract a significant number of users from both the lower and mid-range CAD markets looking for a true alternative to AutoCAD LT at an affordable price.

The official UK release of the full product - ***TurboCAD 2D/3D*** - will include a free standalone 3D modeller and 10,000 industry standard, drag-and-drop symbols.

Contact: **Jenny Hodge, IMSI (UK) Ltd, Printing House Lane, Hayes, Middlesex UB3 1AP. Tel: 0180 581 2000**

Management buy out at Horstine Farmery

The management team at Horstine Farmery Ltd has signed a letter of intent to purchase the business from Rhone-Poulenc Ltd. The new owners will be the present Managing Director, Willie Allan and its Finance Director, Mike Mellett.

Horstine Farmery will continue production of the well known Microband and TMA4 Airflow applicators, Agroband and Cascade fertiliser applicators plus the range of stainless steel sprayers.

Collaboration with Rhone-Poulenc Agro will be maintained through a series of supply and licensing agreements. "Continued high standards of service to our UK customers and the 40 countries where our machinery is exported will be key to all of us in the existing team to ensure future success" comments the new owners of the business.

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