# SOIL and water

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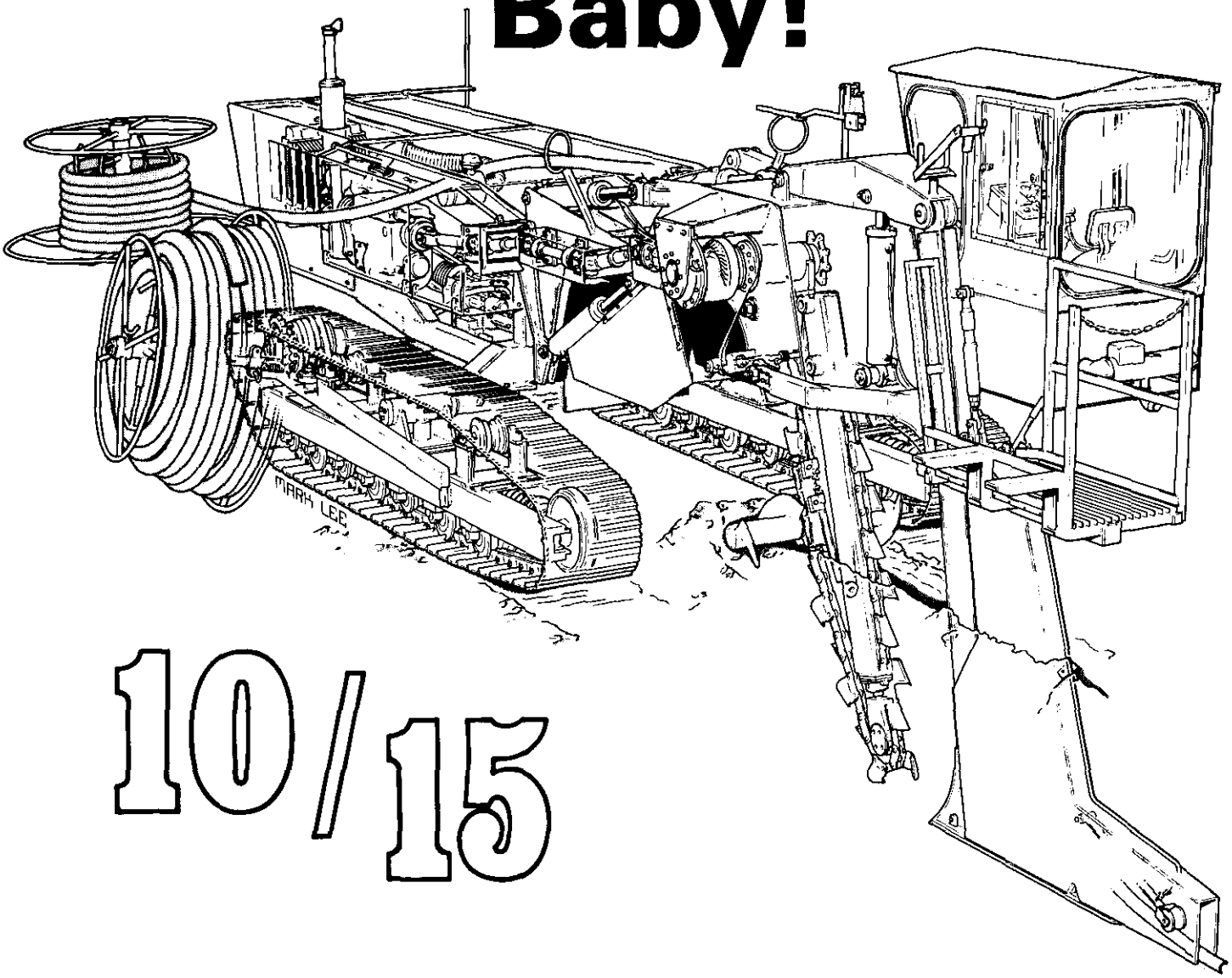
# Oh What a Beautiful Baby!

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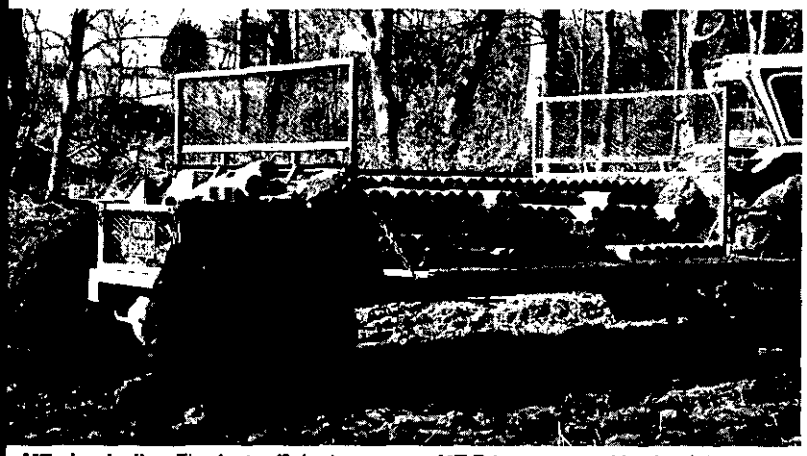
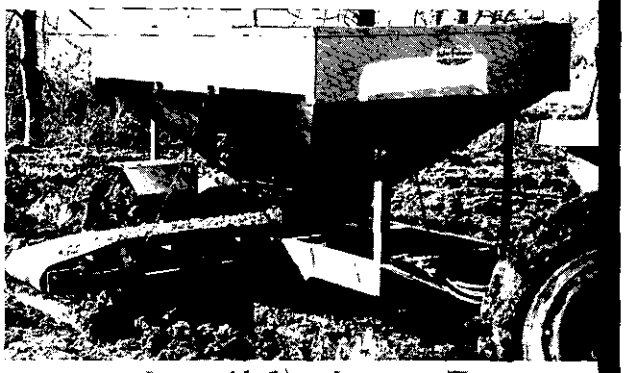
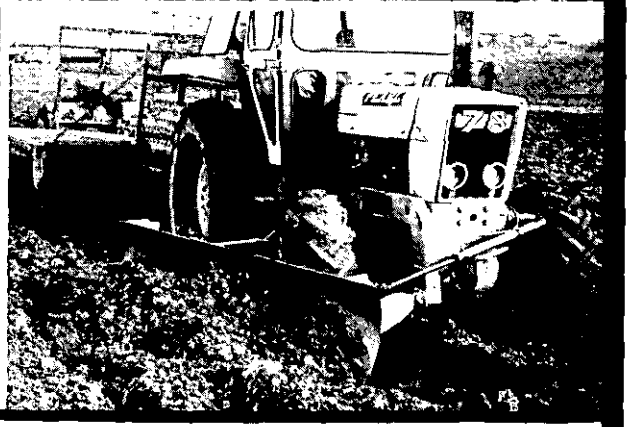
# drainage equipment

**MT** TRANSTER gravel **trailer.** A 10-tonne capacity, self-propelled, articulated gravel **cart** with 4 X 4 wheel drive. Driven by a Ford 7800 power unit producing **98** DIN hp at 2100 rpm. Sixteen forward and four reverse gears with **low / high** gear change on-the-move. Differential lock and brakes on all four wheels. Hydrostatic steering with two double-acting rams. High or low conveyor discharge height and in-cab hydraulic control **of** all hopper **discharge** functions.







**MT pipe trailer.** The fast, efficient way of transporting loose, packaged or crated clay tiles and plastic pipe. Seven tonne capacity. Side board lowers for easy transfer of pipes to drainer.

**MT back filling blade — Ford** *(below right).* A side filling blade designed to fit the full range of Ford 6600, County (small front wheels) and Roadless 78 tractors. Fully hydraulic operation. Supplied with all pipe work and spool valves.

**MT 7-tonne gravel trailer** *(above right).* Constructed of welded steel components bolted together to make a strong and easily serviced machine. Pto-driven conveyor with high or low level discharge. Hydraulic functions to conveyor lift and hopper door. Fitted with 16 X 34 or 15.00 X 20 tyres.

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SOIL and water
THE MAGAZINE ON SOIL CONDITION AND FERTILITY

VOLUME 11, No. 1 JANUARY 1983

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The next issue will be published in April.

# BACKING THE SERVICE

Brian P. Bayley's Christmas present to the farmers and businesses who use his draining contract service was a night out at Drayton Manor Park, near Tamworth, looking at the 'Structure of the 80's'.

The structure under discussion had nothing to do with economics or business efficiency, but was a down-to-earth look at the soil. About 120 farmers from Derbyshire, Leicestershire and Warwickshire accepted his invitation and not only had a good night out but actually learned something.

Mr Bayley recognises the need for follow-up meetings of this nature to ensure that his customers get the best out of the drainage schemes he has installed. Judging from the responses of those who attended, it proved to be an excellent customer relations exercise.

So often one hears of schemes that have failed following bad soil management by the tenant or landowner, surely such an approach should be encouraged. It doesn't take much to pick up the 'phone and ask local ADAS soil scientists, Land and Water Service staff or nearby college experts or drainage consultants to spare an evening to talk to farmers. It cannot have cost much either — the price of a pint, a plate of sandwiches and the hire of a room. One wonders why there aren't more meetings of this nature. The example set by Henry Oakland last year will take some beating. They organised some fifty local meetings which ranged from a handful of farmers chatting around the bar to a fully-fledged conference with numbers in the hundreds, one being chaired by Magnus Magnusson.

More and more the responsibility for the tip top maintenance of a drainage scheme relies on the contractorifarmer relationship, and although ADAS does have local meetings and there are farmer-groups in the regions, the contractor should leap at an opportunity to help his clients.

The SAWMA-organised Drainage Workshop arose in response to contractor and manufacturer comments. Every year, contractors have a chance to update their knowledge at this event. They would, I feel, do a lot of good by taking such an approach and applying it at the farmer level when they get home. Even if he can't secure more than one speaker for any meeting there are a range of films and videos which would add weight to an evening meeting. These include efforts from the Ministry, BCLDI and PLDMA, and from July, a SAWMA video entitled 'Understanding the Soil'.

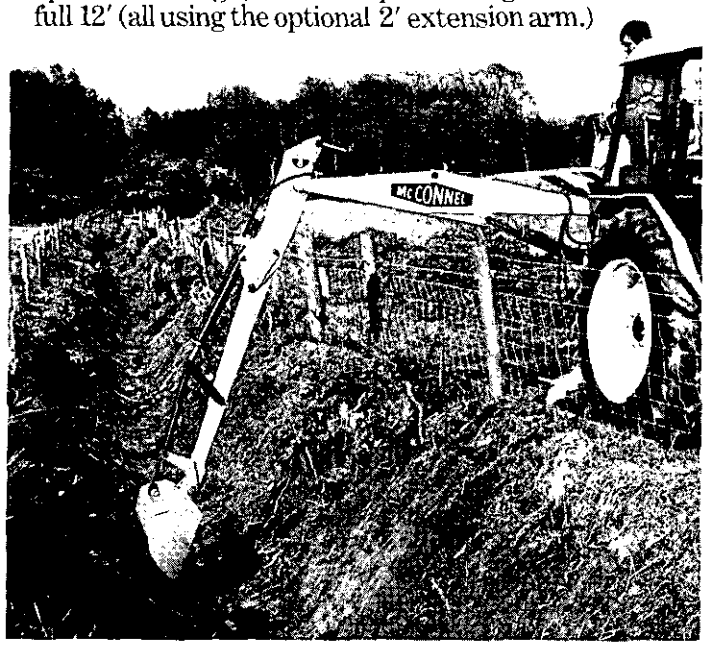
All credit then to Bryan Bayley who, with three teams operating full-steam and with a full order book, faced criticism from one farmer concerning draining in wet conditions. However his guests must have realised that his men are working to ensure good installation at all times, and with back-up meetings such as this, Mr Bayley certainly recognises that secondary treatments carried out by the farmer are often essential to maintain a scheme in good working order.

## CONTENTS

# The McConnel PA8.

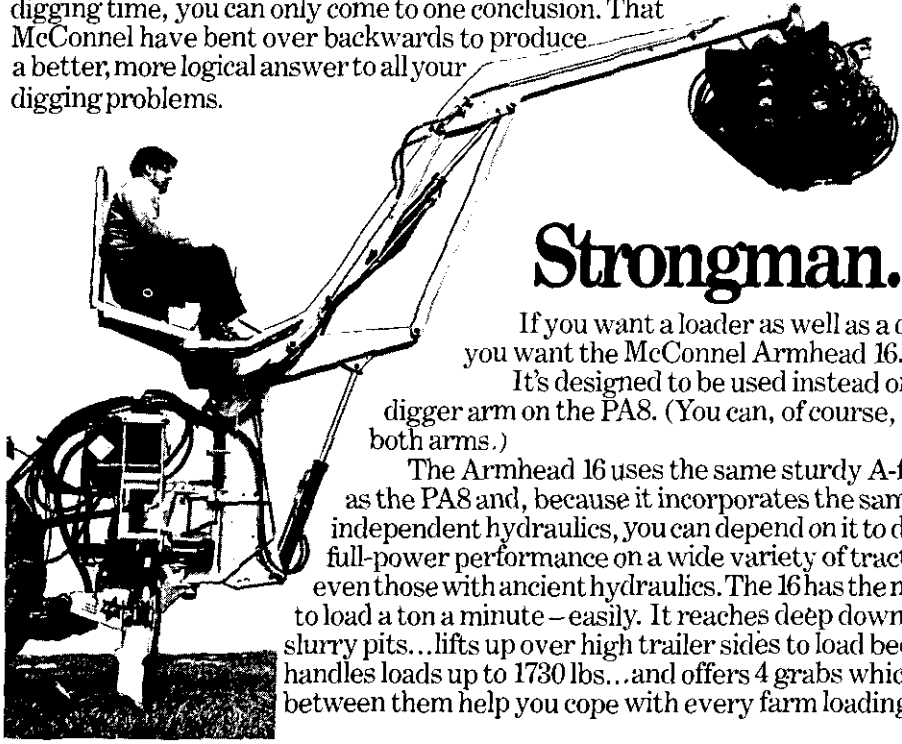

## High-wire act...

Reach has always been a strong point of McConnel Power Arms. The PA8 is no exception. It can reach way over wire fences to reach down deep into ditches. The arm stretches out up to 16'9" horizontally; it goes up almost 16' high, and in low position it goes down a full 12' (all using the optional 2' extension arm.)




## Contortionist...

We admit that the idea of simply levelling up the business end of a digger on sloping ground – rather than jacking up several tons of tractor – takes a little getting used to. Of course, once you've seen how the PA8's tilting King-post enables it to handle awkward ditching jobs we think you'll join in the applause which greeted its introduction. When you also discover the time-saving offered by the PA8's Instant Weight Transfer rams, the optional hydraulic top link for simple fore and aft levelling and its ability to slice 20% off digging time, you can only come to one conclusion. That McConnel have bent over backwards to produce a better, more logical answer to all your digging problems.



## Strongman...

If you want a loader as well as a digger, you want the McConnel Armhead 16.

It's designed to be used instead of the digger arm on the PA8. (You can, of course, have both arms.)

The Armhead 16 uses the same sturdy A-frame as the PA8 and, because it incorporates the same independent hydraulics, you can depend on it to deliver full-power performance on a wide variety of tractors – even those with ancient hydraulics. The 16 has the muscle to load a ton a minute – easily. It reaches deep down into slurry pits...lifts up over high trailer sides to load beet... handles loads up to 1730 lbs...and offers 4 grabs which, between them help you cope with every farm loading job.

Please fill in the coupon and we'll send you colour literature, giving full details of the PA8.

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## ACTION ON STRAW

RESEARCH scientists, users of straw, manufacturers and processors would be among a group of leaders in their own fields which he would be inviting to meet and discuss better coordination of efforts to find new uses for straw, said Lord Ferrers, speaking at last November's ADAS-organised Straw Utilisation conference at Oxford. The subject, he thought, offered many opportunities for innovation, research and development, with large prizes for success.

About 12m tonnes of straw were produced annually in the UK, Lord Ferrers argued, of which roughly 5m tonnes were surplus to needs. It was remarkable that so much was burned in fields when the cost of heating homes was so high.

"It strikes me as astonishing," he said, "that a farmer will pay hard cash for oil to heat his house while at the same time paying hard cash to his men to dispose of hundreds of thousands of BTUs into the atmosphere by burning straw within a few hundreds yards of his home."

As a fuel, he pointed out, straw with a moisture content of 16 per cent had about the same energy value as wood, about half the energy value of coal and about one third of the energy value of oil.

## LAND RESTORATION CONFERENCE. 8 FEBRUARY

SPECIALISTS, advisers and farmers will gather at the NAC in February to discuss land restoration. Papers will be presented by speakers from a County Council, MAFF and Ready Mix Concrete as well as Mr D. Reynolds, a Northamptonshire farmer.

## WORLD WATER CONFERENCE

LONDON'S Royal Festival Hall complex will be the venue for World Water '83 International Water and Sanitation Conference and Exhibition from 12 to 15 July. Enquiries have already been received, say the organisers, from intending visitors and delegates from more than 40 countries.

In addition to papers from internationally recognised experts on subjects connected with provision and maintenance of safe drinking water and sanitation in urban and rural environments, subjects covered will include finance, training, management and water conservation.

For further information, contact The Conference Office, The Institute of Civil Engineers, 1-7 Great George Street. London SW1P 3AA.

## IRRIGATION AND DRAINAGE

VOLUME II of Irrigation and Drainage in the World— *A* Global ***Review,*** has now been published by the International Commission on Irrigation and Drainage. Copies may be obtained by national committees for the use of their members at 33 US dollars per copy from the ICID Central Office, 48 Nyaya Marg, Chanakayapuri, New Delhi 110 021, India.

Based on reports from national committees, this third edition contains updated and enlarged country reports. Headings under which the information is published include physiography, climate and rainfall, population and size of holdings, land resources, water resources, history of irrigation and drainage, irrigation and drainage methods used, statistics, present developments, future plans and potentials, economics and financing.

## INTERNATIONAL CENTRE

IT IS planned to set up an International Centre for Soil Conservation Information as an independent, non-profit-making, educational organisation based at the National College of Agricultural Engineering, at Silsoe, Bedford.

The activities of the Centre will be to:

Collect and collate information on soil conservation, using bibliographic sources and a World network of correspondents. There will be a machine-readable data-base, as well as hard copy and micro storage.

Disseminate information, through a regular newsletter or bulletin, state-of-the-art reviews on particular soil conservation topics and subject bibliographies.

The Centre will work closely with the NCAE in offering training facilities, research opportunities and consultancy services. Anyone *interested* is invited to write to: ICSCI, NCAE, Siloe, Bedford MK45 4DT.

## OCHRE IN DRAINS

PROMISING results from field experiments to prevent or minimise deposition of ochre in field drains are reported by the Macaulay Institute. The material involved in ochre blockages has been identified, a recent report from the Institute states, and further work is aimed at pinpointing the reasons for blockages, predicting areas at greatest risk and the development of prevention methods.

# sawma news

## *HAPPY* 10TH BIRTHDAY

1983 MARKS SAWMA's 10th year since its formation, and what better way to mark the occasion than by increasing the number of issues of our Journal. The Association's Council took the decision in September 1982 to hand over advertising, printing and production to a professional team. Alec Paris Magazines offered terms that made it clear that they too were prepared to invest in the future of the Journal and our Association.

As always, your comments, suggestions and contributed articles are always welcome. Please address items for editorial inclusion to Mike Saull at the SAWMA office, who continues as editor.

## SOILS WORKSHOP. 2 AND 3 MARCH *W83*

FOR THE first time at the NAC, Stoneleigh, SAWMA and ADAS will combine to organise a Soils Workshop for the farmer. The two day event will include papers in the morning and field excursions to the NAC's farm in the afternoon when soils and structures will be examined. More information is available from Mike Saull on 0203 555100.

## ENCORE FOR AUTUMN CULTIVATIONS DEMO

AFTER the successful Shropshire demonstration in 1981, the RASE are bringing their Autumn Cultivations event to their John Eastwood farm at the NAC in 1983. The demonstration, jointly organised with ADAS and in association with SAWMA, will feature tackle being put through its paces on a variety of surfaces — from chopped and spread straw to ready-prepared ploughed land.

SAWMA will be digging more holes and plans are laid for every deep loosener to make one pass through an area on the headland so that visual comparisons can be made.

Following an upsurge in interest in straw incorporation equipment, a practical demonstration of how to deal with residues will also take place.

## WHEAT '83. 15 AND 16 JUNE 1983

AT THIS RASE-organised event, SAWMA will be co-ordinating soils information. Of interest to drainers will be a moling demonstration showing channels pulled at different times of the year.

## CONSULTANCY SERVICES

DETAILS of development planning, feasibility studies, design and implementation of new water schemes are among the contents of a new, illustrated brochure outlining the consultancy services in water engineering provided by the WS Atkins Group. The services provided include planning, engineering, management and environmental consultancy.

Water resources, supply, irrigation, waste water treatment and control of industrial waste are among subjects on which the brochure outlines actions which may be taken. Copies are available from Ms D. Walford, WS Atkins Group, Woodcote Grove, Ashley Road, Epsom, Surrey KT18 5BW.

## BUSINESS BUILDS

FOLLOWING a factory fire last June, Ryan Pipe Ltd have announced that they are fully operational in new premises at Bardsley Road, off Princewood Road, Earlstrees Industrial Estate, Corby, Northants NN17 2AR.

