Soil and water

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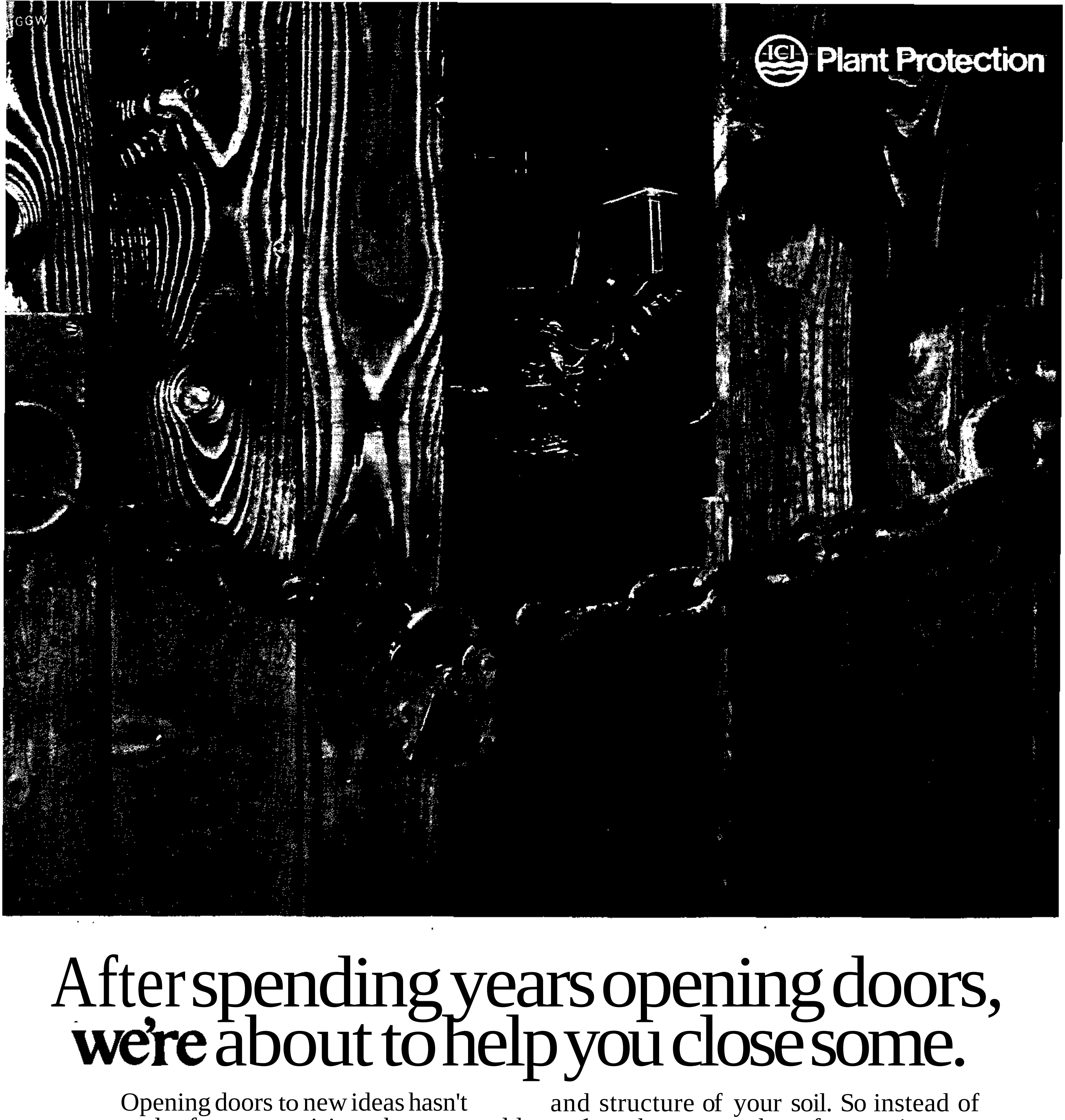

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SOIL and water
THE MAGAZINE ON SOIL CONDITION AND FERTILITY
Volume 12 No 1, September 1983
SOIL AND WATER is the Journal of the Soil and Water Management Association. The views expressed in this publication are those of the contributors. The publishers disclaim any responsibility whatsoever arising from the use of the information contributed.
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COMMENT

Promise of growth

IN THE few months since SAWMA moved to its present offices, the Association has taken part in more outside events than seemed possible at the beginning of the year. Starting with the Farmers Weekly International Drainage Event, we have been represented at no fewer than eight public shows or demonstrations.

Without exception, the volunteers manning our stands have been much encouraged by the interest and support they have experienced. Many new members have been enrolled at these events, and further confirmation has been received that an extraordinarily large number of people in the farming community are aware of being constantly short of information on some aspect or another of their soils. There is a real need, and much for us to do.

Our main means of providing the information that is in so much demand is this journal, which — having been successfully re-launched with this issue — we can expect to expand in both quantity of content and in influence during the coming year.

One of the important functions of Soil and Water during that year will be to collect and pass on information on the research work currently being carried on in this country into aspects of soil condition, structure, management and fertility. Many of the answers needed by the visitors to our stands at the summer shows and demonstrations are suspended somewhere between the researcher and the farmer, and we will use the journal to help bring this knowledge into the possession of those who can put it into practice.

Enthusiasm for the Drainage Workshop

Great appreciation has already been expressed at the news that there will be a Drainage Workshop again next January. In this we are grateful to have the backing and the participation of the National Association of Agricultural Contractors.

An enormous amount of preparatory and organisational work has already gone into the Workshop, much of it from the same hard working Council Members who have been responsible for the success of previous events. The care that has gone into the programme shows in its quality: the more closely it is studied, the more compelling it becomes.

Once the Workshop has been brought to a successful conclusion, we will expect to be planning for an even fuller programme of events next year, including a Spring Conference of our own. This will be the start. The future is full of promise for the continuing growth of the Association and success in our aim of making available more information about the management of the soil. That we are so optimistic, so soon after becoming fully independent for the first time, is a tribute to the work and patience of our most active members.

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1 to disc on g

Workshop opportunity to promote drainage

Next January's Drainage Workshop will be taking place at a time when there is even more to discuss than usual. In particular. what is to be done about the fall-off in the area of drainage schemes being undertaken?

One argument is to the effect that drainage is just one of the many items that farmers and land owners are avoiding or delaying as a reaction to feelings of uncertainty about profitability. Many readers, apart from drainage contractors. could put forward good reasons why drainage should not be delayed or avoided, and it will be surprising if these are not well aired in January in Stratford upon Avon

Welcome involvement

It could not have been more appropriate that the National Association of Agricultural Contractors should be so involved with the Workshop — as backers and supporters. co-organisers and participants. Drainage contractors never had greater need of their association, and it should become clear to them during the Workshop, if it was not already clear before, that a concerted effort is necessary to present the case for drainage to farmers, and that the NAAC exists for just that sort of purpose. Drainage contractors have a marketing job to do. and should be making sure that their association is encouraged. provided with the necessary resources and assured that the work it has to promote is of a high standard.

Practices questioned

This requirement arises. however. at a time when there is widespread discussion about standards. both of scheme design and installation. and more questioning of established practices than we have heard before. Passing to farmers the responsibility for deciding on the merits of the schemes proposed for their work by contractors has proved a great stimulant to re-examination and reassessment of the way farm land should be drained.

Such a situation is one in which both farmers and contractors have more than ever to gain from a strong association concerning itself with standards.

We will hope to find that the Drainage Workshop has played a part in promoting marketing effort by the NAAC on behalf of its members in the drainage business. and in convincing farmers that membership of his association gives a measure of assurance about a contractor's acceptance of responsibility for the work he undertakes.

One matter that is not due for formal discussion but is a cause for concern is the subject of plastic drainage pipe quality.

BS4962 sets out the British Standard Institute's recommendation for the specification of plastic drainage pipes. and that is what the farmer would be well advised to ask for. There is little point in spoiling an investment such as drainage through failure to ensure that adeauate quality of pipe is installed.

If in any doubt that pipe delivered for a drainage scheme is of good quality, a sensible first step would be to ask for written confirmation that it complies with the British Standard.

New opportunities?

While agricultural drainage is being carried on at a lower than normal rate. contractors naturally look at the opportunities for work outside farming. There have been examples of cases where this has paid off. but it is now argued that the scope is greater than ever before as a result of the availability of the small diameter pipe — 35 and 50mm — used in close-spaced schemes. What has been suggested is that there is an almost untapped market for small pipes in playing fields and racecourses. for example.

It is an intriguing part of the argument that where public events that attract large crowds are held, close-spaced drainage systems might even have a dual or triple role, being used for drainage. irrigation and for frost protection — carrying warm air under the turf.