In addition to their range of plastic land drainage pipes in 60mm to 400mm sizes, with fittings and connectors; concrete and GRC headwalls, drain inlets and similar products, the company has recently taken on Bartol building pipes and fittings.

Other recent additions to their product range include Quick-Fit Plasfit drainage junctions with swivel-action connecting pipes for variable inlet positioning, and PJS vermin grids, which are supplied in white plastic coated metal, designed for push-fit fixing.

## COMMANDO COST CUTTERS

IMPROVED design wear shins for the shanks of Commando Shakaerator heavy-duty vibrating cultivators are introduced by F. W. McConnel Ltd for the 1983 season.

The strap-on, replaceable wear shin assembly first became available 12 months ago when the three model Series 2 Commando range was launched.

Attached to the leading edge of each shank, the shins are designed to protect the Commando's vibrating legs in abrasive or stony soils, reducing wear and damage and are claimed to produce significant cost savings during a season's work. Each wear shin can be bought for less than 25 per cent of the price of the shank it is designed to protect.

McConnel have now made three improvements to the design of the shin to give it even greater resistance to wear for extended working life and lower operating costs. First, the 'V-shaped assembly of low alloy wear resistant steel is now heat-treated before final fabrication. This treatment increases the overall hardness of the shin by more than 50 per cent.

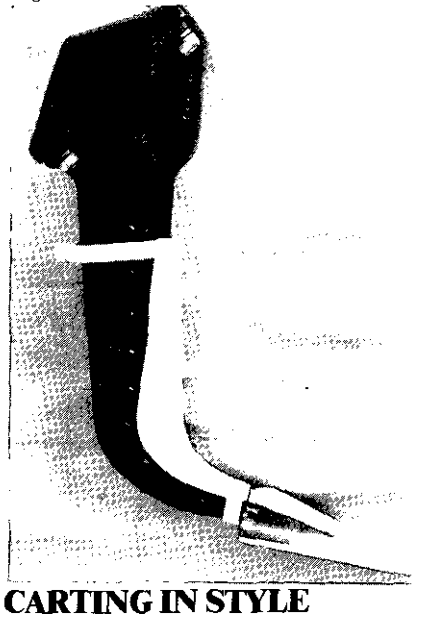
Second, the weld material used to hard-face the leading edge of the shin has been uprated to a steel matrix weld containing hard carbide particles.

Finally, the hard-facing weld deposit is now progressively increased in thickness down the leading edge of the wear shin. The result is a deposit three times thicker at the base, where most abrasion occurs, than at the top, which suffers the least wear.

The price of each uprated wear shin assembly for 450mm (18in) Commando Shakaerator shanks is £24.00. Shins for 600mm (24in) shanks cost £28.00.

F. W. McConnel Ltd is based at Temeside Works, Ludlow, Shropshire, SY8 1JL.

*Uprated, strap-on shin for the Commando leg.*



## CARTING IN STYLE

A SELF-PROPELLED, four-wheel-drive, gravel trailer with a 10 tonne carrying capacity is available from M.T. Agricultural Engineers, of Dunmow, Essex.

The base vehicle, known as the Transter, is made in France and consists of an articulated chassis fitted with a Ford 7710 skid unit and rear axle at the front, and an identical axle fitted at the rear. Drive to the rear axle is taken from the ground speed pto of the power unit.

Steering of the articulated chassis is by two double-acting hydraulic rams which give a turning circle of only 5.5m. The gravel hopper is the standard version used on M.T. towed trailers and is constructed of 3mm plate. All functions are hydraulically operated from the tractor seat, the power being supplied by an auxiliary hydraulic pump mounted on the front end of the engine crankshaft.

A choice of 8ft, 10ft or 12ft conveyors, driven by a 14hp hydraulic motor, is available for either high (4ft 6in) or low level (3ft 2in) discharge for trenchless or open trench drainers. Folding of the conveyor bed is by means of two hydraulic rams, and gravel flow is also controlled by a hydraulically operated hopper gate.

The turbo-charged Ford power unit develops 110hp (SAE) with transmission to the front and rear axles through a synchronised gearbox. Sixteen forward and eight reverse speeds are standard, with instant increase or decrease within a range using Ford's Dual Power system.

Power-onerated. wet disc brakes are used on all four wheels. The driver's cab has a flat floor and insulation giving noise levels no greater than 80 decibels. Filtered ventilation, a comfort seat and radio are all standard.

Price of the MT Transter gravel trailer is from £25,000 to £26,000 depending on specification. For more information, contact Mr N. F. Mascall, M.T. Agricultural Engineers, Unit 5, Industrial Estate, Chelmsford Rd, Dunmow, Essex, CM6 1HD.

## ALL FOR DRAINAGE

GRAVEL TRAILERS, fuel bowsers, drain cleaning and jetting equipment, inclinometers and laser levelling equipment are among the products now available from Multiloader Ltd, a new company managed by Mr Robin Disney, until recently sales director of Bruff Manufacturing Co Ltd and previously a director of Leran Trenching Equipment Ltd. The new company is based at 16 College Grove, Great Malvern, Worcs.

One of the company's main aims is to manufacture and market equipment which has been designed by drainage contractors for their own use. In addition to its equipment, Multiloader also offers service back-up, and training and consultancy services.

Starting with a basic 4 to 6 cu m model retailing at £2,200, the Multiloader gravel trailer range extends to 8 to 10 cu m units with driven axles and high flotation tyres at £7,000.

Intended to carry fuel supplies for between two and four days" work with drainage equipment, the company's bowser has a capacity of 590 litres. Its two-wheeled trailer chassis is designed to be towed by a car or light van.

Both single line and rotating laser levelling kits are available from Multi-

loader, which handles both new and secondhand equipment. Makes available are both Spectra-Physics and Scanlaser Ltd. Consultancy services for operating problems are offered, as well as equipment.

Plans for the immediate future include production of a front-mounted rotary back-filling unit designed by a contractor for 'through-crop' drainage and capable, says Mr Disney, of working quickly on any site, in the widest possible range of conditions.

## DRILLING DIRECT

DISC, SUFFOLK or hoe-type coulters may be fitted on two new combine drills from A. C. Bamlett Ltd, of Station Road, Thirsk, Yorks Y07 1QA. Both of the new models, which have drilling widths of 3m and 4m, are designed for use with metric tramlining systems.

Either close or conventional row spacing can be provided with the CD3.0m and CD4.0m, as the new models are known. With close spacing, the 3m unit has 24 rows at 125mm (6.5in), the 4m version 32 rows. Conventional spacing is 167mm (6.5in), which gives the 3m drill 18 rows and the bigger model 24.

In addition to the normal choice of three types of coulter for both new drills, the Bamlett Direct Till coulter, which may be used for seeding directly into stubble as well as for conventional drilling, is offered on the 167mm spacing models.

For moving on the road, a new end-towing transport system has been developed for the CD drills. A folding drawbar at one end of the drill and a pair of 10 x 12 flotation wheels at the other end provide a built-in system. The wheels are lowered when needed by a double-acting hydraulic ram. Wheels and drawbar can all be removed quickly to reduce weight in soft drilling conditions.

Double acting hydraulic rams raise and lower the coulters, providing positive depth control. Sowing depth is set by adjusting collars on the main coulter lift rams.

## DOUBLE ACT

LINCOLNSHIRE engineers, F. A. and J. Jones and Son, have developed an implement designed to carry out subsoiling and moledraining at the same time. The idea is to produce the ideal sub-surface conditionsfor good drainage and reduce the possibility of compaction from excessive wheelings.

The company explains that the operations are normally done as separate jobs and great care is needed to ensure that they are at the correct depths. Too great a gap between subsoiling and the mole channel can produce insufficient cracks for adequate drainage. Too little clearance can cause damage to the mole, also impeding drainage.

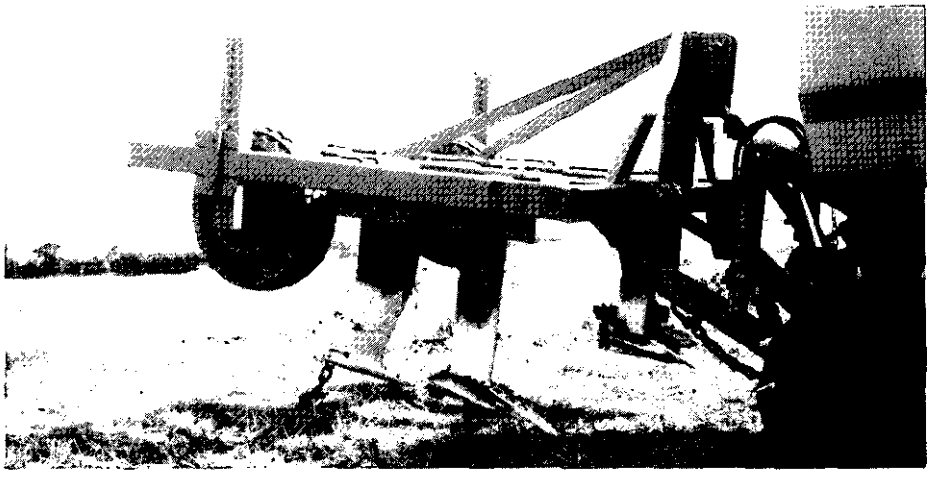
Separate operations are perfectly satisfactory in ideal conditions, says the company. But in poor conditions or when possible compaction from two passes needs to be avoided, the job is best carried out in a single pass.

Enter the Jones Subsoiler/Moledrainer. The implement carries two subsoiler legs which can be adjusted for width along the frame. These are positioned in front of the mole plough leg and all can be set to a variety of depths to give the optimum clearance in all types of soil between the subsoil cracks and the mole channel.

A short run across the field and a quick dig with a spade or digger is suggested by the makers to show if the clearances have been correctly set.

Power requirement is from 120hp. If moling is not required, the mole leg can be replaced by a third subsoiler shank, giving a 'V' formation and a claimed reduction in draught for normal subsoiling work. Further details from the company at North Scarle, Lincoln, LN6 9HB.

***The Jones Subsoiler/Moledrainer is fitted wirh two subsoiling legs and one moling** leg. AN are adjustable for working depth.*



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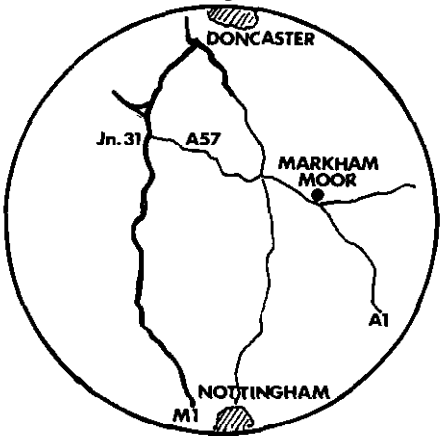


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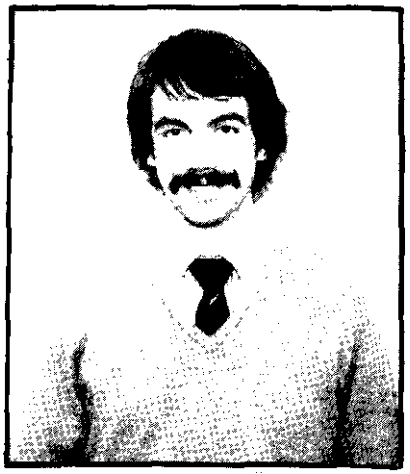

BAS VAN NIEUWENHUYZEN
SALES REPRESENTATIVE
Meadow View.
Markham Moor.
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VII-1



# Move water down the pipe with effective trenchless schemes

In this article, Bob Fry, a research worker at the National College of Agricultural Engineering, examines the interrelating soil, machine and operating factors which contribute to the optimum installation and future effectiveness of drainage schemes laid by trenchless techniques.

UNRESTRICTED WATER flow into subsurface drains is an essential ingredient of efficient land drainage. Any significant resistance to water flow in the pipe, in the backfill, at the trench wall or in the soil profile may produce high water tables and reduce drainage efficiency. Care must he taken when installing suh-surface drains to minimise soil damage around the pipe which may increase resistance to water entry.

With trenchless drainage methods, the extent to which flow restrictions may occur depends upon the type of drainage problem and the nature of the soil disturbance caused by the drainage tine.

## Drainage problems

Drainage problems in the UK can he broadly grouped into two categories. These are groundwater problems similar to those found in the lighter fen or marshland soils; and surface or perched water problems commonly encountered in heavy clay soils.

In the control of groundwater problems, water enters the drain mainly from beneath and alongside the pipe, hence soil conditions in these areas are very important. In the control of perched or surface water, water enters the drain largely from ahove and soil conditions above the drain are therefore of greater importance. In such cases, where a permeable backfill is used to form a vertical connection to the pipe, few difficulties occur.

The likelihood of reductions in drainage efficiency due to soil damage near the pipe in groundwater situations and in surface or perched water cases where permeable fill is not used, depends on the soil disturhance generated by the trenchless drainage tine.

## Soil disturbance

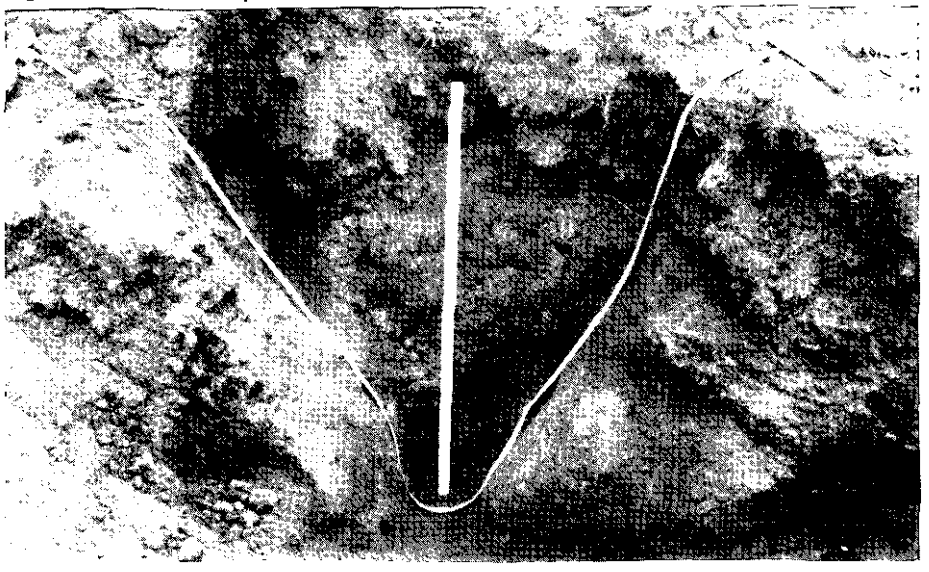
The soil disturbance caused by a trenchless drainage tine depends upon its geometry, its onerating depth and the soil conditions at installation. For practical purposes it is convenient to describe the soil disturbance caused by the tines in terms of the critical depth. This depth is defined as that below which the sideways extent of soil loosening is severely restricted.

Above-critical-depth disturbance, (see Fig 1), produces extensive soil loosening and heave, with the lateral limits of loosening (failure planes) diverging rapidly from the tine tip. Soil within the failure planes is increased in permeability and there is no evidence of soil damage due to smear or compaction alongside the pipe. A narrow compaction hand occurs beneath the drain but electrical analogue studies have shown this to have minimal effect on drainage efficiency when limited in width to twice the drain diameter.

The upward loosening of soil will improve downward water flow to the drain but has been found to reduce mole channel stability in the vicinity of the lateral drains.

Below-critical-depth disturbance, (see Fig 2), can be readily identified by the tendency for a "slot" to form above the pipe. This is caused by reduced upward movement and increased sideways movement of soil at depth. Where such "slotting" occurs, cavities may he formed above the pipe and in unstable soils probiems of piping and siltation could arise.

Fig 1 *Above-critical-depth disturbance*



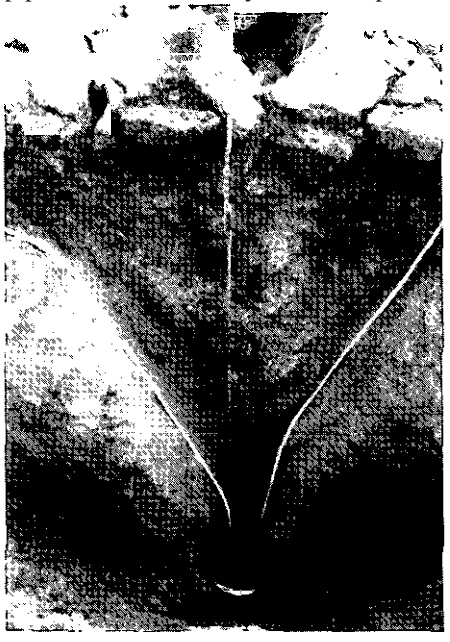


Fig 2 *Below-critical-depth* disturbance

In some soil conditions this type of soil disturbance can lead to considerable soil damage in the vicinity of the pipe. Local reductions in soil permeability may result from smearing, compaction or soil shear. These reductions in permeability have been shown in electrical analogue studies to he capable of causing unacceptably high water tables in some groundwater drainage situations.

The effectiveness of trenchless drainage installation is, in some cases, largely dependent upon the type of soil disturb-

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ance generated by the tine. The factors which influence the type of soil disturbance, and hence the nature and extent of possible problems, can be separated into those connected with the implement and those related to the soil conditions.

## Implement factors

The width of trenchless drainage tines has a significant influence on the type of soil disturbance produced — the narrower the tine the nearer to the surface is the critical depth. Field observations of commercially available trenchless machines have shown that the variations in tine tip rake angles used have much less influence than tine width in determining the type of soil disturbance. There is, however, a tendency for long curved tines, (eg type [c] Fig 3), to have slightly deeper critical depths than more steeply raking tines such as types (a) or (b), Fig 3.

When operating above the critical depth, soil disturbance is unaffected by tine shape. When working below critical depth no differences in soil damage occur near the pipe depth. There are, however, some differences in surface disruption due to geometry variations of the upper sections of the tines. In general there is little difference in the soil disturbance caused by commercially available drainage tines of similar width.

Interaction between the tracks of the drainage machine and the action of the tine has been found to influence the type of soil disturbance produced. Where the tracks interfere with the preferred failure path of the soil and limit the lateral extent of surface loosening, the width of loosening at depth is also reduced and the critical depth occurs nearer the surface than if the soil was allowed to fail to its full lateral extent, (see Fig 4).

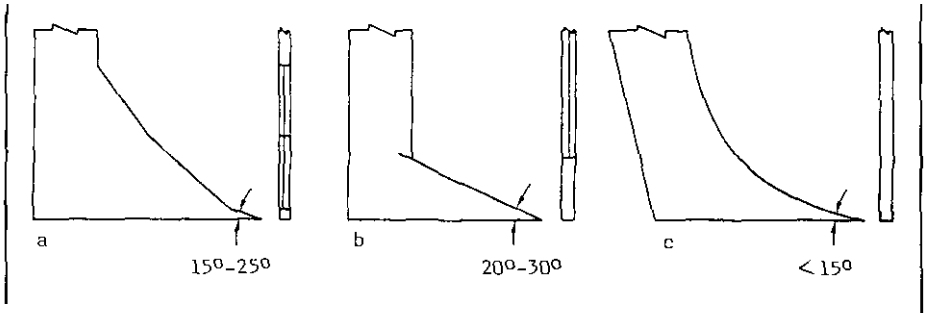


Fig 3 Types of trenchless tine

Machines with close hitched, long raking, curved tines are more likely to experience interaction between the tracks and the tine. When operating depths are less than approximately the distance between the insides of the tracks interference is less likely to occur.

Tile box widths are, in general, less than leading tine widths but in cases where the tile box is wider than the tine severe compaction and smearing could occur to a considerable vertical extent beside the pipe. Tile box action can cause considerable smear and reworking of soil above the drain, sometimes reducing or completely smearing over soil cracks produced by the drainage tine.

## Soil factors

The influence of soil conditions on the soil disturbance caused by trenchless drainage tines is much greater than that due to differences in tine geometry.

Soil moisture content and density, soil compressibility and the resistance at depth to upward soil movement have considerable influence on the type of disturbance produced. In uniform soils the resistance to upward movement increases with depth causing a gradual change in disturbance from the above to the below critical-depth type.

In soils with denser or stronger compacted surface layers, critical depths may be much shallower due to the increase in resistance to upward movement and a greater likelihood of sideways movement.

Where soils are virtually incompressible at depth due to high density and the absence of air-filled pores, soil failure tends to be upwards to the surface causing above-critical-depth disturbance. In dense, saturated, sandy loam soils, for example, critical depths may be deeper than 2m. Compressible soils of lower-densitv containing air-filled vores and cracks, however, are much more likely to have shallow critical depths.

In general, fewer problems occur in coarse dense soils and strong well-structured clayey soils than in weakly structured, fine textured, low density soils. The shallowest critical depths are found in weakly structured clayey and silly clay soils of low bulk density and very high degree of saturation.

Extensive field observations on more than forty sites combined with detailed laboratory studies have highlighted three soil conditions which are most likely to give rise to problems when using trenchless machines to affect drainage for groundwater control.

These are:

Unsaturated. readily compressible soils susceptible to extensive compaction.

@High moisture content, high density clayey soils resistant to compactation but prone to smearing.

@High moisture content, low shear strength soils containing discrete macro-pores, resistant to compaction but susceptible to micro-pore collapse due to shearing.