Aerial revelations

Taken just before harvest this year, this aerial view shows a serious cereal crop failure on a field in Oxfordshire which was drained in 1978 with pipes laid at approximately 20-metre spacing and cross-moling. It was concluded earlier this year that the mole drains had failed, and that there was no point in re-moling. Instead, a close-spaced scheme has heen installed, with **35mm** pipes at **3m** spacing and at depths down to **690mm** — shallower than the **20m** scheme. This had just been completed when this photograph was taken.

The pale areas of the photograph — the left and upper right — show the ground through the sparse crop, while the outline of the **20m** scheme pipes can he seen in the pale lines.

It has been pointed out that if re-moline had heen the course chosen, it would have heen extremely difficult to know where to–draw them. and attempting to do so would have led to the creation of many intersections underground. The simpler the scheme, the less the likelihood of this problem. but in all cases, a record should be kept of the directions in which moles were drawn.

ell developments

Furrow presses, big new reversible plough and a range of implements

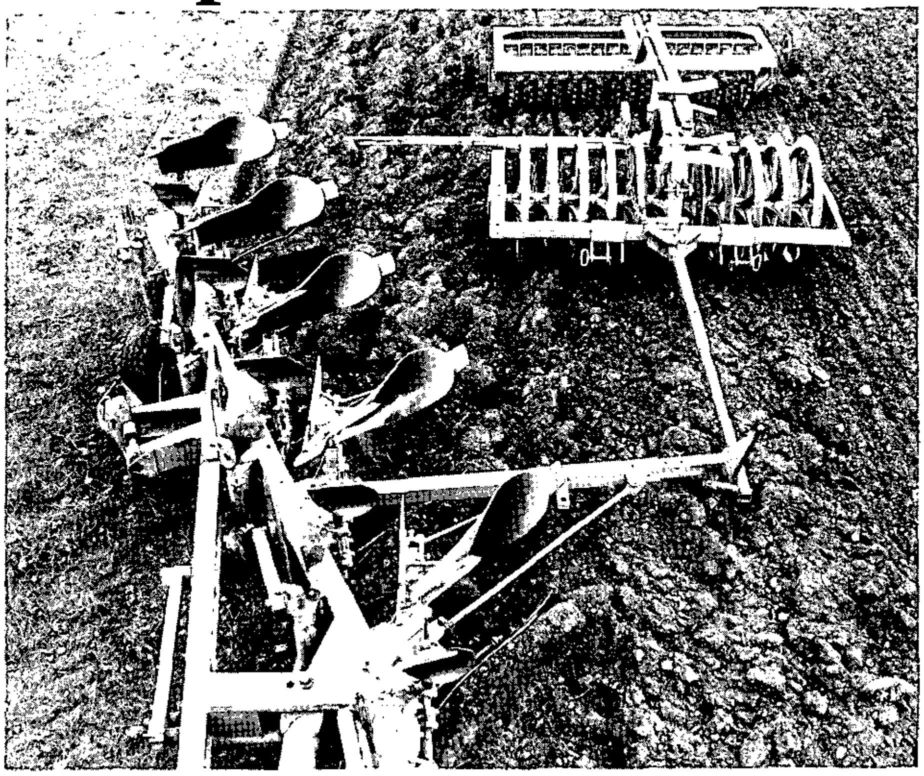
Arrangements to import a range of German furrow presses to suit their plough range, the addition of a new six or seven-furrow fully mounted reversible to that range, the introduction of their own cleverly designed trash boards for SCN and UCN plough bodies and last but not least, the purchase of the Pettit implement range and name have been the main items in a remarkable burst of activity from plough manufacturers Dowdeswell Engineering Co Ltd.

Having expanded his business steadily since his first plough was built in the late sixties, but without becoming involved in any products other than ploughs, Roger Dowdeswell was in the early stages of planning an implement range when the opportunity arose to take on the established Pettit equipment. It was seen as an ideal chance to enter a new area of the market with a range already well tried and proven, and including robust equipment such as disc harrows for tractors of up to 225kW (300hp).

Although in Roger Dowdeswell's view, the ideal straw incorporation implement is the plough, he is also expecting to see the powered cultivator of the Pettit range, the Gyra Spike, achieve good results.

Improved straw incorporation performances with ploughs are the aim with both the new Dowdeswell trash board and the furrow presses. The trash boards are a good example of Dowdeswell ingenuity and economy, being simple, easy to fit, adjustable and inexpensive. They are supplied in kits for SCN and UCN bodies, each kit comprising an extended shin and a curved trash board which attaches to the top of the shin, above the mouldboard. The leading edge of the body is left clear, so that there is nowhere for trash to collect, and the full depth of the body is unobstructed, so that soil rises to the top of the body and gives good trash burial. Straightforward design and economical manufacture have kept the price of the trash board kit down to £15 per furrow.

Simple and economical, the Dowdeswell trash bourd for UCN and SCN bodies attaches to an extended shin.



Dowdeswell-Tigges single furrow press and crumbler with a five-furrow plough. Advantages claimed include reduction in moisture loss, quicker and easier seed bed production and a firmer seed bed, particularly when incorporating straw.

In importing the West German-built Tigges range of furrow presses, and the soil crumblers that may be used in tandem with them Dowdeswells are reacting both to requests from their plough users and their own assessment of a need.

The main advantages of the use of heavy furrow presses — reduction of moisture loss from the soil and the production of a firmer seed bed — are especially valuable when ploughing early after harvest and incorporating straw in the inverted soil. The presses and crumblers, which are available for every Dowdeswell plough width, are also expected to reduce the secondary cultivation necessary to produce a seed bed in most conditions, to speed up the work and to improve timeliness. Further results include improvement of germination and — where it is a problem — reduction of wind erosion.

A mid-range single-furrow press and crumbler combination to match a five-furrow plough costs £2,286.

Designed to bring fully mounted convenience to tractors of 117kW (150hp) and more, the six or seven furrow new DP7F reversible from Dowdeswell can be fitted with a headstock to suit any standard quick hitch system fitted on high powered tractors.

The DP7F has UCN bodies and reversible points. Standard clearances are 838mm (33in) point to point and 660mm (26in) under beam; versions with extra clearance are available.

The six furrow model fitted with skim coulters sells at £5,471, the seven furrow version £6,063. An optional rear disc adds £150 to the price, and knife coulters for the other furrows, as for all other Dowdeswell ploughs, are priced at only £4.50 each.

Dowdeswell Engineering Co Ltd is based at Blue Lias Works, Stockton, Rugby, Warks.

STRAW CONFERENCE

Incorporation of straw into heavy soils is to be the subject of the first in what is planned to be a series of annual two-day 'workshop' events organised by the National Agricultural Centre's Arable Unit.

Papers, posters and a farm visit will be features of the Workshop, which will aim to review this year's experiences in working straw into clay soils. The event will take place on 14 and 15 November, at the De Vere Hotel, Coventry.

Enquiries should be addressed to the Arable Unit, National Agricultural Centre, Kenilworth, Warks CV8 2LZ.

V12-1

Mk II version Earthquake has economy points

Bomford Eathquake. The new *beam* of *the* Mk *II version allows* tines to be fixed *at any* point along *its* length.

Provision of weight trays and a greater choice of tine positions on their Earthquake subsoiler. and packer rollers and a straw screen on their Dyne-drive ground-powered cultivator have extended the flexibility and the straw incorporation capabilities of the Bomford & Evershed Ltd range of cultivation implements.

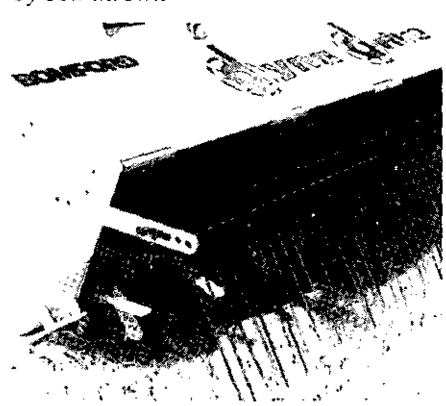
The improvements to the Earthquake flexible-tine subsoiler are incorporated in the Mk II version. Tines may now be positioned at any point along the simplified main frame, rather at fixed locations. The tines are now shear-bolt-protected.

With its slim steel alloy tines. the Earthquake is designed to keep down power requirement. and its economically priced wearing parts also help to limit the costs of cultivation. A tine shin. for example. costs no more than £7.96. a tine point £5.04.

Packer rollers for the Dyna-drive cultivator are designed to crush clods and firm seed beds before drilling, and fit on the same attachment brackets as the crumbler roller option. The straw incorporation screen accessory for the machine is more unusual. It comprises a series of closely spaced, long and straight but springy tines fitted across the rear of the cultivator. What happens if you use the Dyna-drive at the right inclination. Bomfords say, is that straw thrown against the screen by the rear rotor is mostly held by the screen, and falls to the ground, to be covered by soil passing through the screen.