## Practical significance

In perched or surface water cases, soil conditions beneath and beside the drain are of little consquence since water enters the drain from above. When permeable fill is used above the drain, problems of water flow to the drain are unlikely.

Where fill is not used, situations can arise where the soil closes up, or "seals

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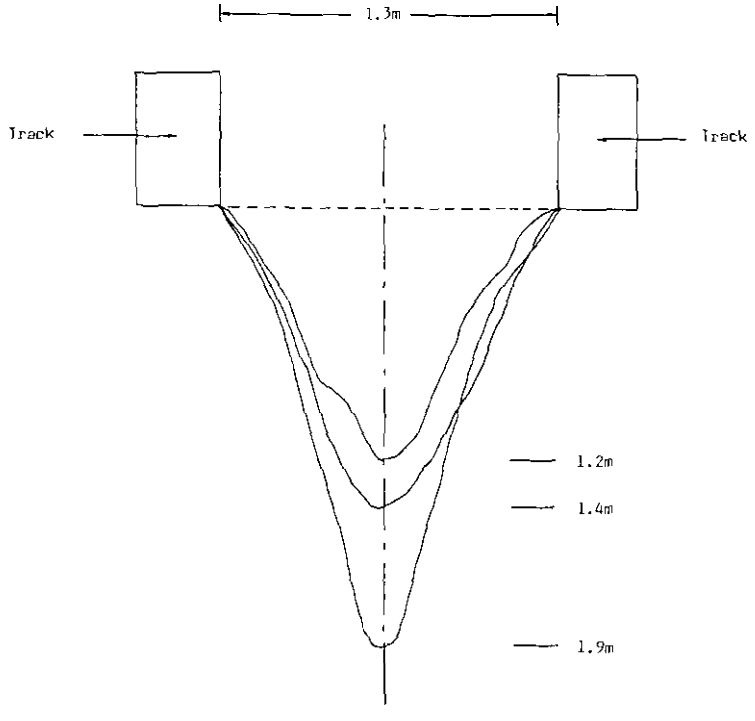
Fig 4 Effect of *tine/track interaction*



up" after the passage of the tine, preventing water flow from the upper layers to the drain. In such cases it is important to generate and maintain a high degree of loosening and cracking above the drain to improve the flow of water. In mole-cum-tile schemes where above critical-depth type of disturbance occurs the extensive loosening can significantly reduce mole channel stability in the loosened zone.

In groundwater control drainage, very few problems occur when working above the critical depth. With deeper working tines, however, considerable soil damage can occur in the vicinity of the pipe resulting in greatly reduced permeability, high water tables and low drainage efficiency in some soil conditions. With the exception of high moisture content, high density smearing clayey soils, the most vulnerable soil conditions outlined above are not widely encountered in the UK but where they are great care is necessary.

## Minimising problems

When controlling surface or perched water, few problems are likely unless permeable fill is absent. In such cases, where the soil may "seal up" after the passage of the tine, more permeable soil from the surface or other layer(s) in the profile should he placed above the pipe to improve the connection.

Maximum soil loosening to improve water flow to the drain can best be achieved by working above the critical depth with a wide tine.

Where mole drains are to be installed above lateral drains installed hy trenchless methods, the loosened soil associated with above critical-depth disturbance should be firmed immediately after the installation of the lateral drain, to improve the stability of the mole channels.

In groundwater situations it is desirable to work above the critical depth whenever possible to minimise any soil damage in the region of the drain. In soil conditions where problems are likely, inspection holes should be dug to establish whether or not the drain depth is below the critical depth of the tine. This is usually indicated by the presence or otherwise of a "slot" similar to that shown in Figure 2.

It may be possible in many cases to shift the critical depth to below drain depth by the use of wider tips to the tines or by pre-loosening the upper soil layers to reduce the resistance to upward movement. When using wider tines care must be taken to ensure that drain depth is above the critical depth otherwise even greater compaction is likely from the wider tine.

Pre-Loosening can be achieved either by pre-ripping using the drainage tine at two thirds the final depth in a separate operation or using shallower leading tines in the same pass. The use of shallower tines has operational and cost advantages over the technique of pre-ripping with the drainage tine itself.

In some cases it may be possible to time the drainage operation to coincide with drier subsoil conditions when critical depths are greater.

When it is neither practical nor possible to work above the critical depth it may be possible to remove thin layers of compaction or smear beside the pipe in the same pass as pipe laying. Simple cutters attached to the rear of the tile box have been successfully used to restore permeability in cases where the soil damage did not extend more than 50-75mm from the pipe.

A fundamental understanding of soil failure processes and soil disturbance caused by trenchless drainage machines combined with a sound knowledge of the drainage requirements should make it possible to "tailor" the implement or the technique to give the best results in most soil conditions. A single power unit on which could he mounted any one of several purpose-designed tines may be a future solution.

Contractors working solely on mole-cum-tile schemes may develop tines which cause minimum loosening even at shallow operating depths. By contrast, in layered soils in the absence of permeable fill and with surface water drainage requirements a wide tine creating maximum soil loosening and upward rearrangement may be preferred.

# Trenchless drainage – past, present and future

**Mike Saull reports on the inaugural meeting of the Institution of Agricultural Engineers' Field Engineering group which took place at Silsoe in the autumn.**

A LARGE AND varied audience attended the first of what must eventually become a thriving group within the Institution of Agricultural Engineers. Not only were the academics present, but more important, contractors and farmers, some who had travelled over 200 miles to be present. Let us hope that they will have taken the concept hack home and will be able to apply it as well as the South-East Midlands branch.

Opening the meeting, Chairman Brian Trafford, assistant director of the LAWS arm of ADAS, thought that agricultural engineers should diversify to perform a similar function to their counterparts overseas, where soil conservation is of primary importance. Doug Castle, group co-ordinator, had long been campaigning for the establishment of the group. Its role, he said, would include field drainage, soil conservation, irrigation and the supply of water to the field, machinery/soil interactions and the supply of potable water.

The group, he went on, would complement existing organisations such as SAWMA, who thrive on practical contact with the farmer and organise conferences, courses and workshops with a practical theme. The Field Engineering group, on the other hand, will bring together all those with a technical background.

The meeting consisted of papers from the contractor, the research worker and the adviser with subjects ranging from past and future trends in trenchless drainage to costings and from problem soils to the importance of blade design.

## Statistics

Chris Stansfield considered trenchless drainage as "just another method of putting drainage pipes into the ground". Ministry figures showed that in 1971-72 only 4 per cent of all drainage carried out used trenchless machines, while the corresponding figures in 1979-80 were 11 per cent. This year it is expected that some 13 to 14,000 hectares will be drained by this method. Mr Stansfield thought that one of the main advantages of trenchless machines was that no unweathered subsoil was brought to the surface, while from the contractors' point of view, trenchless machines were less liable to wear and tear than trenchers working on stony soils (or opencast mined land).

Surveys also reveal that through-the-crop work by a trencher will give a 10 per cent loss of yield whereas trenchless would only give 5 percent. Overall, trenchless drainage should be 20 per cent cheaper than trenchers, and the biggest single factor in convincing the farmer that the system is best to use is the way a contractor approaches the subject.

There were, however, limitations and Mr Stansfield pointed out that blow-outs were a considerable problem when using trenchless machines where fields had an old, existing scheme.

## Plastic reliability

The contractor's view was expressed by Bernard Rose from Suffolk who appeared able to express every positive and negative aspect of trenchless work in terms of profit. Mr Rose pointed out that three years ago he was committed totally to installing clay tiles; now he puts in 90 per cent plastic. Plastic pipes, he considers, are now sufficiently reliable that he does not need to constantly examine them for breakages, and this has greatly enhanced his trenchless operation.

### Teamwork

Mr Rose concludes that each of his five man teams works only 150 effective days each year. Their equipment includes: one 160 hp Interdrain trenchless machine, two excavators, two stone carts, and they are handling 3000 metre of pipe (two Aqua-Pipe Superkoils) and 400 tons gravel every day.

His annual operating costs are £50,000 for labour, £180,000 for machinery and £150,000 for running the business and overheads. This gives a total £380,000 annual expenditure per team.

Mr Rose estimates, on these figures, that each team costs £2533 a day, based on 150 working days in a year. Materials

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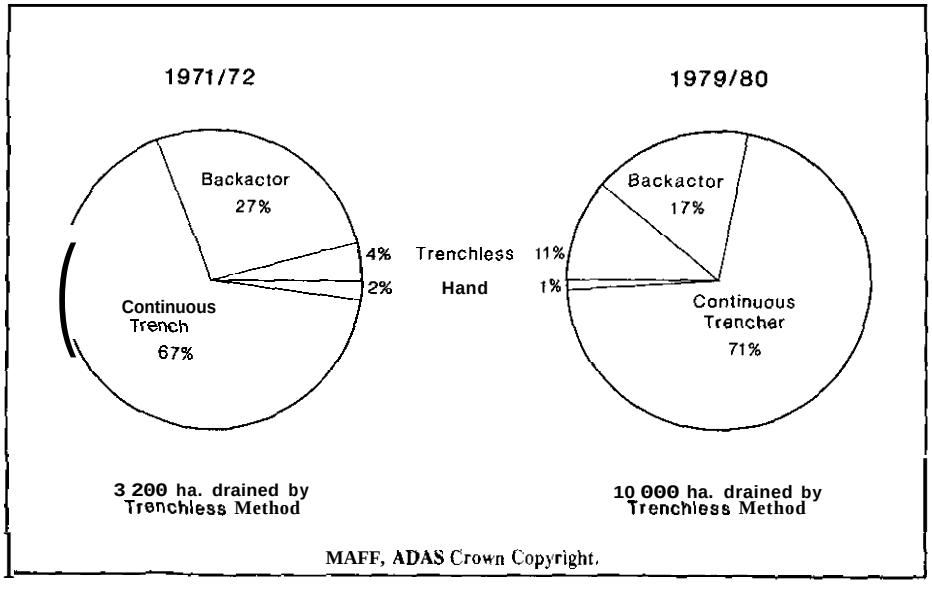
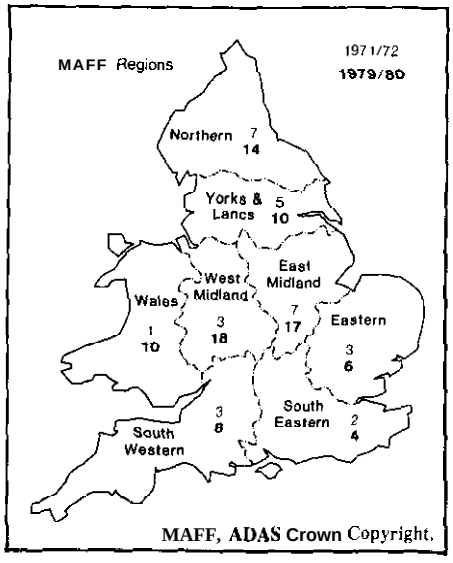
***The statistics showing how drainage has been installed in Britain.***




***The percentage, region by region, of normal underdrainage schemes laid by the trenchless method.***



come to £80,000 a year for plastic pipe, £180,000 a year for gravel and £10,000 a year for fuel. The total spent, therefore, on materials is £270,000, or £1800 for each working day.

Mr Rose concludes that his earning capacity per team is equivalent to 3,000 metres of pipe laid every day — which charged at f1.50 per metre will bring him £675,000 total income each year with each team earning £4,500 every day. Using these figures, Mr Rose considers if he were able to work an extra ten days every year then he could earn £25,000 more each year — and this is a temptation he finds difficult to refuse, no matter if soil conditions may be far from perfect.

## Scottish Work

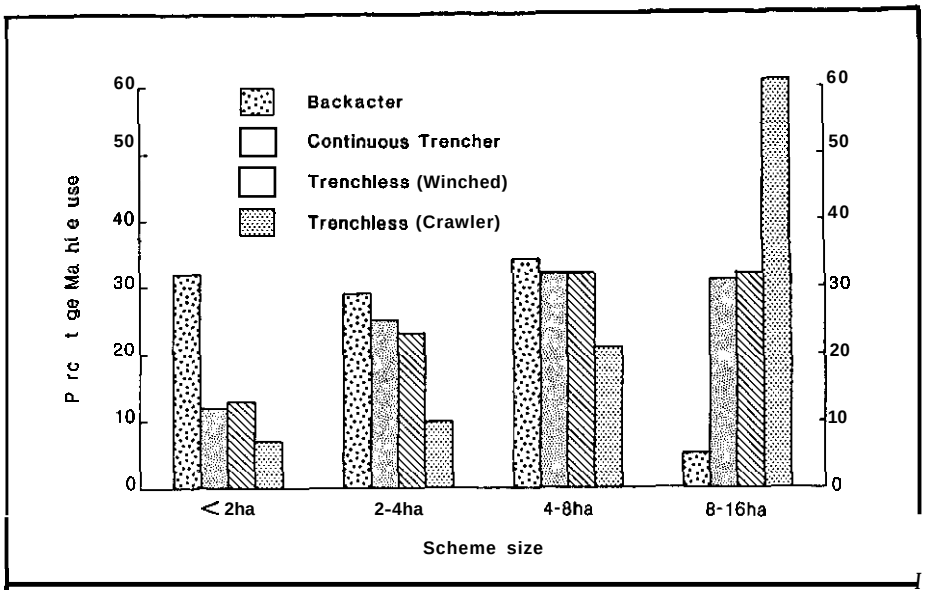
Drainage in Scotland, Ron Spiers from the East of Scotland College of Agriculture pointed out, is very different. The majority of drainage carried out is upland work and in total only 7 to 8,000 hectares are drained each year or about 10 per cent of the area drained in England and Wales. Drainage uptake, he pointed out, is very dependent on the state of the livestock industry, and even though a 70 per cent grant is available to farmers in years when livestock enterprises do not pay, little work is carried out.

Mr Spiers considers that, no matter what scientific factors indicate, tradition and the contractor dominate scheme design. The majority of schemes are less than 5 hectares in size, and usually very closely spaced, 8 to 11 metres spacing being most common in the south of Scotland. Permeable fill was hardly used before 1970, except in the Northern Isles, but now 43 of all schemes incorporate such material.

Contractors have only ten days out of 365 when certain soils are fit to work, unlike the 150 days south of the border.

So is trenchless popular in Scotland? Apparently not, and the reasons are obvious. Firstly, most hill land drainage poses topographical constraints to this type of machinery. Secondly, the structure of contractor businesses, with the majority being farmer, son and backacter, prohibits the use of such machinery. Thirdly, many Scottish soils have been drained before and blowouts are a major problem with trenchless-installed schemes.

However, Scottish soils are usually very stony and boulder clay-derived and surely the larger contractors would use the technique? The answer to this is that in 1977-78, particularly in the south where trenchless drainage is possible, very bad results have been reported. Thus Mr Spiers considers that if trenchless had been properly explained and monitored initially their teething problems would not have been so dramatic, virtually excluding trenchleas from an




*The machines used and the size of the scheme.* MAFF, ADAS Crown copyright.

area where it is quite feasible.

Another possible reason is that, in the West of Scotland, gravel backfill is rarely used. In those soils, trenchless drains can close up quickly without gravel. In such instances, it was the scheme that was at fault and not the machine.

There does appear a long way to go before we get away from the 96 per cent of all Scottish drainage being carried out using the backacter.

In conclusion, it appears that trenchless drainage will become an increasingly important contractor technique. It is a shame that as always the action of a few can set back a technique or product such a long way.

One cannot blame the farmer for his preferences, and meetings such as the one at Silsoe must surely help break the myth of the 'cloistered' researcher. This new group deserves every success. If they get it, then the agricultural engineer will not only be known as the one who bends iron but also one who does so to the hest advantage of soils and drainage.

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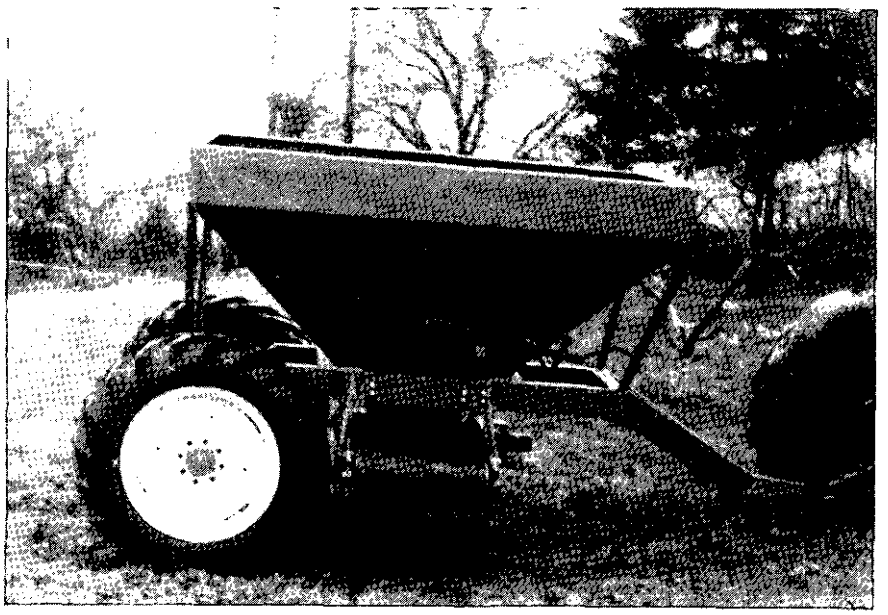

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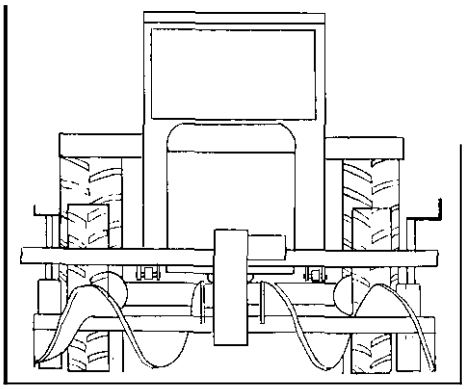

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VII-1

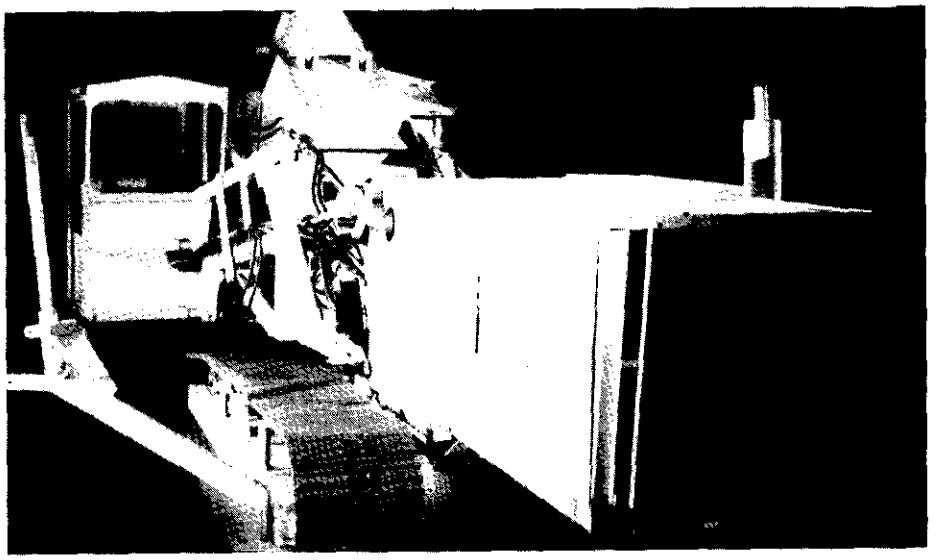
# Baby aims to set new standards

THE NAME Mastenbroek has become synonymous with quality land drainage machinery in the four years since the company began manufacturing in Britain.

In May 1982, the firm celebrated the production of the 100th machine to be built at their Boston, Lincolnshire factory. Last year, 39 drainage machines were assembled and sold, the majority to contractors in the United Kingdom.

Having completed a 10,000 sq ft factory extension midway through last year, Mastenbroek found that there was still not enough manufacturing space to meet demand. As a result, Mastenbroek Eastern was born, taking over Units 10 and 11, Springwood Drive, Springwood Industrial Estate, Braintree, Essex, the former premises of MT Agricultural. This firm has now moved to a new factory at Dunmow, Essex, and has been appointed sales agent for drainage machines built by Mastenbroek Eastern.

One of the first drainers to he sold by the company will be the all-new 10115 trencher, which is aiming to set new standards in the 120hp drainage machine class, hacked up by the acknowledged high standards, reliability and value-for-money associated with the name of the maker.



*The Mastenbroek 10/15: new 'baby' of the range.*

The 10115 is the smallest machine in the Mastenbroek range and is said to fulfill all the needs of contractors looking for a compact unit with high output. With an overall length of just more than 26ft (8m), the trencher's ability to get in and out of tight corners is self evident. And transport from site to site creates no difficulties either.

Mastenbroek say the 10115 will also prove ideal for the contractor who has larger drainage machines, slotting into the 2nd machine position to give him the equipment to tackle any job offered.

The 10115 follows Mastenhroek's established policy of building and selling drainage units without "hidden extras". Customers will find that the newcomer has virtually all their requirements fitted as standard, and included in the basic price. The only options available are a laser, the AID system and a cab heater.

To quote Mastenbroek director, Lindy McCracken: "The 10115 offers everything that a larger machine has — except the price."

Standard specification *of* the ***10115*** **trencher**

***Overall weight — 9 tonnes***
***Engine: Ford 117hp high torque***
***Gearbox: Turner 5 speed***
***Independent hydrostatic drive with oscillating tracks***
***Pivot back-end***
***Independent cab***
***Adjustable pipebox to lay up to 6in tiles; extra narrow pipebox to lay 601 80mm plastic pipe***
***Hydraulically-operated gravel hopper***
***Ground clearance — 23in; minimum grading deplh — 9in; maximum digging depth — 6ft Sin; mar trench width — 18in; overall machine length — 26ft 3in.***

# A gravel-filled mole

APART FROM THE mole plough, subsoiler and ditch equipment manufacturers, the only real 'drainer' at December's Royal Smithfield Show was to be found on P. F. Doggett Engineering's stand.

Managing Director, Peter Doggett, expressed optimism over sales of the company's gravel-filled mole drainage plough. This was shown for the first time at last year's Fanners Weekly Drainage Event and the implement's progress is currently being monitored by ADAS Land and Water Service scientists at the Woodhall Spa site.

Although Mr Doggett was unable to comment on the first of four year's trials, he predicted that it would gain acceptance in Britain, particularly north of the border where a number of contractors had shown great interest.

The Doggett gravel mole drain was developed for slow draining soils where the mole channel closes in a very short time. This closure can be caused by collapse or creep flow, especially in soils with high fine sand or silt content.

Mr John Mulqueen of the Irish Agricultural Institute has carried out tests on the gravel mole in very sandy soils where collapse is common. It was as a result of his work that the gravel mole plough was designed and built by Doggett. He emphasised that, when gravel moling, the soil should he dry and the soil slab overlying the crest of the drain be permeable. If the slab is tight, it must be loosened before drainage starts.

Gravel tunnels are normally laid at 1.22m (4ft) centres. With control over the flow of gravel from the hopper, Doggett estimate that about one tonne of material will be consumed over a distance of 122m (136yds). On this basis, one hectare of moling will need 27 tonnes of gravel.

In certain schemes it may be necessary to let the gravel or fine stone fill up the slit above the base material in the mole tunnel itself. Here, more gravel will obviously be used.

Doggett admit that their main obstacle is the acceptance of the technique by farmers. However, a recent ADAS directive may help here, stating that gravel-filled mole channels are eligible for grant aid, being work of a capital nature. The only provision, apart from a satisfactory installation, is that the mole channels be connected to an underlying pipe system. The pipe lines should not be more than 40m apart and the mole channels spaced at 2m to 3m intervals.

VII-1

# Do-it-yourself drainage

**Over the past couple of years there has been a marked increase in the production of tractor mounted drainers, ranging from trenchless and trencher to slit construction types, that farmers can use themselves. There is no doubt that they are causing a lot of interest among contractors and farmers. This article by Mike Saull combines comments from manufacturers of these machines and assesses the DIY approach.**

FARMERS wishing to drain land and claim grant have until recently had to seek prior approval. Now, however, there is no longer a need for prior approval for a scheme to be eligible for payment. The farmer can take the initiative, go ahead and drain, applying for grant after completion. The question many are considering is should I do it myself, or get in the contractor?

There has always been the problem that farmers would prefer drainage work to be carried out by the contractor at a time which best suits himself and his crops, but this is obviously not always possible. By purchasing his own equipment, he can get on and do the drainage himself. Savings can undoubtedly be made in this way, but the farmer should be warned that schemes have to be of a certain standard if they are to get grant aid.

Although the manufacturer or dealer may claim that grant aid is available for work carried out by using his machine, this is technically incorrect. Grant aid is given for a scheme, not for the work of a certain machine. Schemes have either to be of a capital nature, or an investment which is going to be durable or have a life expectancy of 10 years. Thus unless great care is taken, the purchase of a tractor mounted drainer may be a false economy.

One machine not previously reported in Soil and Water is the Daisy D Drainer, named after the wife of its designer, Jim Gilchrist. Mr Gilchrist started developing his machine in 1977 because he felt that big machines were prohibitively expensive and he wanted drainage done when it best suited him and the weather.

The Daisy D Drainer fits on to the tractor's three-point linkage and lays plastic pipe with or without gravel backfill. It opens up a slot, feeds in the pipe and lays up to 2ft depth of gravel. Surface soil disturbance is minimal as the slot folds together behind.

## Deeper

Power needed for the machine is dependent on soil type and condition, but Mr Gilchrist recommends that in the heaviest soils, a couple of runs are carried out working progressively deeper before pipe and gravel are incorporated. Two models are available; the Daisy D Standard, which can take a hole at 2ft 6in (2ft cover) and the Daisy D Super, which can take the hole at 3ft 6in (3ft cover). The hopper capacity is about 10 cwt, and it can be filled by a continuous feeder.

An additional feature of the Daisy D is that it can be used as a slurry injector, working across gradients. The pipe from the tanker is discharged direct into the gravel hopper; application rate is adjusted by a shutter on the machine.

Mr Gilchrist quotes that material costs for laying 60mm pipe with gravel are about 42p per metre in the Perthshire area, where the machine is built.

The AFT tractor-mounted trencher (see Vol 10/1 Soil and Water) fits on to the three point linkage of any standard tractor in the 45 to 70hp range and uses the pto to power the digging chain. Mr Baker, sales manager of AFT Ltd, calculates that this system cuts scheme costs by half, even when allowing full rates for tractor and labour. A total of 40 units have been sold to contractors, arable and dairy farmers as well as export companies, and Mr Baker considers that contractors could find a use for the machine on their smaller drainage jobs, greatly reducing transport costs. He emphasises that proper surveying is important to maintain grades — though this can be achieved by using boning–rods.

Bruff have had a small tractor-mounted BT1 and BT1D on the market since 1979. The machines were specially designed for tractors developing from 40 to 100hp at the pto. Mr Bob Wall, managing director of Bruff Manufacturing Co Ltd, has found that of the 50 or so BT1 and BT1D models sold, 95 per cent have gone to contractors. He considers that they are mainly of use in small drainage jobs and for the laying of pipelines; the handful sold to farmers were largely to replace hack acters or old, secondhand trenchers. In these cases, the company has been at pains to ensure the buyer has done the job correctly and with expert advice.

Of a more revolutionary design and concept, from Shelton Trenching Systems (reported in Vol 10 No 2 Soil and Water) is the STS Trencher. The technique it uses, which was developed simultaneously in the UK and France over the past five years, aims to remove excess soil water from the top 12 to 15in of the soil speedily to nearby ditches and water courses. Narrow channels are cut in the soil by a gigantic circular-saw-type disc fitted with 16 replaceable cutters. It is mounted on

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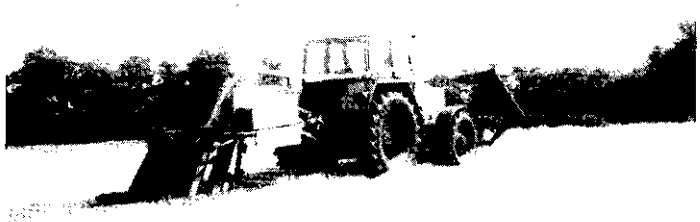
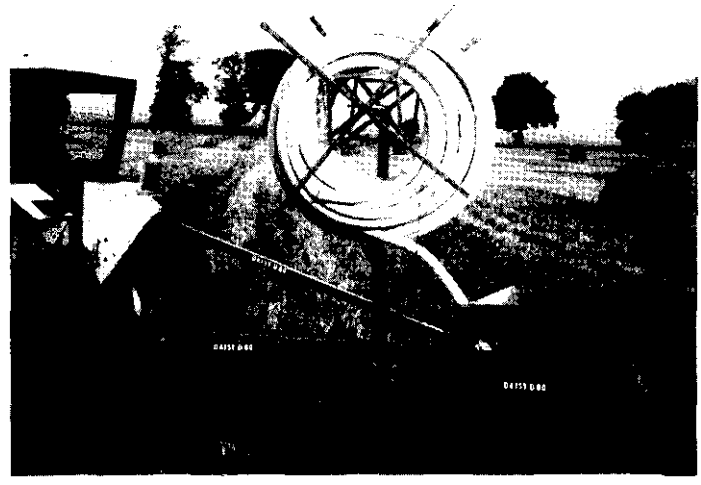


Bruff *BT1D* — a contractors' machine.



The Daisy 'D' — a *farmer-designed* drainer.

category II linkage, 70hp-plus tractors.

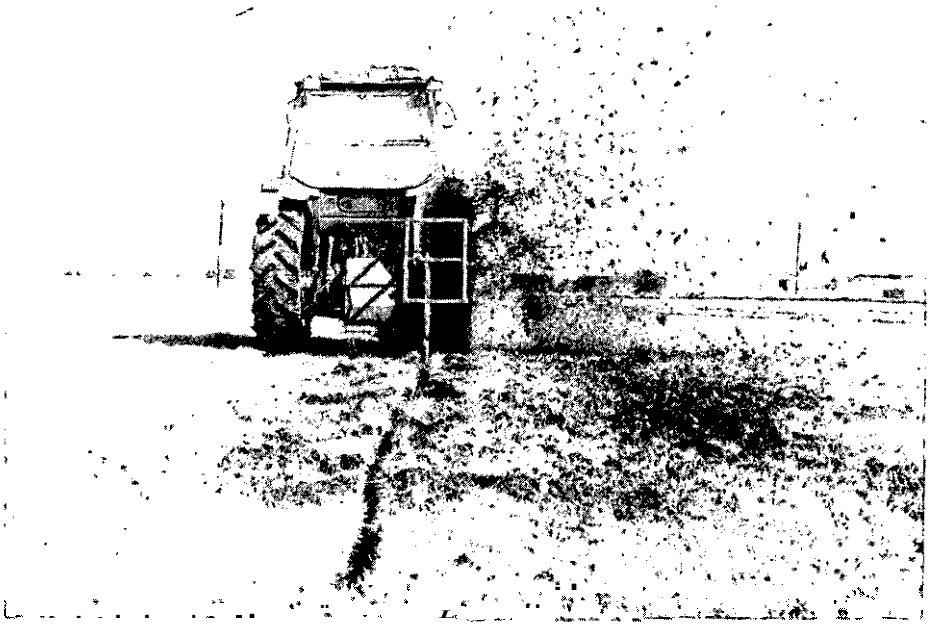
Unlike the other three models, the option to use clay tile or plastic pipe does not exist, and the concept is mainly to speed the flow of topsoil water to connectors, drains, ditches or more permeable soil types.

Mr David Shelton states that the system relies on the fact that water flows to the lowest level, and by cutting trenches 2½in wide and up to 20in deep, and using contours, one can interrupt the natural flow of water through the soil.

The system does not require complicated setting-out in the field. It is a case of determining the direction of natural flow of water across the field and cutting slit trenches to intercept this.

Grant may he payable on slit trench drainage work where porous fill is used, either as a secondary treatment across permanent piped systems or on its own. The length of slit trenches and their spacing will determine whether grant can be paid on the whole scheme, or only part of it, some discussion with the local drainage advisory office is likely to be necessary before proceeding.

There are obviously potential benefits to the farmer in DIY drainage. The work — in theory, at any rate — is done at the most suitable time, and it could be cheaper than getting a contractor in. This depends, though, on whether it is done well enough, and on whether the time involved in finding out how to design the job, and on planning and organising, could not have been used more profitably on something else.



*Slit drainage being carried out by the Shelton trencher at ICI's Saltholme Farm, Cleveland.* Photo courtesy of ICI

It must be emphasised, however, that the design of a scheme, from layout to choice of pipe size, is a specialised job for the reputable contractor/consultant. The maintenance of grade is essential to avoid pockets of waterlogging, and it is questionable whether the farmer in all cases has this ability. Many of the machines discussed in this article are in the hands of contractors, so surely it is better to use their experience and get them in to do small schemes with their less costly machines.

Finally, your local ADAS Land and Water Service officer is available to give general advice. Logically, he should be the farmer's first port of call before reaching for his cheque book.

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# Top class profiles at Wageningen

IN THIS COUNTRY there always appear to be too many jobs and not enough time to complete them. Advisors and research workers are all too often tied to their posts by a short rein and do not have the time or money to spend on promotions or exhibition work. This mould is gradually being broken and a visit to Wageningen in the Netherlands shows good reason why it should.

Holland is famous for its polders and was recently the venue for a 'polders of the world' meeting. Nowhere have I seen a more excellent variation of 80 soils in an area of less than half an acre and all are under cover. The place I refer to is the International Soil Museum.

## Soils of the World

Almost 300 of the world's major soil types have been collected by experts from Indonesia to Ireland and from India to Iowa. The museum, funded by UNESCO and the Dutch Government, was founded in 1966 following an idea put forward by Prof F. A. van Baren as long ago as 1952. The collection comprises some 80 excellent soil monoliths grouped according to FAO world map classifications.

The collection, although of limited interest to agriculturalists in Great Britain, is well used by soil scientists from developing countries. The most interesting feature is the excellent presentation of monoliths. The key to the success is the impregnation of the soil by a lacquer technique and the painstaking removal of material to reveal soil structures.

The 'guru' of the technique is the museum's technician, Mr W. Bomer, spending 1 to 2 weeks on each profile. He has developed the technique using a converted vibrating dentist's drill which, when gently applied to the natural pores, prises apart structures.

## Extracting samples

The complete method is to push a large wooden box into a vertical soil profile face, cut away from behind the face and remove the column and in-situ soil. The monolith is then transported back and sprayed with lacquer. Clay soils may require small holes bored into the reverse side and lacquer poured in.

Chipboard is glued to the back and, when hard, the box can be removed and the soil will remain intact. Loose material is removed and a final spraying with lacquer preserves the soil from all but the heaviest knocks.

A preserved monolith will retain its natural colour and become surprisingly resilient. The process does take a long time, but anyone who has been fortunate to visit the ISM cannot fail to be impressed. The monoliths are excellent and it is hoped before too long that the technique will be used in this country. It is a most valuable teaching technique.

More details of the method can be obtained from the SAWMA office. I would be interested to hear of anyone in Great Britain who has tried it.

**Michael Saull**

**A** *beautifully-presented* monolith preserved for *posterity*.

# Laser on the level

Most land drainage contractors now appreciate the advantages of laser control systems both on the small drainers and on the larger machines. Not only is the setting-up time faster hut the increased accuracy available ensures that all trenches have a constant fall to the depth required, thus giving a steadier flow of water in the pipes and enabling savings to be made in the amount of backfill aggregate used.

The Scanlaser system, recently introduced from Denmark, has been designed after consultation with a number of contractors to try and overcome some of the deficiencies of some existing systems.

The self levelling transmitter has a dual grade facility so that compound grades may he set easily without complicated calculations. The advantages of this are:

O n e grade is set for the main drain. The 'cross' grade may be set for the laterals. This is especially useful if a static mast is used since there is little or no need to change the height of the receiver on the mast for each run.

- When draining across a natural fall the 'cross' grade may be set to ensure that the mast, electric or static, does not reach its limit further down the field and thus lose the beam. This helps to minimise the need to move the transmitter around the field.

The rotating head is not enclosed and cetrifugal action keeps water droplets from the surface and prevents them distorting the beam.

Although the transmitter is compatible with all other laser receivers, Scanlaser feel that their receiver will give better results because firstly, the electronics have been developed so that the receiver will select the centre of the beam regardless of width variations. This removes the need for controls for wide and narrow hands and also means that the effective range is increased to more than 500 metres.

Secondly, the receiver takes an average over every five strikes of the beam, which helps overcome problems of machine vibration and fluctuation of the beam itself caused by differences in ground and air temperature.

All Scanlaser equipment is interchangeable, so that a simple manual system can be added to. rather than having to change the complete system at a later date if a grade breaker or electric mast is required. Even though advanced electronics are used, the basic design is simple, robust, and easy to use, say Scanlaser.

Savings on maintenance costs also have top priority, and most components can be replaced without major dismantling.

The Danish Scanlaser system is claimed to have all the price advantages of "local" common market product with marketing in UK and Eire carried out by Scanlaser UK, 42 Queensway Trading Estate, Leamington Spa, Warks. Tel (0926) 312071, contact Mr Richard Watson.

# Ringing the till at the Smithfield Show

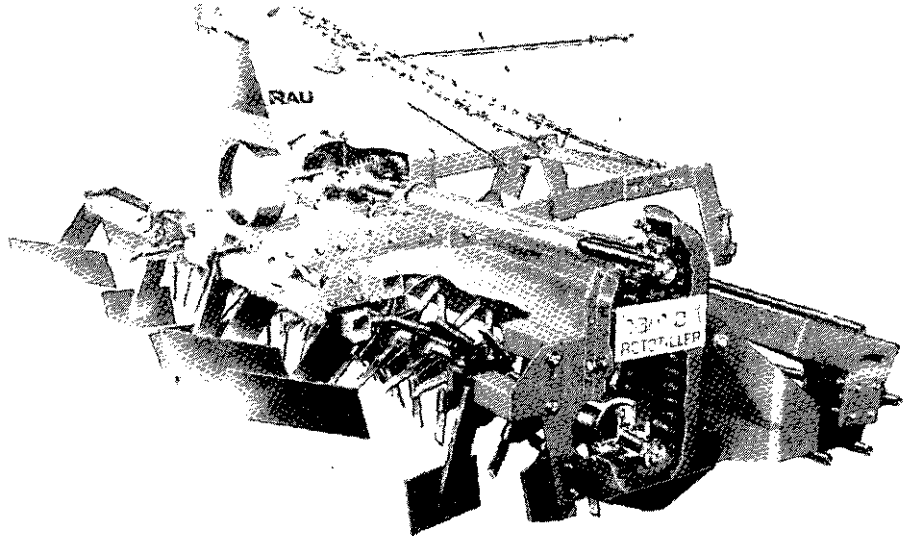
THE SMITHFIELD organisers appeared well pleased with the large number of new items of equipment at this year's show. Mr Chris Evans, of the Agricultural Engineers' Association, quoted a 10 to 15 per cent increase in tackle sales compared with last year, but not all the machinery manufacturers were so convinced.

Despite this, there was still much optimism and plenty of new equipment for those involved with soil and water management. In addition, there were many new labels, most of which seemed to add to the usual show confusion by using prefixes or combinations of the words till, tilth and tiller to describe the gleaming machinery introductions in the soil-working sections.

## Crumblers, tillers and harrows

AC Bamlett, Thirsk, North Yorkshire, are now marketing a rotary power cultivator manufactured by Rau in Germany. The implement, known as the Rototiller, is designed so that three different rotor types can be quickly interchanged by removing six studs at each end of the mainshaft. A mulching blade rotor is used for incorporating harvest residues and an 'L' blade rotor is for primary and secondary soil cultivation in one pass. The third type, a 'wedge-tine', is intended for more effective clodcrushing and cultivation in a wide range of soil types.

The machine also incorporates front levelling plates which can be set at different widths on the front bar to suit tractor width and tyre size. These devices push back soil displaced by the tractor tyre and, the manufacturers claim, helpcreate a more even seedbed.




*Cutaway* of *Bamlett's* ***Rau Rototiller. The soil-levelling plates are clearly visible***

PJ Parmiter, Tisbury, Wiltshire, launched a new single-pass combination tool for seedbed preparation on ploughed land. Known as the Denver cultivator, the machine comprises two rows of sprung tines, zigzag sections with adjustable pressure bars and a heavy-duty packer/crumbler.

Of different design, the Easitilth from ABT Products, Ross-on-Wye, Herefordshire, uses a front crumbler roller, a bank of curved tines, harrow and a final crumbler. Cultivation depth is adjusted by setting the height of front and rear rollers.

SKH from Market Drayton, Shropshire, introduced 4m and 2.5m versions of their 3m crumbler which was launched last May. For autumn cultivations, the crumbler has a front bar fitted with winged tines and can be used direct on stubble to produce a suitable tilth for reseeding winter cereals.

The machine consists of a spiked helical front roller which drives the rear roller some 2% times faster. Both rollers are suspended from the mainframe of the machine and are adjusted by two screw jacks. This adjustment varies the depth of work of the two sets of tines which are positioned in front of the machine and between the two rollers respectively. A rear stone guard prevents the soil and stones being thrown back by the rear roller.

Andover-based company, Taskers, following assistance from the NIAE, had their latest range of primary cultivation discs on show. Available in working widths from 3m to 8m, the Chisel Disc has two adjustable-angle banks of the unique 22in 'cut-out' discs which are claimed to penetrate the soil better than plain or scalloped discs to more fully incorporate trash.

Howard Rotavator, Harleston, Norfolk, introduced the Harrovator range of rotary power harrows which attracted nearly as much interest as their Paraplows.

Designed by the company in Germany the Harrovator is available in 2.5m and 3m widths. Working depth is up to 300m and can be controlled by crumbler roller. packer roller or front mounted wheels. Specially shaped blades are fitted in preference to tines, each having a swept-back design which enables them to cut through the soil and ride easily over stones.

Another powered implement making its Smithfield debut was McConnel's Tillaerator, a three-in-one cultivator for complete seedbed preparation in one pass. Loosening tines at the front prevent smear, a powered centre rotor breaks up the soil and a rear powered crumbler aids firming and final clod breakdown.