This effect. it is claimed. is achieved with the machine tilted forward, so that its front rotor engages firmly with the soil and is driven at ground speed. The rear rotor is then driven by the front tines at three times ground speed, and throws straw, as well as clods. against the incorporation screen. That is the second pass; ideally. it is suggested, the cultivator should make a preliminary run with its chain case roughly level with the ground. At this angle. the front rotor turns at much less than ground speed, producing a shallow tilth and starting the process of straw incorporation.

Straw incorporation screen for *the Dyna-drive.* It holds *larger* pieces *of straw and leaves them at ground level, to be covered by soil thrown through the screen.*



Big fixed-angle discs

Fixed angle disc harrows. used widely in North America but unusual in Britain, have been introduced in the UK by Flexi-Coil UK Ltd. Seaton Ross, York, as the 3590 series Straw Dog.

The 610mm (24in) diameter front gang discs of the Straw Dog. spaced 9in apart. are set at an angle of 20 degrees to the line of draught. The slightly thinner rear discs are of the same dismeter as the front gangs, but are at 8in spacings and at an angle of 17 degrees. Erasing discs are built into the rear gangs.

Power requirement for these discs is roughly 8hp per ft. (20kW per metre) say Flexicoil, who make five widths. from 7.16 to 10m (23ft 6in to 32ft 6in). All fold to 3.5m (11ft 6in) for transport. Prices range from £16,800 to £21,000 delivered in mainland UK.

Among many crumbler-landpackers introduced in recent months by the active Flexi-Coil concern is a continuous steel coil-type replacement for use with the 3m (9ft 8in) Maschio power harrow that is used with Ferranti Accord pneumatic seed drills. Similar units of 3.5 and 4m width are on the way. The 3m unit costs £590 delivered in mainland UK.

Resistant pumps

Diaphragm versions of their Pygme and Variflow plunger pumps have been introduced by Richard Grosvenor & Co Ltd, 21 Woodthorpe Road, Ashford, Middx. The diaphragms are of PTFE, the pump heads of polypropylene and the ball valves of glass, for resistance to corrosion.

Matching moles paired

A linking system has been developed by Michael Moore Moles so that two of their Easy Moles may be used side by side. The company is based at Foxhall Road, Southminster, Essex CM0 7LB.

New drainage book

A text book on the design of field drainage systems, written by ADAS Land and Water Services advisors. is now available from HMSO, or from MAFF (Publications), Lion House, Willowburn Estate, Alnwick, Northumberland, NE66 2PF, price £15.95.

The contents follow the field drainage design process systematically through the stages of the site survey and soil examination, choice of drain layout, depth and spacing, and determination of pipe sizes. The main theoretical aspects of water movement in soils and pipe hydraulicsare covered and the emphasis throughout is placed on demonstrating how theory is put into practice.

A special feature of this book is its presentation of new ideas on the design of field drainage pipe systems. arising from research by the MAFF Field Drainage Experimental Unit at Cambridge.

The editors of the book are Mr Douglas Castle, head of the FDEU. Mr James McCunnall, until recently Regional Drainage Officer for South East England, and Mr Ian Tring, Head of Field Engineering with LAWS.

Drainage Workshop '85

High standards of drainage installation theme at January 1985 event, which receives NAAC backing.

HOW to maintain high quality work standards will be the vital topic for many of the speakers at the SAWMA/NAAC Drainage Workshop in Stratford upon Avon next January 22-24. The second main subject is to be 'Planning for Profit'.

A distinguished cast of speakers for the Workshop includes well known personalities from research and advisory fields. as well as experienced contractors. A guest from the Netherlands, Mr W. Naarding, of the Dutch Land and Water Service, will be a principal speaker on the subject of quality of installation work, explaining the duties undertaken by government agencies in maintaining and monitoring work quality standards in Netherlands drainage schemes.

As is customary, the Workshop's introductory paper will be a review of recent developments given by a senior figure in the drainage industry in the late afternoon of arrival day, 22 January. In this case, the speaker will be Mr Brian Trafford, of the Land and Water Service of the Ministry of Agriculture, one time head of the Farm Drainage Experimental Unit, Cambridge. Mr Trafford will not only review developments of the past two decades, hut will discuss future prospects as he sees them.

During the first morning, emphasis will fall on the management of drainage contracting business, particularly the marketing of the service and the costing of installation work.

The viewpoints expressed will be those of lan Crawford, of Silsoe College, Steve Crowther of ADAS and Richard Warburton, of Agripower Ltd.

Both control of quality and the limiting of costs will be the concern during the first afternoon, when a wide range of machines will be appraised, both from the point of view of their work quality and their efects in terms of soil damage.

An absorbing session, with both wit and controversy as well as extremely useful practical information, is expected on the second full day, when an insurance broker takes the chair for papers by officials from British Gas, the Electricity Council and a Water Authority. Contractors will have the chance to auestion representatives of the utilities about procedures for avoiding and overcoming disasters with undereround services in the field and at the roadside.

Comparisons between the training given to operators in Canada, France and the UK will be made during papers on operator training by Dr Fry, of the National Association of Agricultural Contractors, and Mr Tony Horsfield, of the Agricultural Training Board. A complete training plan for the UK drainage industry is to be presented in Mr Horsfield's paper. *Programme details page 16.*

Short courses at Silsoe College

Three short courses in the series run jointly by Silsoe College and SAWMA are planned for the forthcoming winter programme.

Irrigation: Principles and Practices (17-19 December 1984)

The course in intended primarily for farmers and growers in the UK, but advisers, equipment manufacturers and distributors have also found the programme of value. It aims to provide a basic understanding of irrigation principles and practices and to assist irrigators in improving their water management techniques.

Subjects covered will include:
Soil/plant/water relationships
Irrigation scheduling
Assessment of soil moisture content
Basic irrigation hydraulics
Irrigation equipment selection and management
Farm case study
Crop responses to irrigation
Irrigation economics

Soil Management (7-10 January 1985)

The arable and grassland farmer dare not ignore the problems of soil management and so the primary object of the course is to help farmers and growers understand its many aspects. Implement manufacturers, contractors and consultants will also find it of considerable interest and value.

Subjects covered will **be:**

1. Soil management and crop requirements
   (a) Soil physical conditions for efficient crop production
   (b) Soil physical properties influencing root development. aeration and water movement
   (c) Soil/plant/water relationships
   (d) Soil fertility
2. Identification of soil management problems
   (a) Soil examination
   (b) Techniques lor identification of soil structural problems
3. Minimising problems through management
   (a) Soil behaviour when loaded
   (h) Use of irrigation
   (c) Need fur drainage
   (d) Traction and compaction principles
   (e) Selection of tyres and ballast for optimising performance
   (f) Implement positioning nnd controlled traffic
4. Mechanical alleviation of problems
   (a) The effect of implement geometry on soil disturbance
   (b) Determination of tillage requirements
   (c) Implement selection
   (d) Selection of subsoiling equipment
   (e) Farm operational planning

Field Drainage: Principles & Practices (7-10 January 1985)

The course is designed for those engaged in the design of field drainage schemes for farmers and growers in the UK. It provides training in the theory, design and practice of field drainage, so that participants will be able to design a field drainage scheme from first principles.

The course syllabus will **include:**

The role of drainage in agriculture
Drainage problems and possible solutions
Soil texture, structure and profile description
Approaches to drainage design
Underdrainage design — depth, spacing and pipe sizes.
Water entry into pipes, permeable fill functions and design of open channels
Design of piped ditches
Pumped drainage
Mole drainage and subsoiling
Workmanship and materials
Drainage machinery.

A special reduction on the above mentioned courses is available to SAWMA Members.

V12 - 1

Incorporation combination

A straw chopping, soil mixing combination of heavy duty trailed discs and deep-working, soil-loosening tines is the latest F. W. McConnel development for straw incorporation. Their new Disc-Tine cultivator, as it is called, isintended for use on both stubbles and chopped straw field surfaces.

Comprising a leading, single row of scalloped, dished 710mm (28in) diameter discs followed by a close-coupled two row Commando-Shakaerator frame equipped with up to 13 shanks and rear roller, the Disc-Tine is claimed to provide "a progressive soil-working action with thorough chopping, mixing and incorporation of surface residues and simultaneous treatment of soil compaction."

The prime objective of the new implement is to chop and mix straw and stubble into the top 150mm (6in) of soil to allow the rotting process to start well before final seedbed preparation or drilling.

During development, McConnel engineers concluded that heavy discs provided the answer for optimum straw chopping and incorporation, with following tines fitted to remove soil compaction. The tines also increased down force on the frame to assist disc penetration and chopping ability.

Two widths of Disc-Tine cultivator are available, 3.7m (12ft) and 4.5m (14ft 9in) units to match the largest Commando Shakaerators. Either 450mm (18in) or 600mm (24in) soil-working shanks can be fitted to the frames, the 3.7m unit carrying up to 11 shanks, the 4.5m implement a maximum of 13.