Recent working demonstrations have shown the Tillaerator to be excellent on

***The crumbler from SKH, now available in 2.5m, 3m and 4m versions, has front winged tines*** for ***complete autumn cultivations.***

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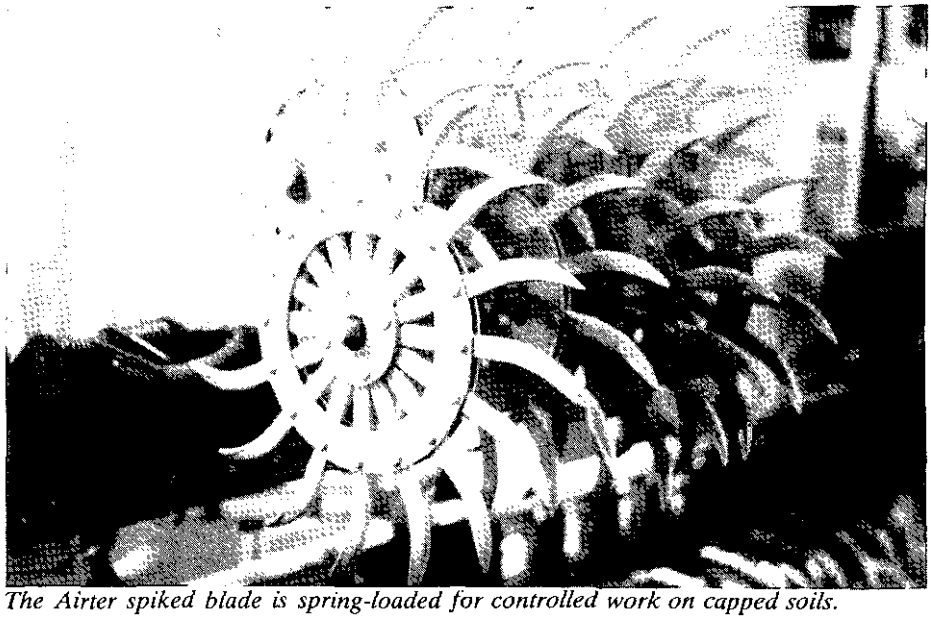
stubble working, straw chopping and incorporation.

An interesting piece of machinery tucked away on the David Goodge stand on the 2nd floor attracted much attention from those visitors who managed to find the firm. The Airter, built by lsomec Divisione Macchine Agricole, was so new that the promotional leaflet was still in Italian.

The tool is principally designed to relieve capping on autumn ploughed seedbeds or between rows of growing seedlings. It comprises two adjustable banks of spiked plates, which are free to revolve as the machine moves forward, kept in position by a spring-loaded mechanism. The importers say it should prove capable of dealing with any capped soil surface.



*The Airter spiked blade is spring-loaded for controlled work on capped soils.*

## Ploughs

A completely new concept in plough design, a semi-mounted plough with variable furrow width adjustment, was shown at Smithfield for the first time by Kverneland (UK) of Rotherham. Mr Cyril Dyke, company managing director, said the vari-width plough is: "the only plough that moves on the move". Available in 4 to 8 furrow models, it is possible, by means of a turnbuckle or a hydraulic ram, for the driver to alter furrow width from 12in to 20in while ploughing.

Main operational advantages claimed for this idea are the setting of correct proportions between depth and width for improved burying qualities. easier ploughing close to awkward fences or hedges and optimum utilisation of tractor horsepower for soil type.

Also from Kverneland came a new plough body, the Number 8 which, compared with the Number 3 body has a redesigned saddle, share and mouldboard. It includes a replacement shin piece which runs the full depth of the mouldboard and a longer landside. The new body follows the move by farmers to vary their depth of ploughing each year in an effort to avoid ploughpan formation. Kverneland say it can also work in a wider range of soil types at varying depths and widths.

On Ransomes' stand was a mounted reversible front plough, together with a new mounted reversible plough range, on which hitching up has been made easier and quicker using a semi-automatic bar coupler. This range also removes the need to alter tractor wheel settings because a spannerless parallel sideshift adjustment is incorporated on the plough.

## Straw treatment

Twelve months' research by Andrew Watts at Reading University with Calor Gas Ltd, has led to the introduction of a controlled burner for stubble. The tractor-mounted equipment incorporates propane-fuelled burners, and has proved effective in trials held near Newbury. Such a burner, claimed Mr Watts, reduces disease and weed build-up, and leaves the field ready for reduced cultivation or direct drilling. The equipment allows stubble burning even in windy weather or shortlv after rain. smoke pollution is also reduced, fire' hazards minimised. and the propane has no harmful effects on the soil.

Mr Watts estimates that the machine costs £5 to £6 an acre to run (including labour and depreciation) at an average working speed of 5 mph. Under the worst conditions (oil seed rape), costs increase to f7 an acre. Further trials are planned for this year.

***Kverneland** vari-width plough* with ***on-the-move** furrow adjustment.*

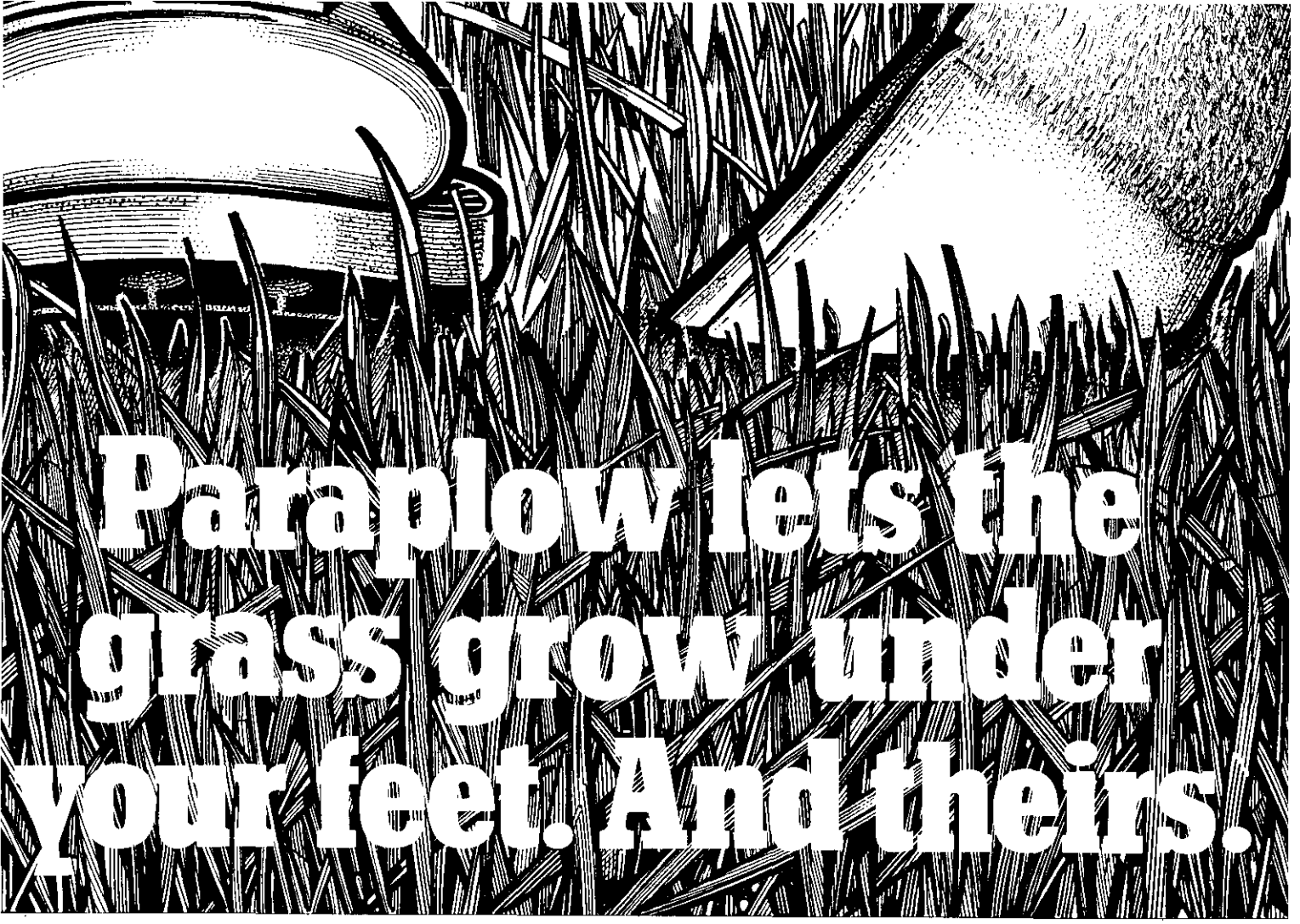
## Irrigation

Javelin Irrigation revealed increased optimism this year and claim to have had record sales, particularly with their reel irrigator range. They have also had success with centre-pivot sales — now marketing a portable 40 acre system. New for the 1983 season is the Delta range of constant speed hose-reel irrigators. These machines can be fitted with the new hydraulic drive or the better known bellows-drive and operate at extremely low connection pressures. They are available with automatic speed control, electronic delayed start, turntables, 3 year hose guarantee and automatic slow shut-off valves.

Wright Rain are similarly optimistic and continued the trend of 'big is best' by launching a Mark 2 version of the Wright Rain Super Torraine hose-driven irrigation machine.

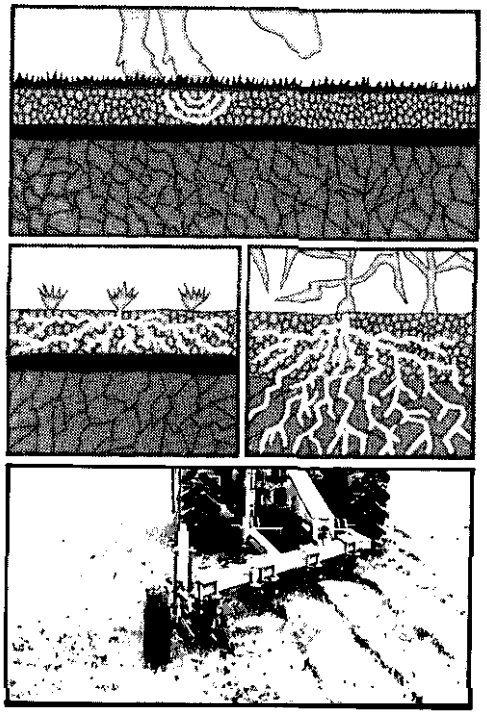
Five new models are available, all turntable units, ranging in size from the ST90/300TT, capable of irrigating up to 4.9 hectares (12.10 acres) with 25mm of water daily, to the ST110/370TT which ap-

25t



# Paraplow lets the grass grow under your feet. And theirs.

Telling you about soil compaction isn't news You're probably all too familiar with the dense soil barrier created by the weight of grazing livestock and farm vehicles that prevents surface water drainage and restricts grass growth.



What you may not realise is that you can now do something about it, with the Howard Paraplow Soil Loosener.

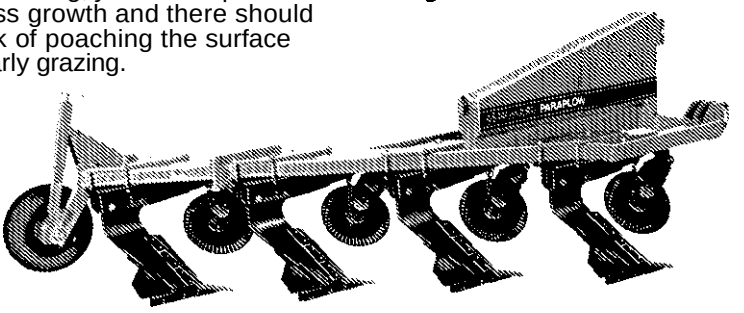
Jointly developed by Howard Rotavator and the Plant Protection Division of I.C.I., the Paraplow has 45° angled legs which cause a lifting and bending effect on the soil passing over them, allowing the compacted areas to crack and break following the natural lines of weakness. The Paraplow breaks up the compaction and restores the soil's natural system of cracks and pores to allow proper water movement and encourage healthy root development.

After Paraplowing, you can expect earlier grass growth and there should be less risk of poaching the surface through early grazing.

## Ask for the "I Don't Believe It" Demonstration

Before seeing the Paraplow in action, many grassland farmers have expressed doubt about the ability of the Paraplow to fulfil its promises So we have organised a special "I Don't Believe It" Demonstration to prove just how effective the Paraplow is Why not ask us to do a demonstration for you?

Write to us at the address below for **your free copy of the new Howard** Paraplow Technical leaflet which provides **in-depth information on the** Paraplow's performance on arable **and grass land.**




**Winner of 11** National and International Awards.

**HOWARD PARAPLOW**

**A NEW CONCEPT IN SOIL CARE**

Howard Rotavator Co. Ltd., Mendham Lane, Harleston, Norfolk. IP20 9DP. Telephone: Harleston (0379) 853221. Telex: 975487.

plies the same amount to 7.8 hectares (19.3 acres) in a day.

Driven by a smooth running, partial flow, low pressure, axial turbine having electronically operated constant speed control, the Mark 2 incorporates a two wheeled raingun carriage which self loads at the end of the irrigation run.

## For deeper working

Ransomes, responding to farmer interest in soil-loosening, unveiled the Subtiller. Using the flat or level lift concept, disturbance of the surface is kept to a minimum by the use of a reduction in leg thickness above the tine, a slim point and the ability to set a low wing lift. Ransomes' experience shows that the thinner leg and slimmer foot are not detrimental to soil shatter but help to reduce draught.

The Subtiller tines, which are pivot-mounted and have a reversible shin, normally have a spacing equivalent to nearly twice the working depth. They have individual wing angle adjustment which when conditions allow, should be increased for greater soil shatter. Front disc coulters are fitted as standard to each Subtiller unit and are essential for trashy conditions, in grassland and also when an even surface is important — for example prior to direct drilling.

Leading shallow tines are available to reduce the number of subsequent tillage operations and to increase the effectiveness of the Subtiller tines without substantially increasing draught.

Depending on conditions, each Subtiller unit requires from 35hp to 40hp, and for smaller tractors are being offered fitted on the company's 'C83B' and '90' toolbars

## Low ground pressure

Designed to fit UK manufactured tractors of 45hp and above, Yield Wheel by Cab-Craft was on show at the Trantor International stand. This cage-like wheel was designed with the help of the NIAE from an idea spotted working on the paddy fields of Indonesia.

The low ground pressure wheel, unlike other cage wheels, cultivates rather than compacts the soil. The concept and success of the wheel lies in the approach angles of the lugs through which the wheel not only transmits fonvard and reverse motion to the tractor, but at the same time cultivates the ground through which it passes.

Results obtained at the SIAE in conjunction with the NIAE enable Cab-Craft to maintain that the Yield Wheel not only produces the lowest soil density reading, but also the highest air to soil volume relationship of the proprietary wheel products tested.

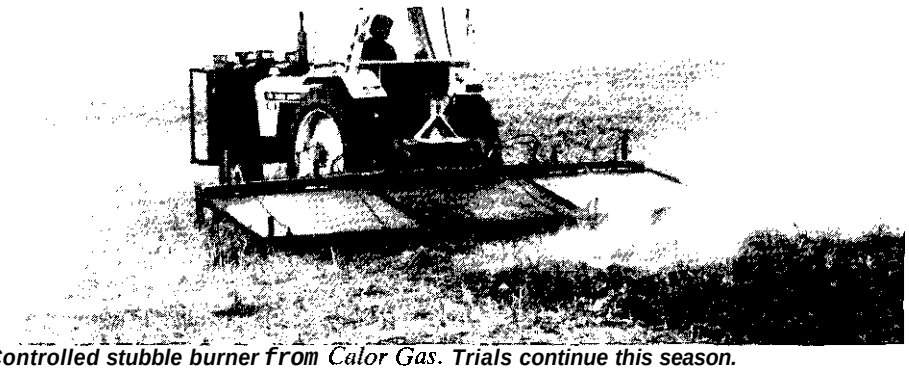
Available at a cost comparable to dual wheels, (£750 per pair plus VAT), Yield Wheel will be a welcome addition to the range of tractor modifications available to help reduce compaction from tyres.

## Ditching

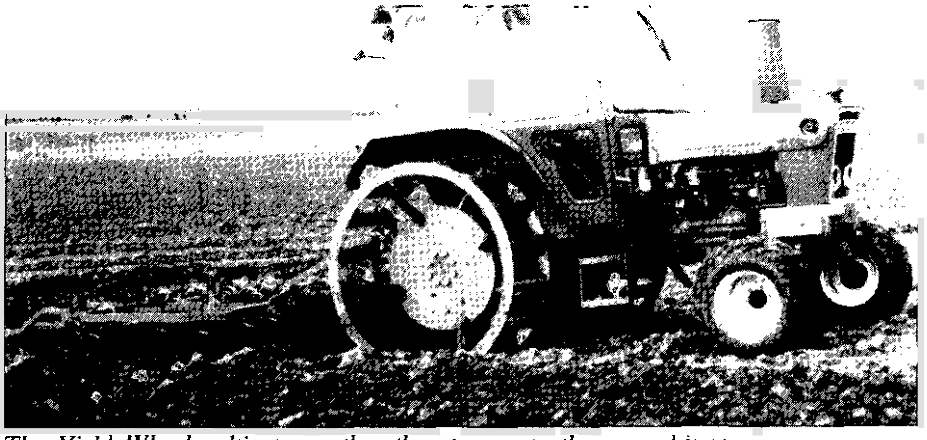
Introduced earlier in the year and making a first appearance at Smithfield was the WestMac D2000 rotary ditcher, specially designed to clean ditches at speed.

The ditcher can disperse spoil to the left, to the right. or when working on the highway, place it alongside the ditch by means of an additional deflector plate.

In tests carried out in various parts of the UK, in conditions where the soil was suitable, WestMac found it possible to clean, or make, up to 1 mile of ditch in an hour, using a tractor speed of 1 mph and 540pto rpm. This result was achieved on runs without obstructions such as tree stumps and telegraph poles. When obstacles are encountered the machine can be easily manoeuvred around the obstruction and little time is lost.

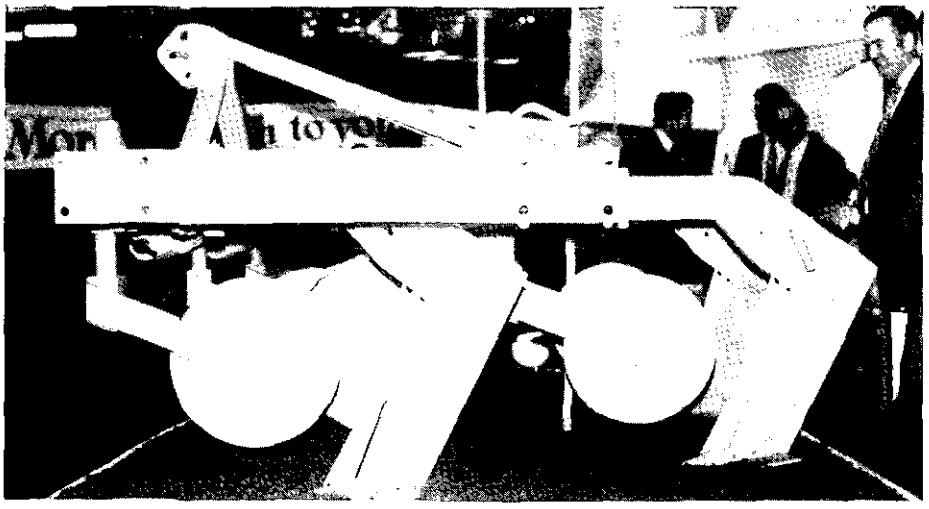


*Controlled stubble burner from Calor Gas. Trials continue this season.*



*The Yield Wheel cultivates, rather than compacts, the ground it passes over.*

*The Ransomes Subtiller*



***Spoil can be deflected to the left, the right or placed adjacent to the trench by WestMac's D2000 rotary ditcher.***

LAND LINE

# Heavy land techniques at home and abroad

Chris Older recently visited the continent to study cultivations as part of a Nuffield Farming Scholarship, sponsored by the South of England Agricultural Society. Here he passes on information to farmers and reveals some interesting overseas moves in heavy land management.

## *BACKGROUND*

*I* farm, with my father, about 1850 acres in the Ashford area of Kent and on Romney Marsh; the Romney Marsh soils (Newchurch, Ivychurch and Dymchurch Series) have clay fractions of up to 45 per cent.

Having used direct drilling with great success on lighter upland soils and obtained good crops on the better gault-derived soils, we have only had mediocre results on the marshland soils.

Faced with this situation, we tried minimum cultivation on the heavier land and this has given better results, but compaction at deeper layers and the soil's impervious nature increases the risk of 'slumping' and ponding resulting in impeded root growth.

So in 1981 we reached a 'turning' point with our farm planning and had to consider whether further investment was required in larger tractors and deeper working progressive cultivations.

I believe that many heavy land farmers are in this situation and it was with this in mind I started my Nuffield Scholarship Tour.

## *CROPPING CONSIDERATIONS*

Winter cropping

The swing to greater areas of winter cropping that has taken place in the UK is quite evident throughout northern Europe and the importance of winter wheat, winter barley and winter oil seed rape is emphasised by current EEC policies. With the fall from favour of livestock producing enterprises it is quite evident that winter cereals or rape are now the saviours of the heavy land arable farmer.

Continuous wheat growing

I found many instances of continuous or near continuous wheat growing and it is quite evident that a good economic yield can be expected from an intensive wheat cropping system.

At Boxworth EHF, Cambridge, where continuous wheat has been grown for thirty years, yields followed and were slightly above the national average year after year.

It was advised in Holland, and it was mentioned in the UK, that on embarkation of a continuous wheat growing system it may he advisable to have two years' wheat followed by two years' barley, and then continuous wheat growing after that.

The two years of barley continue the takeall infection, but do give a more economic return than two poor yielding years of wheat.

## SOIL *CONDITIONS*

Top soil

The last 10 to 15 years work in the UK with direct drilling and minimum cultivation have taught us that it is particularly important to have a well-structured friable top-soil suitable for the next crop.

Traditionally, ploughing has been of prime importance as the main operation for weed control and soil structure improvement but today we have a greater understanding of the careful application of less energy-absorbing systems of cultivation and selective use of herbicides.

Ploughing can be considered as an unnatural operation in that it mixes well-weathered and friable top soil with large quantities of more difficult deeper soil, leaving a lumpy surface and a greater dilution of the organic matter through the ploughed Layer. The ploughing operation requires more energy than minimal cultivation to obtain a good root seedbed, though obviously it still has its place.

Soil drainage

Work at the Letcombe Laboratory is beginning to show that the water-holding capacities of soils varies according to the system of cultivation used. This is associated with the fissuring of the soil and the cracking of the subsoils.

After direct drilling for a number of years, vertical fissuring takes place naturally right to the surface of the soil and facilitates the drainage of that soil, whereas on ploughed or cultivated land there is an interruption to the vertical fissuring at plough depth and this therefore interrupts the free drainage of the soil.

Organic matter

Care should be taken to watch the biological balance between the organic matter breakdown in the soil and the amount of nitrogen used. Related to this there is the amount of cultivation activity going on in the field which could speed the organic matter breakdown to an extent that organic matter is depleted too quickly especially in warm moist conditions.

In Germany, work is proving that the higher organic matter soils are less liable to fluctuations in yield, this being mainly due to the retention of mineral nitrogen in the soil. The nitrogen is being locked up in the organic matter breakdown complex.

Levels of organic matter in the different soils vary widely, but I gained a distinct impression that where they were low, farmers were complaining that they required more and more horsepower for their cultivations each year, whereas those farmers who were working in straw and other crop residues found they could cope quite adequately with their existing power units.

Soil texture improvement

Several people stressed to me the importance of considering the soil and the plant together, and thinking carefully of the optimum conditions for plant growth. It was interesting to hear how the use of reduced cultivations may give a more stable top two inches of soil structure with the reduced cultivations. There is a better root density after minimum cultivations.

In the south of Holland where there are ample quantities of both sugar beet, factory waste lime and poultry manure, I saw these by-products had been very successfully used to improved the texture and workability of the heavier clay soil. Land that had been considered unsuitable for potato growing was now being successfully used for potato production.

Subsoil cultivation

Identification of the need to subsoil is a very important prerequisite before carrying out the job. There is only one way of doing this — with a spade.

Subsoil cultivations for direct drilling

The latest subsoil cultivator developments will increase areas of land that can be direct drilled, and the original land classification scheme for direct drilling

may soon be modified in the light of experience and experiment. The land in class 1, the land most suitable for direct drilling, may not require subsoil cultivation but that in classes 2 and 3 may find increasing benefit from subsoil cultivation.

Progressive cultivation

The use of the progressive type of cultivator is becoming fairly widespread on heavy land farms in the UK. The advantage is that a three level cultivation operation takes place at the same time: The machines require considerable horsepower hut leave a tilth that is worked to depth, free draining and in a ready condition for the quick preparation and drilling of the subsequent autumn sown crop.

Controlled traffic

Work in Holland and by Herr Weichel in Stuttgart is centred on controlling where wheel traffic moves on the field. In Holland, systems have been perfected for sugar beet and potato growing where tractors and machines are standardised to a 10.9ft (3.3 metre) width so that the tractor wheels always follow the same path in the field. The system is particularly of merit for potatoes and sugar beet as these crops are very susceptible to compaction.

## THE STRAW DISPOSAL PROBLEM

General

I am not generally accustomed to driving through much of southern England during September, but I was horrified to find in September 1981, the very considerable amount of damage being done to the countryside through careless straw burning after harvest. This prompted me to give considerable attention during my tour to the treatment and disposal of straw in a way that is less harmful to the environment.

European scene

I was surprised to find that straw was little problem in Europe, it was either sold to adjacent livestock farms or was chopped, worked into the soil and mulched. Often, in Denmark particularly, it was baled and used for communal heating systems, briquettes, cellulose and building boards. Straw was also used for feed by enhancing its value with treatment in the form of ammonium nitrate.

Quick mulching

European experience stresses the need for short chopping the straw to 2 inches, careful mulching and then careful ploughing should take place, to 10 inches seemed common.

It was stressed to me on two occasions that the straw should be chopped by the combine and cultivated in on the same day as harvest, thus giving the quickest breakdown, utilising what limited soil moisture there is after harvest and before the straw becomes too dry and completely lignified by the sun.

Economics of handling

I believe that methods must bc found to utilise the straw in the field, otherwise the cost of baling and storage as well as the energy required to handle from field to plant destroys the economics of any utilisation system when the whole energy balance is studied.

## CONCLUSIONS

Cropping

At the present time I cannot see any alternatives to the increased importance of winter cereal and oil seed rape crops on the more difficult land. As margins are eroded by increasing costs and only slowly increasing returns per tonne, considerable weight will be added to the argument for gaining the most economic return per acre rather than the 'maximum yield at any cost' attitude.

I should like to see more use of green manuring as a tool for the improvement of soil structure especially on the more difficult soils. The careful use of, say, winter barley, catch crops of mustard, fodder rape or even Phacilia, can be used when difficult soil conditions exist, to increase the root organic matter in the soil and therefore the structure of the soil.

Cultivations

Where conditions permit, direct drilling will remain a useful method of crop establishment especially when it is coupled with the use of some form of subsoil cultivation ie the para-plow or flat lift. Direct drilling may become the most popular method of oil seed rape establishment in the future when linked with these machines.

Straw handling

If straw disposal becomes a bigger problem in the UK, concentrated mulching techniques will have to be adopted and improved to suit our climatic conditions. Quantities of straw used for industrial purposes will always be a small proportion of the whole in the foreseeable future, so the onus will still be on the farmer for considerate methods of crop residue disposal.

Mulching will require a considerable new investment in machinery including combine choppers, cultivators and more plough capacity on the farm. To offset this, special systems of grant aid may be required to help farmers offset increased cost for environmental reasons. Although more man hours per acre will be required to cope with the problem compared with existing systems, some benefits will accrue:—

The increase in organic matter in the soil will give a more 'bioactive' soil that may lead to the storing up of more mineral nitrogen.

Allied to this the workability of the heavier soils could improve, thus stemming the call for more and more horsepower.

The more bioactive soil should also give more stable yield potential, cutting out some of the lows experienced especially in dry years.

Controlled traffic

In the longer term it will be interesting to watch developments from the controlled traffic angle so that wheelings on the land are reduced. I believe that systems will develop that, with specialised machines, will mean that wheelings are reduced to certain tracks through the field and all operations will be carried out using these tracks. Lower power specialised tractors will be used and these will be controlled by radio guidance systems to keep them on the right path.

*The above article is a summary of* **'Cropping and cultivation on the more difficult** arable **soils — UK and northern Europe'** *by* **Chris** *Older.* **Copies** *of his report ore available at £1.50 (incl p & p) each from rhe Director,* **Nuffield Farming** *Scholarships Trust, Mill House, Olney, Bucks, MK46 4AD.*

VII-1



# From little acorns . . .

## A profile of drainage machine makers, K. G. Hoes.

The acquisition of a factory at Great Ryburgh. Norfolk, in 1980 was in many ways an extraordinary event within manufacturing circles.

Firstly, and contrary to the general trend in these negative days of recession, we had a German company, sufficiently confident in British engineering expertise and manufacturing capability, taking the positive step of establishing a manufacturing base in this country.

Secondly, it was the final move in a sequence of events which completed a full circle regarding the marketing of land drainage equipment by the company K.G. Hoes.

The founder of the company, the late Klaus Gerd Hoes, first became involved in trenching equipment when, in 1955, he imported into Germany the Howard trencher. Importation of Howard equipment continued until 1961 when the first Hoes machine was designed and the Howard franchise given up. Hoes machines were developed using the latest technology and soon created an expert demand in such diverse markets as the USA, Egypt, Syria and many European countries including Britain.

### Developments

Substantial numbers of Hoes trenching machines were sold in this country when the Superdrainers Mk VI and Mk V were introduced in the 1970's. When the Great Ryburgh factory was set up, the first machines were assembled with parts imported from Germany. To meet the critical demands of contractors and the industry in the UK it soon became necessary to establish a design team.

Under the leadership of Norman Johnson the team have produced two new designs, the Superdrainers Mk IV and 5671 130 in the two years since the factory was started.

The 5671130 has been particularly well received and are now being exported to Germany. Several of these machines have been sold into the USA and orders are still in the pipeline from France and Sweden — the circle is now complete.

The success at Great Ryburgh is testament to the vision and entrepreneurial flair of the late Klaus Gerd Hoes. This gentleman established, from a modest start in 1949, a significant manufacturing company employing over 600 people in three main factories at Westerholt, Lathen and Garrell. The latter factory specialises in the manufacture of blades and chains for trenchers. Last year, the corporate turn-over increased by 23 per cent and is now approaching £29 million.

Norman Jobnson, Hoes' consultant engineer, is well known in the industry with many years experience in the development of the Howard trencher product line. In addition to Superdrainers Mk IV and 5671130 his current product development plans should put K G Hoes into the forefront of UK manufacture within the next two years.

### Manufacturing

The agricultural engineering connections at Great Ryburgh go back to the mid-nineteenth century when some of the first steam-driven farm machinery was manufactured there by the Norfolk Foundry. This tradition was continued by various companies including Leefords, who purchased the original premises in 1969.

Mr Heinz Liebrecht, currently Managing Director of K G Hoes (England), is considered by many as 'The Patron' because of his forty years in the agricultural machinery manufacturing business. Mr Liebrecht was co-founder of Leefords and formerly a Director of Howard Rotavator.

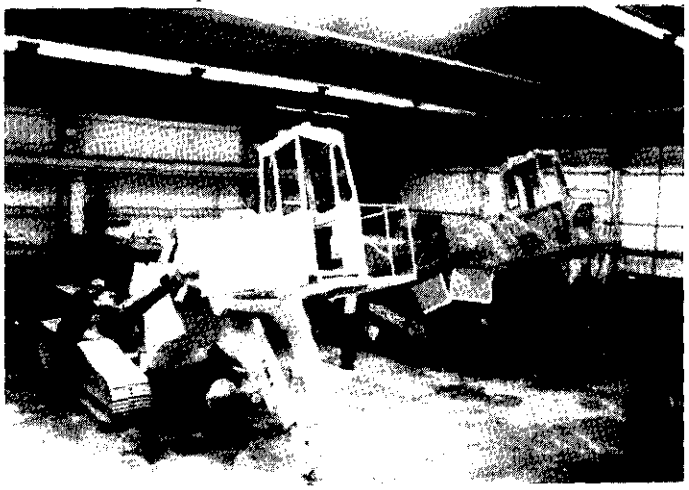
While the main activity at the factory is the manufacture of trenching machines, the manufacturing base has been broadened recently by the introduction of hydraulic cranes, asphalt paving equipment in addition to production of graders, dozers and snow ploughs.

Production capacity has been trebled by recent purchases of machine tools and factory reorganisation. Ken Kynoch, the plant manager, is responsible for installing the new equipment and supervising the modernisation of the factory. Mr Kynoch has had extensive experience in the industry with Hestair where he was Production Manager.

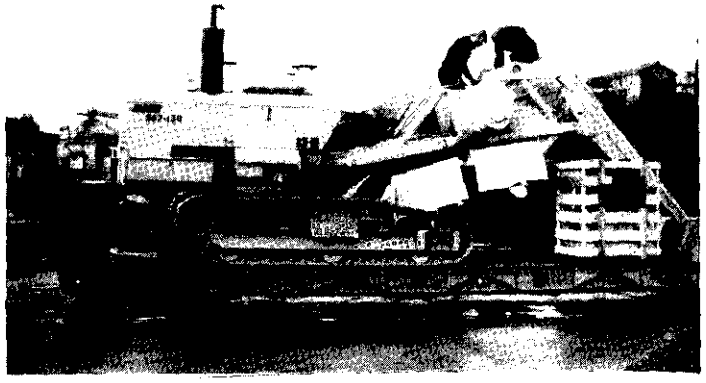
Selling the increased volume is the responsibility of Tony Lowndes, Marketing Executive, who joined the company last year from Barber-Greene England Limited where he was Director of Marketing at their Bury St Edmunds factory.

The policy of K G Hoes in the UK is to substantially increase its market share over the next two years. This objective is backed up by a wealth of experience in management, an efficient factory equipped with modern machine tools, a committed workforce and a positive product development plan.

*Hoes machines in production within the assembly area.*



*The final check before leaving the factory.*



VII-1

# Crop reaction to compaction

**A NUMBER OF workers have reported substantial yield losses attributable to soil compaction but have often failed to indicate how the yield depressions occur. The effect of soil compaction on the growth and yield of a numher of crops has been investigated at Sutton Bonington. In these trials, attempts have been made to separate yield losses attributable to reductions in plant populations and losses attributable to reduced performance of individual plants. This article, by Mr T. C. K. Dawkins, Lecturer in Agronomy, Sutton Bonington, summarises the various experiments and indicates the relative sensitivity of crops to soil compactiou.**

The initial experiments investigated the effects of soil compaction on the yield of dried and vining peas. These experiments, together with a later series, revealed that soil compaction reduced the yield of peas by up to 70 per cent.

The use of a control thinned treatment, a treatment which was not compact but thinned to exactly the same population and distribution as the compact treatment enabled distinctions to be made between losses in yield due to plant numbers alone and losses attributable to poor performance of individual plants. Use of this treatment showed that compaction not only reduced yield through a reduction in plant number but, by comparison with the thinned treatment, it was shown that compaction reduced the plants ability to compensate for the low population.

In many cases, the thinned treatment yielded nearly as well as the control. In most cases compaction reduced dry matter accumulation per plant and per sq metre, leaf area per plant and per sq metre and rooting was restricted. In 1979 and 1980 root studies revealed that pea roots rarely extended beyond 40 cm on compact plots as opposed to 60 to 70 cm on the thinned and control plots.

Additional studies (Dawkins, 1982) on vining peas have isolated other factors which may explain some of the observed growth modifications produced by compaction. If peas are impeded at the shoot they produce a plant hormone, ethylene (Goeshel et *al*, 1966). This plant hormone causes certain structural changes within the plant cell resulting in altered growth habit. It is suggested that the changes in plant growth shown in Plate 1 as a result of comnaction may be caused, in part, by ethylene produced in response to the impedence produced by compaction.

In 1981 no yield reduction occurred as a result of compaction. A similar soil type was used as in previous years hut the soil was wet at the time of emergence. In 1979 and 1981 the soil was dry at emergence resulting in increased soil strength. This may have caused a reduction in plant numbers emerging and these that did may have been more damaged by ethylene production.

A wet soil in 1981 reduced soil strength and allowed better emergence with less mechanical impedence and hence better yields in that year.

Several points are of practical significance. Dry seed bed conditions at emergence are likely to exacerbate the effects of soil compaction. This raises the question as to whether irrigation could be applied to poor seedbeds to improve establishment. Secondly if ethylene is implicated as a contributor to reduced yields, could an ethylene inhibitor be applied to reduce the severity of compaction? Compounds such as D I H B have shown some promise in this respect (Wilkins and Wain, 1976).

Experiments conducted in 1977 and 1978 by Hebblethwaite and McGowan (1980) revealed that compaction significantly decreased root, top and sugar yield in sugar beet. Plant population was only affected in 1977 (see table). Unlike peas, single beet plants were unable to make compensatory growth when thinned. As a result, the yield reduction in 1977 due to compaction could be largely accounted for by a reduced population.

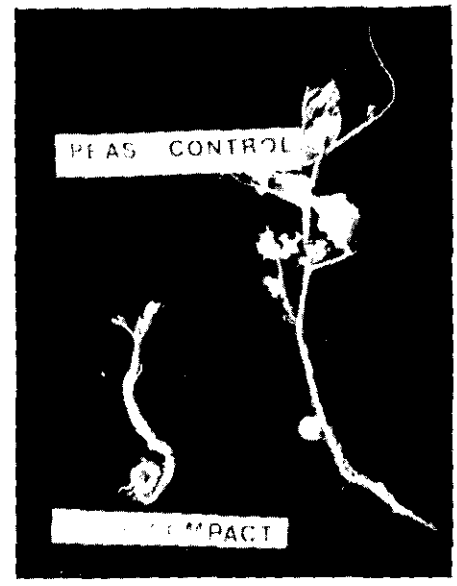



*Plate 1. Effect of soil compaction on early growth of pea seedlings.*

In 1978 when populations on compact plots were similar to the control, yield reductions attributable to compaction were due to restricted yield of individual plants. The depth of rooting was restricted to about 60 cm by compaction compared to about 110 cm in thecontrol and control thinned treatments.

In 1980, an experiment was conducted

32►

**The effects of soil compactiou on** sugar beet **1977-78.**

| | 1917 | | | | 1978 | | | |
|---|---|---|---|---|---|---|---|---|
| | Compacted | Control thinned | Control | LSD | Compacted | Control thinned | Control | LSD |
| Plant population × 1000 $ha^{-1}$ | 57 | 62 | 80 | 21.0 | 71 | 78 | 74 | 4.2 |
| Fresh yield per plant (g) | 249 | 303 | 326 | 8.0 | 573 | 588 | 661 | 26.3 |
| Tap fresh yield (t $ha^{-1}$) | 16.4 | 21.9 | 34.2 | 11.3 | 39.2 | 41.0 | 43.6 | 4.8 |
| Root fresh yield (t $ha^{-1}$) | 14.2 | 18.8 | 26.1 | 9.0 | 41.0 | 46.1 | 48.9 | 4.2 |
| Sugar % | 17.8 | 17.6 | 17.8 | 0.5 | 19.4 | 19.8 | 18.8 | 0.4 |
| Sugar yield (t $ha^{-1}$) | 2.5 | 3.3 | 4.7 | 2.1 | 7.9 | 9.1 | 9.2 | 0.8 |

on the susceptibility of winter oilseed rape to soil compaction. The crop was established by ploughing or direct drilling but poor establishment occurred on the direct drilled areas. Soil strength measurements indicated compaction in the direct drilled plots in the surface layers. The top soil compaction on the direct drilled site reduced plant number by 50 percent and caused severe stunting of the crop. Compaction reduced root length, root dry matter, leaf area index and total dry matter accumulated.

Despite the reductions in these components, there was no difference in yield at the end of the season, demonstrating the remarkable ability of rape to compensate for poor conditions. However, other factors interacted to reduce the severity of compaction in that year. The season was generally wet and despite the poor root development, adequate moisture and nutrients were available to the crop. Had the year been drier then severe losses may have occurred.

Secondly, a heavy fall of snow in April lodged the crop on the uncompacted areas but the stunted crop on the compacted direct drilled area resisted lodging.

Current experiments at Sutton Bonington are investigating the differential sensitivity of crops to soil compaction using two sowing dates in the same year. Crops under test include spring barley, spring rape and spring beans.

Last year's experiments showed that compaction reduced plant population in most crops: beans were least affected in this respect. Both spring barley and spring rape were very sensitive to soil compaction, especially in the second sowing date trial where dry conditions prevailed at emergence. In one case, only four plants emerged on the spring rape plots. Plant height, dry matter accumulation and root growth were reduced by compaction in all crops.

Plates 2, 3 and 4 illustrate the damage to seedlings of different crops caused by soil compaction. Plate 5 shows the effect of soil compaction on the height of spring beans. Population was relatively unaffected by soil compaction in this crop.

Results so far suggest yield reductions for spring beans of between 28 per cent and 48 percent, depending upon sowing date, as a result of compaction. A reduction of 50 percent occurred in spring barley but the majority of yield loss was through reduction of plant population. About 60 percent of the yield was lost through soil compaction in spring rape, the principal losses being attributed to reduction in plant population. Once again there was evidence to suggest that dry conditions at emergence exacerbated the problems of compaction.

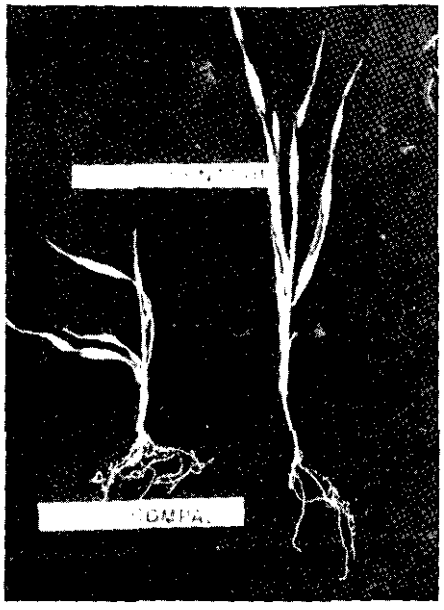
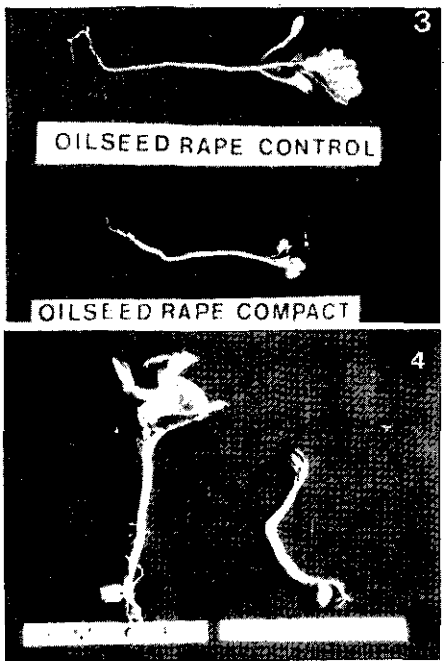


Plate 2. ***Effect*** of soil compaction on spring barley.