Another McConnel combination, the Shakaerator-Tillaerator, was adjudged winner of the prestigious Rohert Barrow Award for developments in straw technology at this year's Royal Show, in an entry of 25 machines and combinations.

Mr Jim Barr, managing director of F. W. McConnel Ltd, receiving the *1984 Robert* Barrow trophy from Mrs Edmund *Vestey* during this year's Royal Show.

Research at the Macaulay Institute

Summaries from the recently published 1984 Annual *Report* of the Macaulay Institute for Soil Research, *Craigiebuckler,* Aberdeen.

Soil fertility information system

Information on soil analyses from the three Scottish Colleges of Agriculture is to be recorded on micro-computers at each college, then fed into the Macaulay Institute's main computer. This project will provide a soil fertility data base for Scotland as a whole, detailing trends in soil nutrient status by district, farm type, soil type and fertiliser usage.

Nitrogen for winter barley

On the basis of 22 experiments over three years on sites with a low to medium nitrogen status, an average spring nitrogen dressing of about 180kg N/ha is recommended for winter barley crops. There is no indication that more N is required when high yields are attained; only that high yielding crops make more efficient use of N.

Ochre in field drains

The use of coniferous hark in field drains to prevent their blockage by iron ochre has continued. In a field trial near Turriff, drains have now been kept open for 18 months where previously ochre formation caused blockages twice per year. The bark should be weathered in the open air for at least three months before placement in the drains, to prevent subsequent foaming of the drainage water.

Gems image processing system

Multi-temporal space imagery is used in the Gems image processing computer system recently acquired by the Institute. It is used to interpret and display data from Landsat satellites, and, it is hoped, in the future, from the French satellite SPOT. It will be used to develop techniques to map and monitor agricultural crops, peat and other land resources.

Trace **elements** in soils – new analytical technique

A new method of analysis (inductively coupled plasma optical emission spectrometry) has been introduced for elemental analysis. Initially it is being used for the determination of Ca and Mg in crop samples as well as for analysing top soils. It provides simultaneous multi-element analysis and because of its high operating temperature, 6000 degC, is relatively free from chemical interference. Information on trace element contents of soils is stored in the Institute's soil data bank.

Trace element contents of herbage crops

Many years' work on trace elements in herbage crops has now been summarised, and confirms that imperfect and poor pedological drainage conditions increase trace element (cobalt, copper and molybdenum in clover and grass) availability in herbage. It is also confirmed that high levels of added nitrogenous fertilisers reduce trace element contents of herbage, mainly by eliminating clovers from the sward.

Many other findings of concern to those interested in all aspects of soil science were revealed in the annual report. Further information can be obtained from Miss E. M. Watson (information officer) at Aberdeen (0224) 38611.

Blockage seeker

Measuring only roughly 25mm (1in) long by 12mm (½in) diameter, the latest micro transmitter for the Woodbridge Electronics Tracka drain and pipe tracing system can be mounted on jetting heads used for long inspection runs in drainage systems with little effect on the performance of the jetting equipment. The transmitter weighs just over 31gm (1oz).

Transmissions from the Woodbridge micro can be sensed by the company's standard receiver through no less than 3.6m (12ft) of concrete. The receiver indicates the position of the transmitter by emitting a tone which rises as the carrier moves nearer to it.

Distributors for the Tracka range, which includes long lasting static markers and transmitters suitable for use in sewers and drains as much as (7.5m) 25ft below ground, are being sought by the manufacturers, Woodbridge Electronic Services, 102 The Thoroughfare, Woodbridge, Suffolk IP12 IAR.

Computer services

Training courses for computer users, computer time hire and business programmes for a wide range of purposes are now offered as a new venture by Multi-loader Ltd, better known for backfill trailers, laser levelling equipment and other equipment for drainage contractors. The company, managed by Mr Robin Disney, is now based at Franklin House, Blueschool Street, Hereford HRI 2AZ.

V12-1

Little digger has hydraulic pto

Powered by a Honda 10hp petrol engine, a new addition to the Fleming range of excavators has an auxiliary hydraulic power take off to drive such equipment as road breakers, submersible pumps, cut-off saws and vibrating pokers.

Capable of digging to a depth of 2.03m (7ft), the Micron Turbo 20, as it is called, uses buckets up to 650mm (25½in) wide, and has a tear-out force at the bucket lip of 1.9 tonnes.

Swing-out front legs and a telescopic rear axle enable the excavator to pass through doorways only 700mm (27½in) wide and to dig alongside walls.

The makers, Fleming International Machinery Ltd, are at Cosgrove Road, Old Stratford, Milton Keynes MK19 6AG.

Slurry tankers to continue

Following the purchase of all designs and rights previously owned by Molex Ltd and Molex Pumps Ltd, vacuum tanker specialist manufacturers Whale Tankers Ltd, are continuing the production of the well known Molex helical rotor sludge pump and agricultural slurry tankers.

Supply of both complete pumps and spares will be uninterrupted as a result of quick action by Whale to re-start production and organise the storage, handling and despatch of spares at their factory at Ravenshaw Lane, Solihull, West Midlands, B91 2SU.

Irrigation need measurement

A new, simple and accurate method of monitoring irrigation needs of potatoes was explained by Mr Tom Randell during a recent farm walk at R. W. Randell and Sons', Beech Farm, Skeyton, Norfolk.

The tensiometer, promoted by UKF Fertilisers in conjunction with Environmental Resource Management, of Norfolk. is quoted as being easier to use and more accurate than the "water balance" method, offering greater accuracy in timing and volume or irrigation and allowing for exact soil and crop needs.

Bryan Howling, UKF Fertilisers' regional technical advisor. warned that farmers must receive full guidance on this new technique, as such factors as a detailed soil survey were essential for instrument siting.

Pipe finders

Infra-red thermography services for the location of underground pipes are now offered by Thermoscan (DBM) Ltd, of Shaftesbury. Dorset.

Quiet, tilt-cab mini excavator

Hydrostatic drive to the tracks from the 20hp *Lister* diesel engine is a *feature of a well appointed* mini excavator, the *5T*, from *Smalley* Excavators Ltd, Cherry *Holt* Road, Bourne, Lincs. The tilt cab has refinements such as *heating* and a Bostrom seat; joy *stick-type* controls for digging and *slewing* make for easy *and* precise work. *There is* a hvdraulic dozer blade. mechanical offset *digging* and *pto.*

Geomorphology and erosion books

Three publications covering erosion and fluvial geomorphology from GEO BOOKS, Regency House, 34 Duke Street, Norwich NR3 3AP are now on offer.

The most recent methods and modelling techniques, with data analysis in the subject of erosion in a variety of environments are covered by R. F. Hadley and D. E. Walling in Erosion and Sediment Yield: some methods of *measurement* and modelling. Catchment Experiments in *Fluvial Geomorphology* edited by T. P. Burt and D. E. Walling incorporates 33 papers on run-off processes and erosion dynamics, sediment and solute yields and hill slope and channel processes. *Badland* Geomorphology and Piping edited by Rorke Bryan and Aaron Yair is of value to those concerned with managing land in seasonally arid or semi-arid areas all over the world.

New low cost pump

A new low cost submersible pump, introduced by British Guinard Pumps Ltd, 29-30 Kernan Drive, Loughborough, Leicestershire, LE11 0JF, is now available for farm, horticultural and domestic water supplies. The electrically operated Challenger pump is designed for boreholes and wells to depths of 40 metres, is corrosion proof and has an integral automatic safety cut-out as protection against dry-running.

Commercial users require a water abstraction licence but this is not necessary for domestic usage.

Sports field drainer

Shelton Trenching Systems of Underriver Farm, Sevenoaks, Kent, brought out their new tractor mounted slit trench drainage machine complete with elevator at the Institute of Groundsmanship Exhibition, Windsor on 18-20 September.

Named the Shelton Trencher, the rotary digging wheel excavates a neat trench with permeable walls at speeds in excess of 700 yd per hour.

Seed-covering harrow

Low power requirement is a feature claimed for the latest Harrier seed-covering harrow from Harpley Engineering, of Harpley, Kings Lynn, Norfolk. The new model has a linkage-mounted central section 2.5m wide. Outer sections may be added to make up a maximum width of 12.5m. The lightweight spring tines of the Harrier may be mounted in one, two or three rows.

Drainage in France

Drainage work in France has expanded rapidly in the past 10 years and is now over 120,000ha/annum (cf UK 100,000ha levelling off or declining). From the knowledge they have accumulated, the Insitute National de Recherche Agronomique (the French equivalent of our Agricultural and Food Research Council) organised a four-day drainage seminar at Dijon in May to discuss soil water properties in the field, drainage design and hydrology, tillage and soil structure and to visit experimental sites. Dr Peter Bullock and Mr Arfhur Thornasson (Soil Survey), Dr Mike Goss (Letcombe Laboratory) and Mr John Rands (Field Drainage, Experimental Unit), all SaWMA members, were included among a small contingency of British, German and Yugoslavian visitors. Mr Thornasson discusses their findings.