Clearly numerous crops can be affected by soil compaction, the seventy depending, to some extent, on the type of crop grown, soil type and weather conditions at emergence. Measurement of soil conditions have shown that compaction by tractor wheelings exerts greatest influence at about seed depth.

Experiments are continuing to assess




the sensitivity of other crops to soil compaction when sown in the same year. Further studies will continue to establish the mechanism by which compaction modifies growth which may result in the use of chemicals to reduce the severity of compaction.

In the meantime it cannot be emphasised too strongly that soil is a vital component in any successful crop and should be treated as a valuable asset.

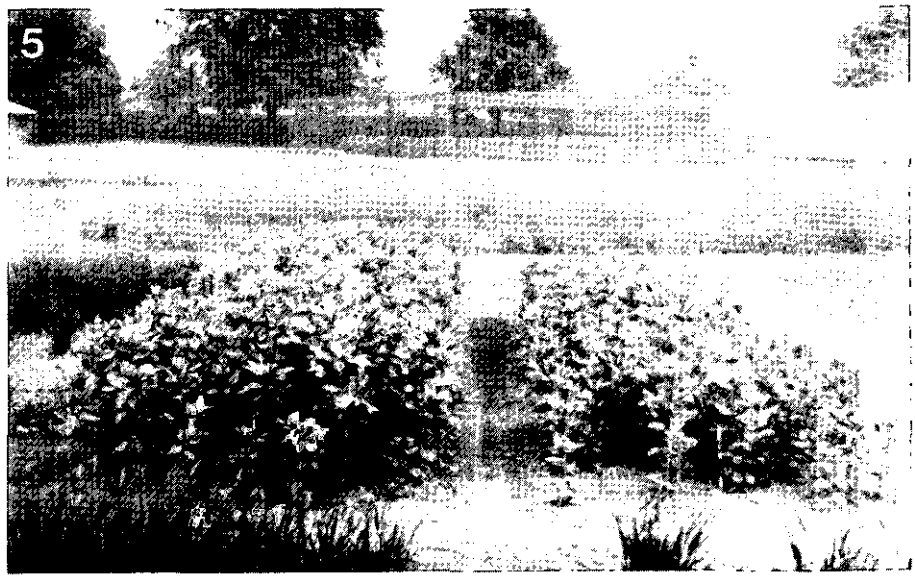



*Plate 3. Effect of soil compaction on seedling growth of spring oilseed rape.*
*Plate 4. Effect of soil compaction on early growth of bean seedlings.*
*Plate 5. Soil compacrion affecting plant height on a sandy gravelly loam (beans).*

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# Reduce wheelings, increase yields

**Bed systems for horticultural crops have been used for many years, particularly in the intensive growing areas of Kent and the Thames Valley. However, many of these systems were not what is now known as the 'pure' type in that beds were wheeled out after second or third stage cultivations had been carried out. Luddington EHS, Stratford-on-Avon, Warwickshire had been using bed systems for some years but from 1977 moved totally to the 'pure' system. Here, A. C. W. Davies from Luddington describes the method and the results of reduced compaction.**

THE FIRST OPERATION in a 'pure' bed system is autumn subsoiling if soil conditions are suitable, followed by liming and application of manure if either are necessary for the crop to he sown in the spring. Autumn ploughing comes next, with soil left well ridged up so that maximum weathering can occur during the winter.

In late winter or early spring the beds are wheeled out from the plough (picture 1) and from then on, all subsequent operations on the field use the same wheelings. Prior to crop drilling or planting the secondary cultivations are carried out (picture 2); in our case using a 1.5m Lely Roterra powered machine or a small Dutch tine harrow, whichever is considered suitable to obtain the planting or seed bed required.

Base fertiliser and incorporated herbicides can be applied to the soil prior to the secondary cultivation by using a spreader (picture 3) or the harrows.

Drilling or planting can then take place on the worked bed as in picture 4. In this way we ensure that no crop is planted on areas that have suffered from soil compaction when running over the field carrying out secondary cultivations. Should one pass of the secondary cultivation be insufficient to get the required seed bed, then no harm is done to the growing areas by a second or even third pass.

When adopting this 'complete' or 'pure' bed system, Luddington decided to investigate what the yield losses could be when crops were grown on compacted soils.

Wet soils were said to be more damaged, but there was little hard data on what percentage soil moisture content serious compaction occurred. Soils at Luddington are very variable — there are light loams, heavy clays, sandy clay loams, light loams with stones and most grades in between. The most difficult of these types to manage are probably the sandy clay loams which, at Luddington, can contain up to 35 per cent clay. These can compact very easily, yet if managed well, can produce very high yielding horticultural crops.

In the investigations to attempt a quantitative measure of crop loss due to compaction, the experimental treatments were as follows: The ground was ploughed and wheeled out as described but prior to the secondary cultivations the planting area of the bed was run over with a small to medium sized tractor, either twice side by side, designated 2 WSS and covering 50 per cent of the planting area, or four times side by side, designated 4WSS, and covering up to 90 per cent of the growing area.

Soil moisture contents were taken at the time of these deliberate wheelings over the bed. Subsquent operations were as previously described, with secondary cultivations followed by drilling or planting, fertiliser application and spraying all done from the original wheelings.

Alongside these compacted plots were control plots where no wheeling were imposed in the growing area and crops could experience non-compacted conditions. Soil bulk density measurements were made soon after crops had become established to see if some measure of compaction could be made.

These experiments commenced in 1978 with a crop of spring sown bulb onions; in 1979 and 1980 butterhead lettuce was studied, followed by parsnips in 1981 and carrots, crips lettuce, parsnips and leeks in 1982.

The results of these trials are presented briefly below starting with the bulb onion crop in 1978, Table 1. All figures quoted are the mean of four replicated plots for each treatment and all experiments were designed and analysed by statisticians and only significant results are highlighted.

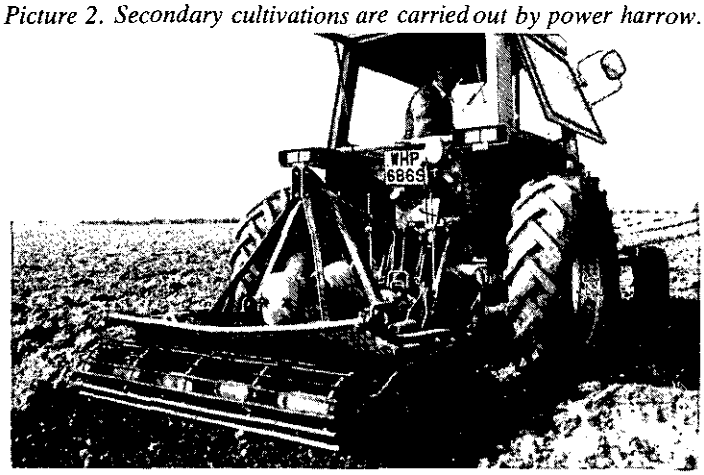
In Table 1 no difference occurred between controls and treatment 2WSS but the 4WSS (90 per cent bed wheeled over) the yield was 12 per cent lower than either of the other two treatments. A high proportion of unmarketable onions in the 4WSS treatment was due to 'thick necked' onions which is an indication of premature flower development, often a sign of distress in plants.

**Table 1 — Bulb Onions 1978**

| Treatment | Yield t/ha (marketable bulbs) |
|---|---|
| Control | 52 |
| 2 WSS | 53 |
| 4 WSS | 46 |

Picture 1. The beds are wheeled our on the weathered ploughing.

*Picture 2. Secondary cultivations are carried out by power harrow.*



Lettuce Experiments **1979180**

Table 2 shows the yield figures obtained from the two years experiments on lettuce. In these two trials, four harvests were made from the plots but for the sake of simplification, only two of these are quoted.

Table **2—Lettuce crop**

Yield **t/ha** (marketable crop)

| Treatment | **1979** harvest | | **1980** harvest | |
|---|---|---|---|---|
| | 1 | A | 1 | A |
| **Control** | 26.3 | 45.6 | 17.0 | 30.4 |
| **2 WSS** | 23.4 | 38.4 | 15.7 | 26.1 |
| **4 WSS** | 19.0 | 31.9 | 13.2 | 21.8 |

As can be seen from the figures, the control plots gave the highest yields with the 4 WSS treatments heing up to only *66* per cent of the controls. It is noticeable that as the lettuce matured, the difference got greater, indicating again plants on compacted areas were showing stress.

In addition to lower yields, a quality difference was noted on the compacted plots. Lettuce can often suffer from a disorder called 'tipburn' which is a necrosis of leaf margins or a browning in the heart. The cause of this is not fully understood hut indications are that it is a calcium deficiency occurring within the leaves which again could be postulated as a stress factor. Table 3 shows the percentage tipburn occurring from the lettuce trials in the two seasons.

The results for 1979 were very clear in that both compaction treatments gave higher tipburn figures. In 1980 however, the 4 WSS was similar to the control but both these were lower than the 2 WSS which gave a very high tipburn percentage. The three trials were carried out on sandy clay loams and in 1980 on a sandy clay loam with pebbles.

Table %Percentage 'tipburn' lettuce

| Treatment | | |
|---|---|---|
| Control | | |
| **2 WSS** | 11.9 | 27.0 |
| **4 WSS** | | 14.0 |

The soil bulk density measurements, again the mean of replicated plots, are given in Table 4. A higher figure indicates a denser soil. Although the figures are low, a different of 0.20 indicates a much denser soil.

Table **4—Soil** bulk densities at **10cm depth (g/cc)**

| **Crop** | **Control** | **2 WSS** | **4 WSS** |
|---|---|---|---|
| **Onions 1978** | 1.34 | **1.49** | **1.54** |
| Lettuce **1979** | 1.32 | 1.44 | — |
| **Lettuce 1980*** | 1.38 | 1.39 | 1.47 |

*Sandy **clay loam** with pebbles.

In the ahove three trials and the 1981 parsnip trial the treated plots were at 121 13 per cent moisture content — below soil capacity, 17 per cent.

These deliberate compacting wheelings were done when weather and soil conditions were such that growers could well he tempted to go out and work land, with dry top soil hut wet underneath. Conditions when a 'pure' bed system is perfectly feasible but where a secondary cultivation could well he damaging if crops are to he grown above wheelings.

**1981** Parsnip Crop

This trial was conducted on a lighter soil, a sandy loam with pebbles hut relatively little clay content. Again the moisture content was 12.5 per cent when the wheelings in the growing areas were made. Within eight weeks of drilling there were visible differences in foliage growth. The figures at harvest (table 5) are quite spectacular and highlight the problems that can be caused by compacted soils on a deep rooted crop like parsnips, hut also showing that good crops can be obtained if such compaction is avoided.

Table **5—Yields** marketable **parnsips 1981**

| Treatment | **Harvests—yields t/ha** | | |
|---|---|---|---|
| | **1** | **2** | **3** |
| Control | 38.2 | 36.2 | 35.3 |
| **2 WSS** | 28.6 | 31.6 | 24.9 |
| **4 WSS** | 14.9 | 16.2 | 16.5 |

In 1982 we have repeated the trials on parsnips hut also used crisp lettuce, carrots and leeks as test subjects. Weather conditions in the spring of 1982 were a lot drier and warmer than those of the three previous years, so Luddington chose to carry out the wheeling treatments at lower soil moisture contents, namely 7 to 8 per cent.

The results are not yet complete, nor have statistical analyses been carried out but so far the figures are less dramatic than in the previous years, though the trends are still apparent. This indicates that damage to soil structure was less at 7 to 8 per cent moisture content than it was at 12 to 13 per cent which was expected. Thus at such moisture contents, growers and farmers can be less constricted in their use of machinery in preparing seeds beds for crops than at the higher levels.

In 1983 Luddington hopes to continue this work to try and locate the threshold moisture content figure at which damage to soil structure occurs and significantly reduces crop yield.

**A** further series of trials started in 1982 used a low ground pressure tractor, comparing this to a standard MF 550 for secondary cultivations and possible soil structure damage. If such low ground pressure vehicles are used and do not cause the type of crop loss mentioned ahove, then perhaps bed systems can he abandoned and with it one of the disadvantages of losing field area to the permanent (for the individual crop) wheelings.

This is a point of importance when growing crops at row spacings of less than 51 cm (20 inches), as in a bed 6ft wide, one sixth of the field area is lost to wheeling (assuming a 12in tyre). However, crops grown 61cm apart or more do not suffer in this way as the outer rows beside each wheeling can be at this distance without suffering ill effects.

In company with other countries, some work is also being done on wide beds to reduce the wheeled area and Luddington has a 2.3m wheel centre to centre tractor behind which a 2 metre power harrow can he used without obscuring the wheel markings.

Elsewhere, feasibility studies are heing made into the use of gantries from 3 to 12 metres wide which could also revolutionise crop growing. However, in the meantime, growers can avoid some of the compaction problems and improve both crop yields and quality by adopting the type of bed system described ahove.

***Picture 3. Apply fertiliser following the wheel marks.***

***Picture 4.** The final operation.* ***Drilling the crop.***

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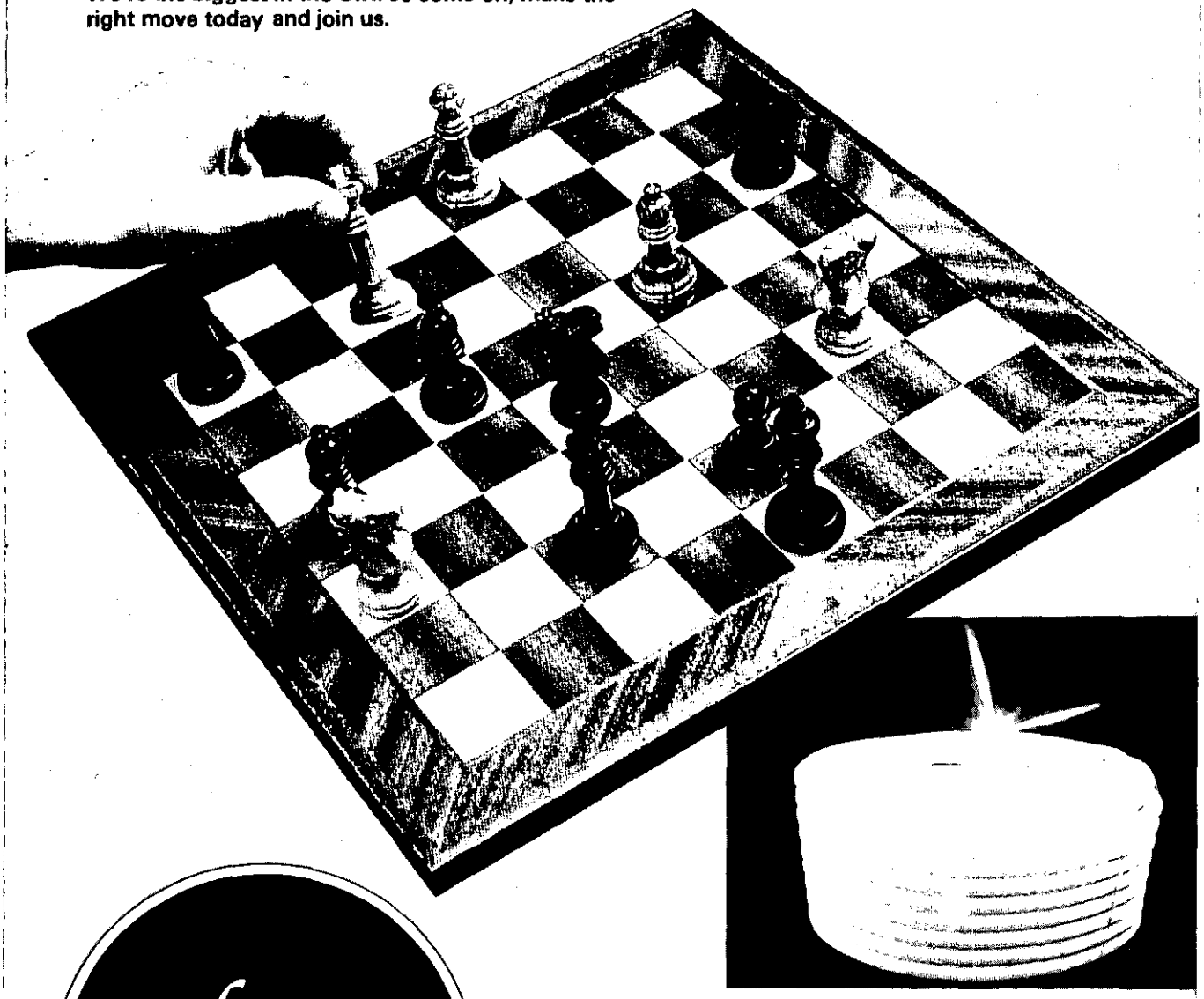



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VII-1

REVIEWED

# Drainage advice on film

THE MORAL OF the photograph shown right is that wet patches in a field breed weeds, not barley. North-west farmer, Mr John Kay, has now drained the area and is confidently predicting a 20 percent yield increase.

The picture is taken from "Here to stay", a new film programme about land drainage available on free loan to Young Farmers Clubs, Agricultural Colleges and other interested groups. Produced by the British Clayware Land Drain Industry, it should prove of great interest to all interested in or involved with land drainage.

The package is available in video cassettes, slide/tapes or as a 16mm film strip, and has been impressively put together, giving many examples of the benefits of drainage. A 36 page booklet backs up the presentation and includes comments from farmers and contractors on the subject and their experiences.

Mr Roger Joice, Chairman of the 1982 SAWMA Drainage Workshop, expresses his findings in the booklet. He states that through-the-crop drainage using open trench machines has increased overall production by up to 30 percent on his arable acreage. He has also been able to extend his cropping to include peas, potatoes and oil-seed rape.

## Savings

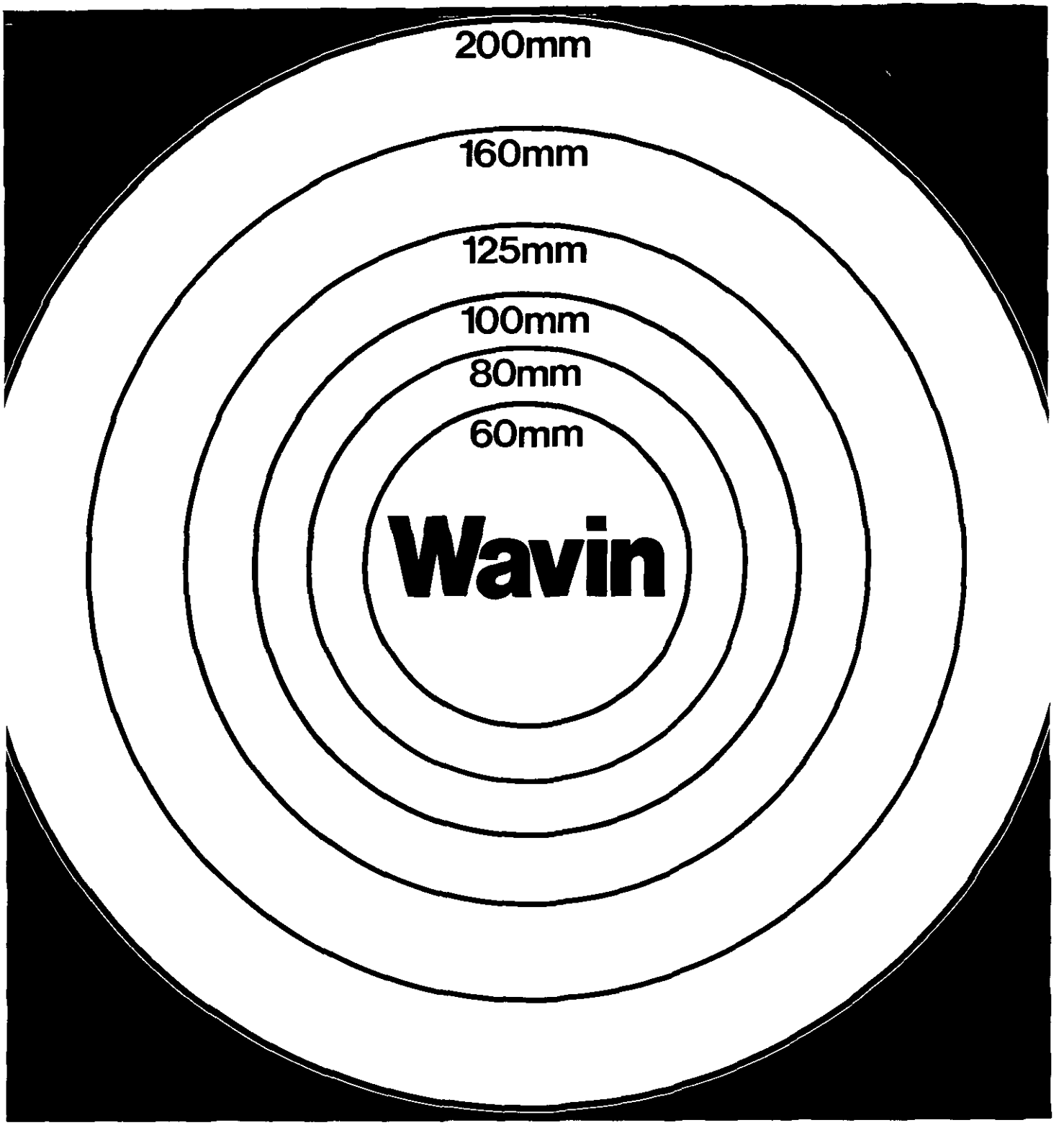
Also quoted is Mr David Edmunds from Hull. He put all his savings into the purchase of a 36 acre holding and the drainage of the land. He regards the drainage as the saviour of the land and is confident of getting his investment back in three years.