In view of the frequent references by French speakers to heavy impermeable soils, it is surprising to note that gravel backfill is used in less than 10 per cent of French drainage schemes. There are some mule ploughs, but more emphasis on deep subsoiling. Drain spacings tend to be close — 10, 15 or 20m — and it is claimed that the permeability of natural soil backfill remains satisfactory for 20 years or more. We were somewhat sceptical of this, as it was also stated that subsoiling was needed to alleviate panning over the trench line.

From the seminar it was clear that the differences between English and French drainage work are considerable.

1. France is a big country with a lot of naturally well drained land and Britain is small with a lot of poorly drained land.

2. While our own drainage background goes back as far as the medieval enclosure movement, leaving boundary ditches and field drains throughout the lowlands, most French farmers have had their first exposure to any kind of land drainage in the past 10 years.

3. Through their historic experience, British farmers developed their drainage techniques to incorporate gravel backfill to provide a hydrolic connection from the surface to the pipe; particularly in clay lands. Now some French farmers are asking for 'drainage anglais' (with gravel) on their clay lands but frequently land in France with restricted permeability is on ancient, strongly weathered loessial (silty clay loam) deposits which are less plastic than English clays, and do retain a good permeability as natural backfill. Conditions in France cannot therefore be related to conditions in Britain and care must be taken when comparing techniques.

4. Farm size and system also pose differences. The large English lowland winter cereal holding on clay land (100 to 200ha) is rare in France; clay land is in smaller and more mixed livestock and arable holdings with the bigger farms on easier land. These differences probably mean that there is less compactive pressure on the drainage system and, under grass, a better chance of structure regeneration over the pipes.

5. Climatic differences between the northern half of France and the English lowlands are well known. Summers are warmer in France, but many areas have comparable rainfall. Clay soils in the Paris basin are waterlogged for a similar period (four to six months) to those in Berkshire. Eastern France has colder winters.

Summer soil moisture deficits rise to generally higher values, which implies deeper drying of the soil profile. The importance of these differences for drainage design is speculative. Deeper drying offers a better chance of reconditioning soil structure, particularly in the trench backfill. It may also cause increased movement of soil particles into the drains on re-wetting. Sediments in pipes do seem to he more important in France than in Britain. However this may also be due to a general use of 60mm plastic pipes (few clay pipes are used). British drainage is dominated by 3m (75mm) pipes which have greater capacity, and would be little affected by even a 20mm layer of sediment in the pipe.

France has a very good network of experiments with contrasting drainage designs and hydrolic measurements. Much activity of the French Soil survey is directed to intensive studies of groups of parishes forming a "secteur de reference" around long-term drainage experiments, where farmers are also starting drainage investment. There is much here that would interest British advisers, contractors and farmers. The pity is perhaps that drainage activity in the two countries has peaked at different times. The French can certainly learn from our experience of moling and gravel backfill on clay land.

Soviet erosion and salinity solutions

The Selkhoztekhnika – '84 Moscow farm machinery exhibition, held in June, gave the opportunity for visitors from all over the world to study the Russian market and to compare the requirements of the Soviet farmer with their own. Mr F. P. D. Moore, of Howard Rotavator Co Ltd, a SaWMA council member, gives his impressions.

It is impossible to compare Soviet agriculture with that of the UK, because both the scale and the problems are largely differcnt Quite apart from the exhibition of such equipment as tea and rice harvesting equipment, there was emphasis on mechanical solutions for problems of wind erosion and saline soils.

The majority of Soviet machines exhibited appeared to be orthodox and influenced by North American and some Australian practices. Ploughs on the whole bad knife or share, rather than disc coulters, and a number were fitted with hydraulic trip mechanisms. One particular plough described as a "mounted three-deck plough" consisted of two plough bottoms operating in each furrow at different depths. It was intended for ploughing saline or structureless type soils, the idea being to lift humus layers above the structureless ones.

There were cultivation machines consisting of tines and rolling spiked harrows with working widths up to 15m, various blade ploughs used for wind erosion prevention, with widths up to 8m and a number of deeper working implements, one of which was described as a "mounted slitting and mole plough" which combined simultaneous moling and forming 15 to 18cm high ridges for trapping moisture. The ridging mechanism was adjustable for contour work.

There was some evidence of work on single pass equipment using combined cultivators and seeders, or rotary cultivators and drills (either towed or directly mounted) and a number of different types of crumblers and packers were on display. It was interesting to note that the excellent catalogue produced by the Soviet industry stated that "chisel ploughs, a novelty in our country, are about to go into quantity production".

There is obviously increasing interest in conservation tillage and the Howard Paraplow displayed at the show attracted

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The professionals in land restoration

Taking the guess-work out of farmland restoration after gravel extraction, was well described during a visit in May to the Greenham Sand and Ballast site at Shepperton Pits. For SAWMA members, this first field day since re-organisation proved to be fascinating. Mr Michael Darbishire reports.

Attracting a complete cross-section of SAWMA membership, comprising contractors, farmers, consultants, Ministry field engineers and company representatives, a wealth of constructive discussion was soon generated. The importance of SAWMA was well expressed in the role of co-ordination and communication at this event.

Mr Barry Bransden, the Restoration Manager for Greenham Sand & Ballast Co Ltd, at Shepperton, hosted the Association visit. In his opening remarks, he said: "Our future depends upon our record in restoration of worked-out sites. If this is bad, we shall not get consent to extract from new sites. Detailed planning and a thorough understanding of soil behaviour before restoration work is vital if the land is to be returned to a productive state in the shortest time."

It appears that all too frequently, planning authorities and estate offices of the extracting companies fail to study and plan each step adequately, being content to achieve a superficial cosmetic result. This means costly and tedious subsequent operations to overcome such problems of compaction due to passage of heavy earth nroving equipment. The MAFF publication, the only guide to restoration in this country, recommends the use of elevating scrapers to cut and fill, but this technique serves only to aggravate the problems. However French authorities are taking the matter extremely seriously and it is from their practical recommendations that Greenham have developed their technique.

The Greenham method enables grade 2 land to be restored after gravel extraction to interim grade 2 within two years by adopting similar methods to those used in France. At the company's Laleham farm site, comprising some 90 acres, the extraction permit was granted in 1974. Having removed the top soil and subsoil from the initial area to form baffle banks, the area was marked out with a 50m east/west grid with level marks surveyed at 30m intervals. The fill level was checked to ensure that the planned finished levels were achieved. The depth of soil replaced was calculated to give 1m of settled soil over the whole farm area.

The topsoil and subsoil are placed on the prepared and levelled area progressively, as the area to be worked for gravel in the next year is stripped. Clean fill (builders' waste) is used to fill the extracted area. The stripping of top and subsoil and re-location to the restored area is a continuous operation. Using 6m-reach excavators, sections some 150m long are stripped. Dumpers are used to transport the soil, the topsoil being kept separate from the subsoil. All traffic runs on the filled area, never on the restored land.

Plastic drain pipe is laid at 12m intervals — every two section widths — on the fill area and covered by gravel before the subsoil is replaced. Each is fitted with a JKH headwall. The fall of one in 100 has been graded to the ditch formed as each section is replaced. This controversial method of drainage has proven effective.

Having been allowed to settle, the restored area is sown with broad beans, which are noted for their extensive rooting, which assists in soil structure development. No crop is removed, but grass is undersown. Later this cover crop is killed with a herbicide, and the residue is ploughed in.

Soil that is moved and replaced is extremely fragile. Great care is exercised to monitor the soil condition at the time of removal. The checking of moisture content and plastic limit of the soil is carried out daily. The recording of water tables by the use of dip wells and monitoring of hydraulic conductivity are considered essential. The technique of stripping and replacement of soil means that the farming area over a period remains relatively constant. The data being accumulated, it is hoped, will be invaluable to future restoration work.

on show

a great number of visitors and many questions. It was evident that compaction is a problem in the USSR.

There were a few novelties in fields other than tillage. Among these was a massive silage cutter and loader built around a crawler tractor.

From superficial inspection the quality of the Soviet products varied considerably, as did the styling. Some machines had excellent lines and appeared to be well finished; others were crude.

The size of the market would be mouth-watering for any western manufacturer. I understand, for instance, that one factory producing seed drills turns out 60,000 per year and one plough factory, over 120,000 per year.

Contacts with Soviet technical staff were extremely friendly. A common interest in agriculture breaks down all national barriers.

Mr Frank Moore of Howard Rotavator Co Ltd, explaining the Paraplow to officials from a Soviet agricultural institute.

Finding those pipes

A review of current drainage pipe location methods and a look forward to future needs by Mr R. K. Fry, now of the National Association of Agricultural Contractors, and Mr M. T. B. Evans, of Silsoe College.

Buried services, including electricity cables, gas mains, pumped sewers, water pipes, telephone wires and existing land drainage pipes can be both potentially dangerous and expensive obstacles to the contractor installing drainage.

An effective multi-purpose detection device for sub-surface pipes and drains would be a great aid to drainage contractors and to those working in electricity, water and gas industries. The ability to work without risk to personnel and machinery, or to expensive underground services, could bring considerable financial benefits. Time savings in location and excavation as well as reductions in breakages and time for repairs could be considerable. The existence of an effective detector may even reduce insurance costs, and would certainly open the way for drainage contractors to diversify into other areas, such as cable laying — greatly extending the working seasons of their machines.

Requirements of a general-purpose detection device

The full specification for a detection device suitable for the agricultural land drainage industry is shown in the table.

This also details the effectivenessof the methods currently used to detect underground services. The essential needs are to detect pipes of different materials including clayware, metal and plastic to a depth of approximately 1.5m in any soil conditions. In addition, the device should be cost-effective, rugged and portable.

It can be seen from the table that no single device currently in use meets all the criteria. It is. however. worth considering the advantages and limitations of existing methods and equipment, as well as potential improvments and future possibilities.

Methods already employed in agriculture

Nearly all heavy land in cultivation in the UK has been drained before. When an accurate plan exists, the systems may be located relatively easily. When plans are inaccurate or non-existent, however. other methods must be employed.

Knowledge of old drainage practices can be invaluable when locating outfalls and tracing the old systems back. An understanding of the likely patterns and spacings used, as well as the markers used for outfalls, can all help with locating the old drainage scheme. However. such work is time consuming and far from perfect.

Dowsing, a traditional method for locating drainage and water pipes, can be successful, but has limitations and cannot be used on some days or in some places. It is dismissed as unscientific but with skilful use can be effective.

Aerial photography is now increasingly used with land drainage. In particular, it can he used for characterising farm layouts in the design of schemes and for preparing final records of the installed work. With the increasing use of aerial photography by local authorities and similar bodies, current monochromatic aerial photographs of most areas can be obtained at relatively little cost. An aerial photograph taken in spring or after harvest may reveal evidence of existing drainage systems. However, as a method to give confident location of sub-surface drains or other services, the technique is far from perfect. Study has shown that not all known drains show up, and that in some instances, spurious information can be obtained from aerial photographs (see Figs 2 and 3). An alternative to monochromatic aerial photographs is the use of film which is sensitive to light outside the normal visible spectrum. Film sensitive to "near" infra-red light is being used more and more, and can provide useful additional information. This area of aerial photography relevant to land drain detection is currently being developed, and initial tests seem to be promising.

Methods employed in other industries

Since many industries are faced with similar difficulties due to buried objects, it is not surprising that much effort has gone into finding suitable detection devices. It is possible that such devices could he used in agriculture with some modification.

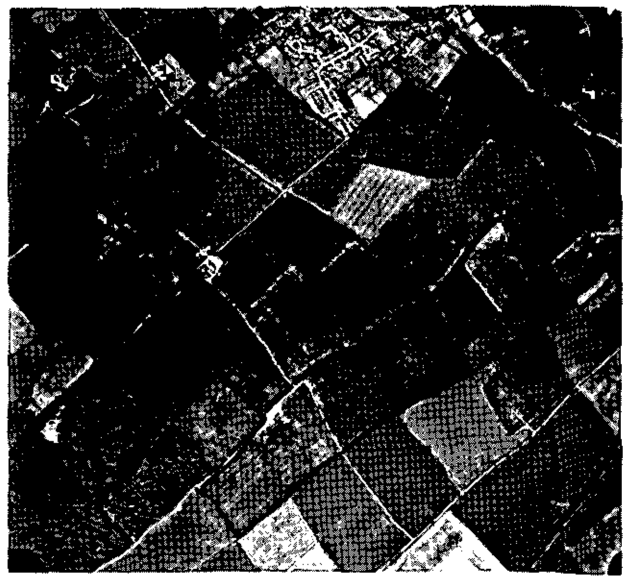
Resistivity meters are used extensively by geologists to determine the characteristics of materials in the sub-strata. The principle on which they operate is that any sub-surface variation in electrical conductivity will alter the current flow and electrical potential at the surface.

Since the electrical resistivity of overburden and bed rock varies considerably with moisture content, the delineation between materials can be located. Figure 1 shows that many limitations may apply to such devices, and the reliability and cost-effectiveness is doubtful.

Gradiometers magnetometers can be used to pick up weak magnetic signals from sub-surface objects. Clay pipes exhibit this property but plastic pipes do not. Very little commercial application information is available for such devices and as yet they may be be too expensive for use in agricultural operations.

Radar, or more exactly downward-looking radar, operates by sending bursts of electro-magnetic energy into the ground and receiving an echo or return signal from an object or any discontinuity. The device can relate distinct electrical properties of buried objects to that of the surrounding soil. Plastic pipe represents a change in the dielectric constant, while metal pipes represent a better conductor. With suitable antenna configuration, cylindrical objects can be distinguished from stones etc. Depths of up to

Fig 2 An example of the use of aerial photography for the location of drains.



3m are said to he effectively scanned; but to date the equipment is expensive and may not be suitable for use with a moving vehicle.

Metal detectors are cheap and readily available, but have severe limitations in that they can locate only metallic objects, and the depth to which they are effective is extremely shallow.

Cable **locators** require electrically conductive material for the signal to be transmitted along, so may at first glance he dismissed as unsuitable, since agricultural land drains do not possess this property. There are, however, marker tapes and tracer wires, which are electrically conductive which are currently being buried alongside such services as sewers and gas mains. These allow transmitterlreceiver devices to he used. A brief investigation of marker tape and tracer wire showed it to be very expensive, adding as much as 10% to the cost of installing a drainage scheme.

Pipe tracers. These consist of a small transmitter passed up a pipe, usually by means of a flexible rod, with a receiver tuned to the transmitter frequency following the progress on the surface. These devices are common, but do have severe limitations since they require access to a pipe (ie an outfall) which in many old land drainage schemes may not be visible or accessible.

	Dows'ng	Aer'l	Res'tivity Met rs	Grad/Mag	Radar	Metal Detector	Transc'G
Essential							
Able to detect small pipes of various materials including clay &plastic	✓	✓	?	X	✓	X	X
Does not require any previous knowledge of likely subsurface pipework of site	J	J	J	J	J	J	J
Must be effective in all soil types	X	X	?	?	X	✓	✓
Able to detect a depth of 1.5m	✓	✓	✓	✓	✓	X	?
High lateral definition	✓	X	?	✓	✓	✓	✓
High % success rate	X	X	X	?	?	X	?
Fast response time	✓	X	X	✓	✓	✓	✓
Cost effective	?	✓	X	?	X	✓	✓
Desirable							
Depth readout	?	X	✓	?	✓	X	X
Unambiguous readout	X	✓	X	?	✓	X	✓
Rugged	✓	N/A	✓	?	✓	✓	✓
Portable	J	N/A	✓	?	✓	✓	✓
Capable of working in high interference zones	X	✓	X	?	✓	X	✓
Does not create interference in other services	✓	✓	X	?	✓	X	✓
Use with moving vehicle	?	X	X	?	?	J	?

Key: ? inconclusive
✓ achieves spec.
X fails spec.

Fig 1 Tables showing the specifications for detection devices.

Discussion and conclusions

It appears that currently there is no general purpose detection method for subsurface drain pipes or other buried services. Considerable scope exists to improve or adapt existing techniques for the land drainage industry. The methods showing most promise for the future seem to be downward looking radar, aerial photography (particularly infra-red), and possibly magnetometers. All are currently expensive and relatively untried in land drainage work. An expensive machine may, however, be acceptable if it is effective and reliable. Initially it may he feasible for a contractor to operate such a device on a consultancy basis where sub-surface services are a known potential problem or where existing drains might cause considerable blowouts to occur.

Today many kilometres of plastic pipe are being ploughed into fields in the UK, Europe, *N.* America and in many other countries. Knowing the difficulty in locating old systems, it is cause for concern that we have no way of locating the new pipe which we are now installing. The reduction in MAFF/ADAS involvement in the UK may make final plans less acccurate and the time of keeping such plans is being reduced to 20 years. Without a record of the final installations, the plastic pipes of the 1980s will he no easier to find than the clay tiles of the 1880s.

Considerable scope exists to modify the composition of plastic pipes, or to coat them in a suitable substance, to enable them to be located or traced by existing devices. Possibilities exist for developing the pipe material alongside a location device suitable for agricultural land drainage contractors to use. Initial trials and experiments with conductive paints at Silsoe College have been unsuccessful, but further work in this area could he profitable.