Contractors included in the programme are Bob Hutchinson from Littledale, Lancs and Bob Stuart from Fife, both of whom are extending the ways to get more work and top class results from their machines.

Although the pictures show no plastic pipe, (hardly surprising as it is a BCLDI production), the programme does cover many basic points concerning basic drainage principles. The message: 'If you want greater profits, then drain your land', comes over loud and clear at all times.

Due credit must go to the British Clayware Land Drain Industry for producing a well-nresemed and informative package. Further details on both the film and the booklet can be obtained from the BCLDI, Weston House, West Bar Green, Sheffield, S1 2DA.

*John Kay with the weeds that he predicts will be replaced by barley stubble next harvest. A scene from the new film produced by the BCLDI.*

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# The non-burning issue

***The ideal equipment for incorporating chopped straw into cereal seedbeds is not yet attainable, says Mr David Patterson, of the National Institute of Agricultural Engineering, but it is clear what implement actions are necessary. Future systems, he believes, will achieve cultivation, straw incorporation and drilling with only about half the total energy needed for some conventional techniques. The following article is reproduced from Mr Patterson's paper at the Oxford Straw Conference last year.***

IF BURNING of straw was restricted in the UK, many farms in the predominantly cereal-growing areas would have to incorporate whole straw crops in the soil. This would probably lead to wider use of straw choppers, deeper cultivations and a need for more power to avoid timeliness penalties.

There would he farms where the straw was baled and carted off, in which case it would be necessary to incorporate only the stubble into the soil. It is therefore important to distinguish between the two distinct sets of requirements: in one case cultivating and incorporating all the straw crop, in the other, cultivating and incorporating only the stubble. This paper concentrates on the incorporation of all the straw from a cereal crop.

Fig 1. Mean yield of winter wheat following different straw disposal methods at five EHF stations, 1974-76

| | Yield as % of yield after burning | | |
|---|---|---|---|
| | Burned | Baled | Chopped |
| Ploughed | 100 ⊥ | 91 ⊥ | 91 ⊥ |
| Cultivated | 100 ⊥ | 87 ⊥ | 89 ⊥ |
| Direct drilled | 100 ⊥ | 78 ⊥ | 78 ⊥ |

## Straw pre-treatment

The simplest aid to disposing of the whole crop of straw is the straw spreader, but there are few cultivation implements that would be able to operate into uncut straw.

When incorporating the total crop of straw, chopping will be vital for satisfactory incorporation of all the straw residue with the soil. Choppers may be mounted on the combine harvester or trailed behind a tractor — when chopping becomes a separate operation. As modern combines generally have sufficient reserves of engine power, a combine-mounted chopper has obvious advantages of timeliness. Also, the chop is finer and requires less power than with trailed units, as the straw is in a more suitable condition at the time of harvesting.

In experiments carried out at Hohenheim, Germany, straw chopped to lengths up to 2in (50mm) was mixed into a greater depth than material lengths in the range 6 to 8in (150 to 200mm). These results confirm that straw needs to he finely chopped.

A further aid to successful incorporation is a short stubble, and implements with a swinging flail or knives rotating about a vertical axis are effective without requiring a high power input.

## Specification for cultivation equipment

Most of the experiments carried out in the UK by ADAS, Letcombe Laboratory and other centres have shown that poorer cereal yields occur when incorporating straw residue compared with burning. The yields obtained in ADAS experiments are summarised in Fig 1.

The largest yield reduction occurred on heavy land in wet years, and it was deduced that the most likely cause was straw toxicity. Work at Letcombe Laboratory has shown that decomposition of straw by bacteria under wet, anaerobic conditions causes the production of acids which inhibit root growth and early seeding development. Further studies at Letcomhe have shown that this difficulty can he reduced by early shallow cultivation. If this operation had been carried out in these early experiments at different centres, higher yields may have been obtained.

In Sweden, Germany and other areas where straw residue is incorporated, it is normal practice to carry out tining operations to mix in the material immediately after harvest. This is followed by ploughing at depths of 20 to 30cm, the greater depths being used on the lighter, fertile soils to provide reservoirs of moisture for deep rooting. Studies at Hohenheim have shown that minimum depths of about 15cm are necessary to obtain maximum straw decay (Fig 2).

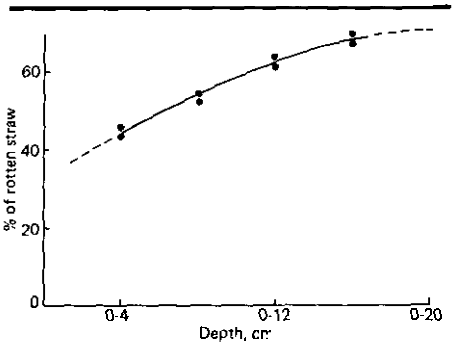


Fig 2. **Effect** of depth of straw incorporation on straw decay (after seven months) — Hohenheim 5.0t/ha chopped straw

Experiments examining the required dilution of soil to straw are currently being undertaken by Letcome Laboratory and Ministry Experimental Husbandry Farms.

What should the aim be in designing cultivations for successful incorporation? Taking account of the aspects so far known (more information is required for UK conditions) the ideal number and type of cultivation operations is shown in Fig 3.

This sequence of operations also allows a degree of weed control by an early stubble cultivation, although additional

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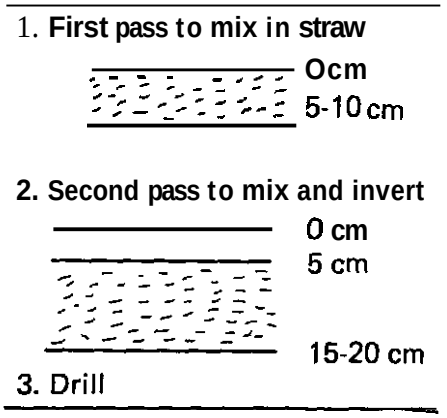
Fig 3. **Ideal** system (not ***attainable*** yet)



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spraying may be required. In practice, two initial passes may be, necessary and we may not be able to achieve the inversion set out under the second pass. But it will be vital to minimise the quantity of straw in the top layer to allow the passage of drill coulters without blockages.

## The performance of existing cultivation equipment

Mixing in of chopped *straw*

There is a wide range of implements that will mix in chopped straw. Tandem discs provide good incorporation of crop residue, and are widely used for soil cultivation. Poor penetration and soil compaction can occur under adverse conditions.

Heavy duty spring tines or fixed tines provide a degree of mixing, but little burial of material is achieved. Combinations of tines and discs, as in the Tillage Train, provide good incorporation and mixing, and overcome many of the disadvantages of discs and tines when used separately.

Rotary cultivators fitted with L-blades provide good incorporation and mixing, but work rates are slow; the spiked rotary cultivator does not incorporate satisfactorily

Inversion of chopped straw

Ploughs produce complete burial of straw residue but there is little mixing of straw with the soil, and work rates are slow. Shallow ploughs provide higher outputs, but poor penetration and ground contour following somewhat restrict their use. Following a previous shallow cultivation to mix in straw, however, penetration problems would be reduced.

The Rotadigger provides good incorporation and mixing, particularly when soil conditions are moist. As this implement has good work rates and an ability to work in a wide range of conditions, it has obvious potential in straw residue.

## Energy requirements

Figs 4 and 5 show power requirements and output potentials for selected cultivation systems on clay soil, and indicate the difficulties of using a plough system on heavy land, particularly the slow output of the plough and the need for high energy input of secondary cultivation to obtain a suitable tilth for winter cereals. System 3, operating at depths of 5 to 10cm is unlikely to be suitable for straw incorporation, but system 4 is likely to be the minimum number and depth of operations and provides satisfactory work rates. System 2 provides intermediate results.

## Future opportunities

Straw chopping

The available evidence and experience of farmers practising straw incorporation is that short chop length is vital for successful incorporation. In the UK there

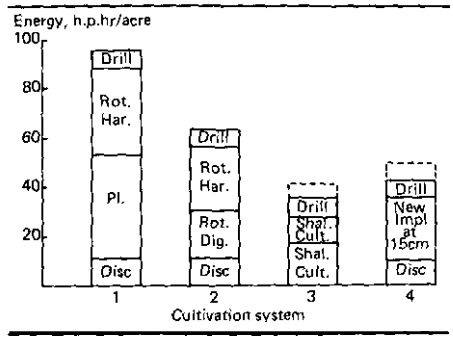


Fig 4. Energy required to incorporate chopped straw (Clay soil)

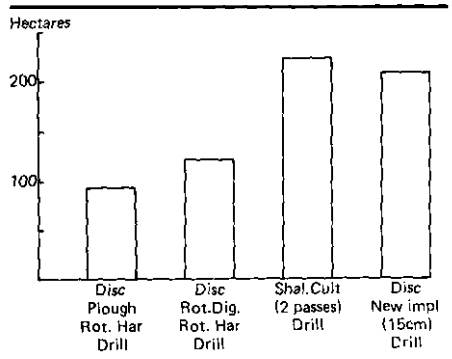


Fig 5. Output potential of cultivations systems (Clay soil)

are about 50 Claas combines fitted with straw choppers, whereas in Germany and France 80 percent of all combines are fitted with them. So, if burning was restricted in the UK, there should be an obvious move in this direction.

Cultivation equipment

The vital need is for equipment that is capable of mixing in and incorporating straw residue thoroughly so that very little material remains in the top layer of soil.

Variants of the Tasker Tillage Train have obvious potential and the Mulch Train consisting of chisel discs, shallow tines, deeper tines and a second set of chisel discs is capable of deeper operations with a good mixing of crop residue.

The Glencoe Soil Saver, using a combination of vertical cutting discs and an angled share, aims to provide more inversion and burial of straw material.

At the NIAE there are a number of projects aimed at developing improved equipment for straw incorporation. One machine is a rotary cultivator fitted with alternate rotor blades and stationary tines, and this is providing good potential for straw incorporation. Also field experiments at the NIAE and other Government establishments are examining the suitability of different cultivation systems for straw incorporation.

It is hoped that this work will lead to further suitable developments, so that if burning of straw residue is restricted, farmers will have an armoury of cultivation equipment that can function satisfactorily in straw residue. However there is likely to be a requirement for a little more horsepower in tractors to ensure that timeliness of work for winter cereals is not reduced, particularly on heavier soils.

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The Chisel Discs which, with *the* addition of *tines* form the Mulch *Train*, capable of deeper *working* and better straw-mixing and incorporation than the Tillage Train.

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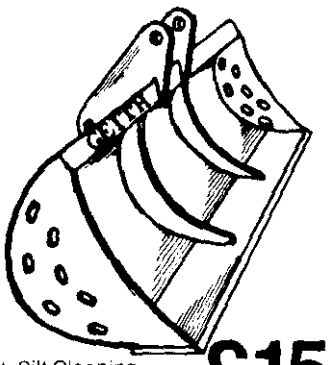


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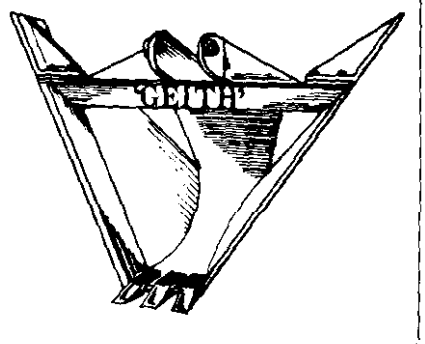


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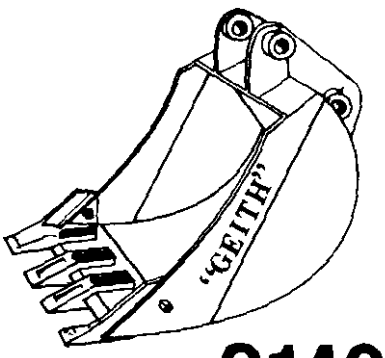


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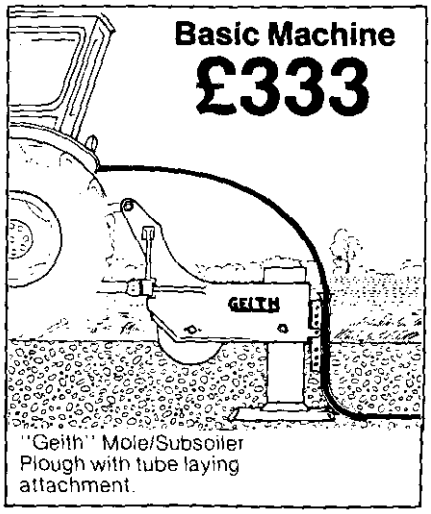


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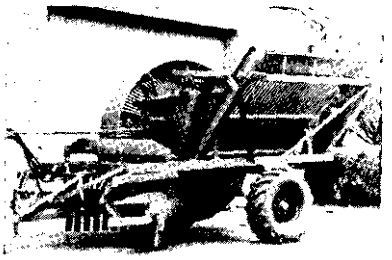

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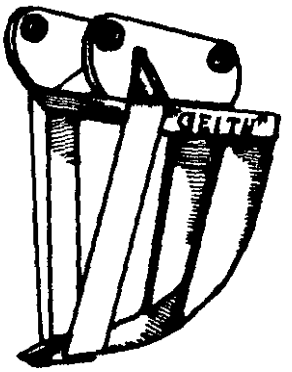


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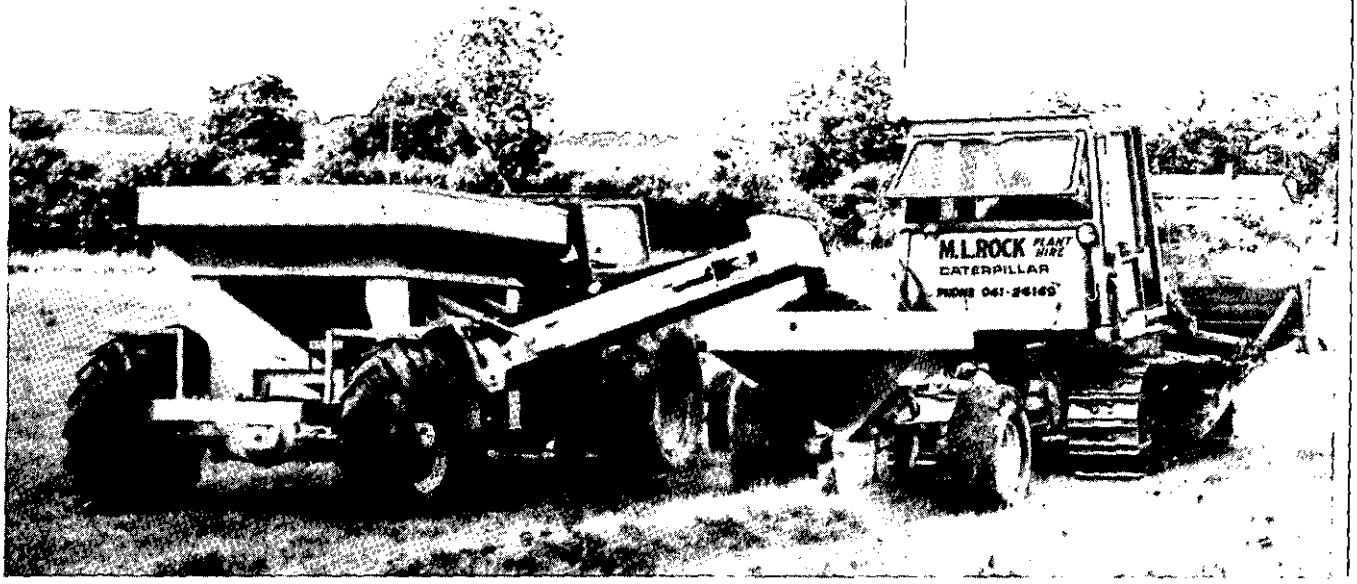

# DIARY

FEBRUARY 1983

**2** Chalk Soils Management — High Post Hotel, Salisbury, organised by ADAS and Chalkland Cereals Group, with SAWMA

**2–4** Yield of Potatoes — Organised by Cereals Unit, RASE, to be held at Peterborough

**S** Restoration of Land to Agriculture — RASEIADASISAWMA, at the NAC

**10** Soil Structure — S.W. Regional, IAE, Barnstaple

**15** Inefficiency in Nitrogen Use — SCI Agricultural Group with the Fertilizer Society, London

**16** Making Irrigation Pay — Organised by the UK Irrigation Association at the NCAE

**21** Straw as a fuel and a valuable resource in agriculture — S.E. Midlands IAgE Branch Meeting at NCAE

**28** The Advantages of the Paraplow and Ploughing — W. Midlands IAgE Branch Meeting

MARCH

2–3 Soils Workshop — RASEIADASISAWMA at the NAC

**16** Weed Research Organisation Visit — SAWMA AGM

**25–27** ICID Weekend meeting visit to Hydraulics Research Station and Institute of Hydrology, Wallingford and FDEU Research Unit, Faringdon — ICID, Institution of Civil Engineers, Gt George St, London SW1P 3AA

APRIL

**6–8** Soil Water Meeting — BSSSISAWMA, at Sutton Bonnington

**19** Plant Growth in Stress Conditions — SCI Group, London

For further details, contact SAWMA, tel 0203 555100.
A national calendar of agricultural events is available from the Conference and Exhibitions Manager, RASE. National Agricultural Centre. Kenilworth, Warks CV8 2LG, at £2 incl p&p. Please send cash with order

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'Soil and Water', the Association's journal, provides a similar outlet for the exchange of views and realises the need for down-to-earth comprehensive coverage of soil and water topics.

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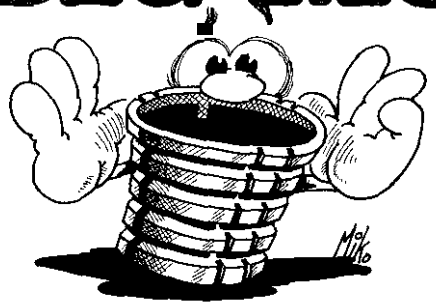

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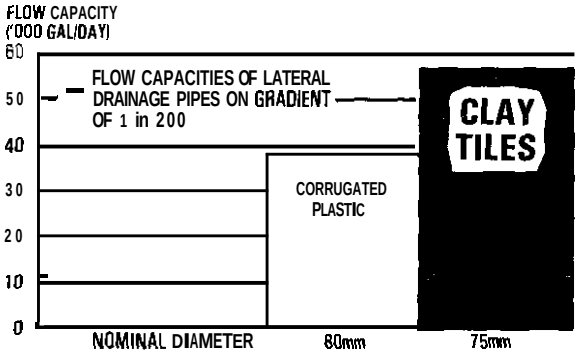


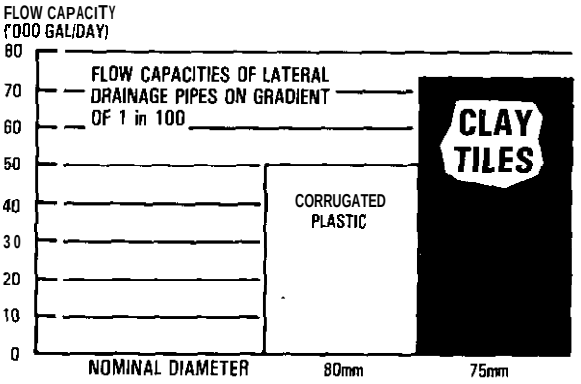


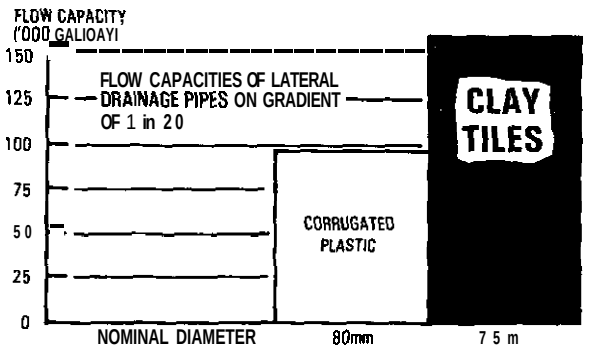


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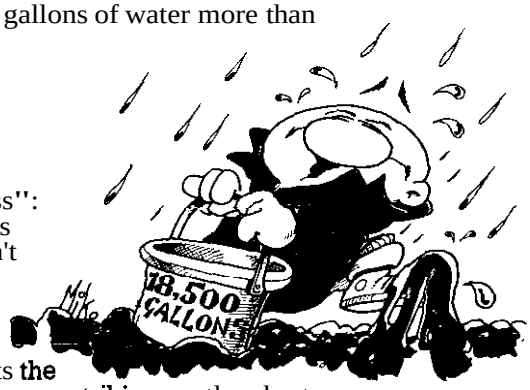


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