The ideal detection device mounted in front of a drainage machine, able to locate all buried obstacles and to indicate the depth, position and nature of the obstruction, is still a long way off. If, however, drainage machines and trenchless machines in particular, are to find work in the laying of electricity cables or fibre optic telemetry cables an answer to this problem is urgently sought.

The authors can provide further details of the devices mentioned in this article along with a list of manufacturers and the results of experiments carried out at Silsoe College.

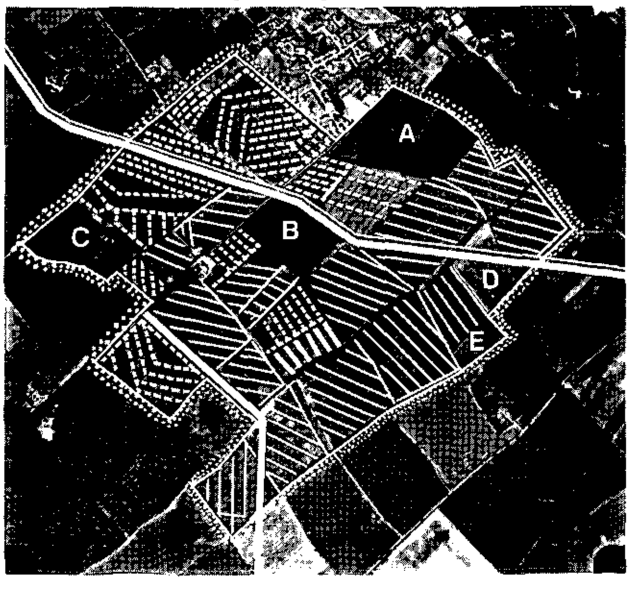


Fig 3 Not *all* known drains *show* up, and in fact in this *particular* example, *spurious* information shows *through.*

Key

Lines on photograph matching drainage plans.

Known underdrains with no corresponding lines on photograph.

Drainage lines showing up with no corresponding plans.

Gas main.

Fuel line.

Farm boundary.

A. B. C. D. E, fields known not to be drained.

DRAINAGE '85 the SAWMA/NAAC Workshop

AIMING FOR QUALITY — PLANNING FOR PROFIT

January 22nd-24th 1985 at the
Stratford Moat House Hotel, Stratford-upon-Avon, Warks

DAY 1. LAND DRAINAGE: THE SUCCESS STORY

15.30 Registration and tea

16.45 Introduction. Welcome and introduction of Guest Speaker, by R. Fry (NAAC) and M. S. Darbishire (SAWMA).

17.00 Land drainage: the **success** story
A review of the development of the UK drainage industry in recent decades. The progress made in machines and productivity.
Speaker: Brian Trafford (LAWS/MAFF)

18.00 Happy hour. Refreshments in the hospitality rooms.

DAY 2. PLANNING FOR PROFIT

Session 1. The money

Chairman: A. P. Wiles (J. W. **Vickers &** Son **Ltd)**

09.15 Marketing for the Drainage Industry
Assessing the market, producing sales literature and making personal approaches to the customer, by both contractors and manufacturers.
Speaker: Ian Crawford (Silsoe College)

10.00 Counting the **Costs**
Keeping accurate cost records, estimating true costs. The financial and hidden costs of correcting poor work.
Speaker: Steve Crowther (MAFF/ADAS Lincoln)

10.45 COFFEE

11.15 Managing a Drainage **Contracting Business**
Optimising the use of men and machines. Planning work schedules, transport and site management.
Speaker: Richard Warburton (Agripower Ltd)

12.00 Chairman's summary
A critical review of the session's papers and questions.

12.15 LUNCH

Session 2. The Machines

Chairman: Prof Gordon Spoor (**Silsoe** College)

14.00 Tracks, Tyres and Soil Damage
An appraisal of all drainage machines, including gravel carts and diggers, concentrating on traction and soil damage.
Speaker: Martin McAllister (Fossitt & Thorne Ltd)

14.45 Minimising wear on **subsoilers** and mole ploughs
The principles involved in wear **on** soil engaging implements. The use of ceramic materials on subsoilers and mole expanders. Possible uses for ceramics in future drainage machines.
Speaker: Andrew Foley (NIAE)

15.30 TEA

Session 2, continued

14.00 Purpose-built machinery
The advantages and disadvantages of specialist tackle. Making it pay?
Speaker: Dick Hughes (Hugh Pearl Land Drainage Ltd)

16.45 Chairman's summary
A critical review of the afternoon session.

DAY 3. AIMING FOR QUALITY

Session 1. Underground Services

Chairman: G. Hammon (Hammon Oshorne, **Insurance** brokers)

09.15 Safety problems with **gas services,** technical and practical advice.
Speaker: British Gas executive

09.45 Locating buried electricity cables.
Who to ask, what to use.
Speaker: Electricity Council executive

10.15 COFFEE

10.45 **Mapping of underground water pipes**
The problems with old services and sewers etc
***Speaker:** Severn Trent Water Authority executive*

11.15 Discussion panel
Delegates' chance to question the representatives of Gas, Water, Electricity, BPA and B Telecom about procedures, problems, location, markers, standards, future plans etc.

12.00 **Chairman's summary**
How our insurers see the situation, following the morning session.

12.15 LUNCH

Session 2. Workmanship and quality

Chairman: Douglas Castle (Field Drainage Experimental Unit)

14.00 **Quality of installation**
Measuring pipe grades — The Dutch experience and the role of the government.
***Speaker:** W. Naarding (Netherlands Land & Water Service)*

14.45 Drainage problems and techniques in land reclamation
A new and effective method of reclaiming land.
Speaker: Barry Bransden (Greenham Sand & Gravel Co)

15.30 Training Needs in the Drainage Industry
A review of training in Canada and France. Presentation of a complete training plan for the UK at all levels.
Speakers: Tony Horsfield (ATB) and Bob Fry (NAAC)

16.15 **Chairman's summary**
A review of the implications of the session's papers.

16.30 TEA — WORKSHOP CLOSES.

APPLICATION

Please send me a Drainage Workshop Registration Form, with full details of fees and hotel charges.

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Organisation ....

Address ....

....

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Each form may be used to register up to six delegates.

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Down to Earth

an exhibition about soil

Soil monoliths on display at the 'Down to Eartk' exhibition at New Walk Museum. Leicester.

The new national soil map, published last year by the Soil Survey of England and Wales, is featured in a special touring exhibition created this year by the Art Galleries and Records Service of the Leicestershire Museum. Entitled 'Down to Earth' the exhibition was opened in March this year at New Walk Museum, Leicester. It has since been seen at the Royal and East of England shows, from which it was taken to Elvaston Castle, Derbyshire, for display during September and October.

For the last two months of this year, the exhibition will be at the Mansfield Museum and Art Gallery, Notts; from Jan to April '85 it will be seen at the Geological Museum, South Kensington, London, from May to August at the national Museum of Wales, Cardiff. There are further arrangements for its display in Derbyshire, Lincolnshire, in the South East, and in Yorkshire, extending until the end of 1986.

What soil is, how it is formed and how it varies are explained in 'Down to Earth' and illustrated with a series of soil monoliths.

Describing these, Dr R. Evans of Soil Survey noted that each soil illustrated an important point.

The coarse, loamy, deep, well-drained soil from the Royal showground at Stoneleigh, for example, with large earthworms burrowing vigorously below 1500mm, was a high quality soil, but its topsoil structure could easily be damaged by ill-timed cultivations and lead to a reduction in crop yield. In Lincolnshire. the chalk rubble underneath the shallow topsoil contained much more brown fine silty material than was found in similar soils in Norfolk and Cambridgeshire. This less rubbly subsoil could release larger amounts of water to plants than the chalk subsoils in East Anglia, which might explain why the Lincolnshire soils were considered less droughty. The clayey soil on Keuper marl from near Castle Donnington, Derbyshire, has an extremely dense subsoil, and few roots penetrate between the large prisms. On the similar looking but fine loamy' soil from near Ashby-De-La-Zouche, Leicestershire, the subsoil was less dense, roots went deeper and the pit was easier to dig.

In Clipstone Forest, Nottinghamshire the deep sandy soil from a coniferous woodland was acid and severely leached of nutrients; it contained hard subsoil layers of organic matter and iron deposited from water draining rapidly through the soil profile. To reclaim this land for agriculture would be costly and lead to wind and water erosion. The carefully restored soil on the former opencast coal mine near Mansfield, Nottinghamshire had been under grass for less than six months when the pit was dug, and in the very wet spring of 1983 the topsoil was like porridge and easily rutted by vehicles. Drainage would help, but driving a vehicle across this field and at another site near Countessthorpe, Leicestershire, where the subsoil was waterlogged for long periods of the year, showed how easy it was to damage soil structure. At Countessthorpe the land was under allotments which had been double-dug to improve drainage and subsoil structure.

On the floodplain of the River Soar near Cossington, north of Leicester, clayey alluvium overlay buried soils at about 800mm depth. The alluvium was deposited when the slopes of the Soar basin were cleared for agriculture, showing that soil erosion is not only a modern phenomenon, as described in Soil ahd Water 10(1) 1982 and 11(3) 1983, but has been slowly denuding topsoils for many centuries. The shallow well-drained soil on sand and gravel at Maxey, Cambridgeshire has a long history of settlement, as witnessed by the crop marks seen on air photographs, but the early settlement was probably related more to the fact that the soils were easily cultivated rather than to their productivity, as the soil appeared very droughty. The stony, well-drained soil under coniferous woodland near Howden reservoir in the Peak district showed little evidence of soil profile development below 150mm, emphasising how slow soil formation can be.

The Leicestershire Museum's exhibition was built to travel. and we hope that over its planned life of five years it will he seen by many people. Much interest has been shown already in the exhibition, not only at Leicester Museum and the Royal Show, but also wherever the Soil Survey has had a stand at agricultural events, as we always have on show the colourful book, written by Stephen Northcliff, which accompanies the exhibition. David Bellamy did a grand job opening the exhibition in March, and his presence ensured widespread publicity. The exhibition dispels the illusion that soils are dull, and emphasises the need to care for them.

V12-1

Slopes on the South downs exploited by confined surface flow with sufficient energy to erode these destructive gullies.

Erosion on the South Downs

IN THE autumn and winter of 1982-83, serious erosion occurred on agricultural land on the South Downs, East Sussex. Sixty-five eroding sites were recorded in an area of 50km^2, whereas in previous years, little erosion had been observed. Dr John Boardman, Senior Lecturer in Geography and Deputy Director of the Countryside Research Unit at Brighton Polytechnic, discusses the causes and proposes remedies.

The weather

Autumn of 1982 was wet and October was the wettest month on record: on two separate days rainfall exceeded 40mm in the Brighton area. Total rainfall for the autumn was not, however, very different from that for 1974 and 1976. The number of days on which rainfall exceeded 7.5mm was also very similar during the last four months of 1974, 1976 and 1982.

The role of rainfall intensity is more difficult to evaluate. In general, British rainfall is of low intensity compared to that in tropical regions and therefore, on most soils, intensity is not thought to be a critical factor in initiating erosion. However, if an intense storm is arbitrarily defined as one where rainfall exceeds 5mm/hr, there were 12 such events in the autumn of 1982 compared with 10 in 1976 and 6 in 1974 *(Dr T. Browne, pers comm).*

The soils

A wide range of British soils are potentially erodible and those with a restricted clay content (less than 35 per cent) are particularly at risk *(Evans, 1980)*. The organic carbon percentage in topsoils has also been shown to be a factor in structural stability, soils with less than 2 per cent having unstable aggregates *(Greenland et al, 1975)*. At the eroding sites on the South Downs, soils have a high silt and low clay content, but the organic carbon was never as low as 2 per cent. An important factor at many of these sites was the tendency of the soil to slake and cap after heavy rain, thus forming relatively impermeable surface crusts.

The use of the land

The explanation for the unprecedented erosion on the South Downs in 1982 and '83 seems to lie with recent land-use change and current farming practice. In the past five years there has been a substantial move into winter cereals on the Downs, and large areas with little crop cover throughout the autumn and winter have become potential sites of erosion. Forty eight of the 65 sites recorded were under winter cereals or autumn-planted grass leys. The others were on harrowed or ploughed agricultural land without crop cover.

Adoption of winter cereals appears to be the major reason for the occurrence of soil erosion at these sites, but a number of other factors help to explain the location and scale of erosion:

- Removal of field boundaries has created long, uninterrupted slopes and larger catchment areas for water. Thus water velocities tend to be higher and discharges greater than in previous years.
- Slopes which are convex in profile, with a flattened crest acting as a water storage area, tend to erode. This erosion is initiated on the convexity and extending upslope and downslope in the form of rills and gullies. Unfortunately, the removal of field boundaries from the slope convexity has often exacerbated the problem.
- The use for arable farming of steep slopes which were previously under permanent grass has extended the area at risk. Such slopes were classified by the Soil Survey as Icknield series (steepland phase) and considered 'ill suited to regular cultivation' (Hodgson, 1967). On these slopes soils are generally thin, often being less than 15 cm.
- The widespread practice of working the land directly down the maximum slope leads to erosion along drill lines and especially along the wheelings of agricultural vehicles. In this context,

20 ▶

Table 1. **Site** characteristics and amounts of soil **eroded**

Site	*Type of* feature	*Catchment* area *(ha)*	*Maximum gradient (deg)*	*Slope length (m)*	*Total* soil *eroded (t*)*	*t/ha*	Notes
1.	valley-side rills	2.31	25	250	1.30	0.56	cleared of wood
?.	valley-side rills	3.25	12.5	360	3.90	1.20	
3.	valley-bottom gully	3.15	3	350	1.04	0.33	**
4.	valley-side rills	1.38	26	I80	1.95	1.41	**
5.	valley-bottom fan	10.50	13	500	0.26	0.03	cleared of wood**
6.	valley-side rills	2.27	8.5	220	4.29	1.89	**
7.	fans along hedge	2.15	2.5	190	0.60	0.3	**
8.	rills in dry valley	4.81	7.5	320	7.80	1.62	**
9.	rills in dry valley	3.84	14	240	19.50	5.08	**
10.	valley-side rills	3.56	12	215	3.50	0.98	**
11.	rills, gully, fan	20.84	14	h70	100.00	4.80	

'assumes bulk density of 1.3
**hedge-line preventing further sediment movement and inhibiting water flow

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the wheelings produced by the application of herbicides to winter cereals are particularly prone to erode. At some sites, the working of the land under extremely wet conhitions led to erosion along deep wheelings.

An illustration of the importance of some of these factors is provided by an examination of eroding sites in a small area to the north-west of Lewes, East Sussex.

In two adjacent valleys, similar chalky, silt-rich soils are found. Parts of this area have only recently been brought under cultivation, having been cleared of woodland and scrub; other parts, such as Highdown, have been arable since the second world war. The character and amount of rainfall affecting the sites investigated is assumed to be uniform.

Table 1 lists 11 sites where erosion was recorded. Amounts of erosion were estimated by measurement of volume of sediment removed from rills and that deposited in fans.

Of greatest concern in this area was the cause'of erosion at site 11. Highdown, where erosion and flooding affected allotments, gardens, houses and roads on the Nevill estate, and resulted in considerable loss of crop due to rilling, gullying and sheet flow in a field of 21ha under winter barley. The district and county councils were involved, at great expense, in protective and remedial measures (Boardman *et al, 1983).*

At this site, loss per unit area is not exceptional, but total soil loss is between 10 and 100 times greater than at other sites (Table 1). Total soil loss is a function of discharge, and, assuming that the whole catchment contributes water to the main valley-bottom gully. is therefore closely related to catchment area. From November to early January, during a series of storms, run-off occurred from the total area and a very high proportion reached the major gully. Once widespread and efficient rill and gully systems were established, even minor rainfall produced high discharges in the major gully, for example, 6mm on 13.1.83.

There are a number of reasons why the whole catchment area contributed water to the valley-bottom gullies during storms:

Intense storms caused slaking and capping of the soil soon after drilling on 5 November; efficient rill systems quickly develooed: flattish slope crests acted as storage areas for water which then flowed down, causing erosion on the slope convexity; in many parts of the field, the direction of drilling served to channel water into valley-bottom gullies.

The size of the catchment appears to be particularly significant: It is almost six times larger than the mean (3.72ha) of the other 10 sites (Table 1). Thus, given the same rainfall, six times the amount of water is likely to fall on the Highdown catchment, and the enhanced potential for sediment transport is clear.

The maximum gradient of 14 deg in the Highdown catchment is less than that at some sites on Table 1, and is not excessive compared with other sites of erosion in winter cereals on the South Downs. However, a detailed survey of the catchment shows that about *35* per cent of the

Highdown, Lewes. Trench dug by council in December 1982 to protect houses on *Nevill* Estate (on *left)* from *silt*-ladenflood *water. Eroding field* is seen in distance.

Bevendean, Brighton. Fan of chalk andflint gravel at base of eroding slope (grass *ley).* January 1983.

V12-1

Bevendean, Brighton. Gullies and fans on left, ploughed-our gullies on right. *January 1983.*

area is made up of slopes greater than 11 deg *(Boardman et al, 1983).*

Serious flooding and exceptional soil loss at Highdown are related to the physical characteristics of the catchment, its size, shape and length of slopes. The long unbroken slopes lead to high velocities in the rills. The circular shape of the basin equalises the travel-time from all parts of the basin, resulting in a peaked flood with large amounts of water arriving at the basin exit soon after the commencement of a storm. Soil capping and the availability of storage areas on the slope crests also contribute to run-off and erosion.

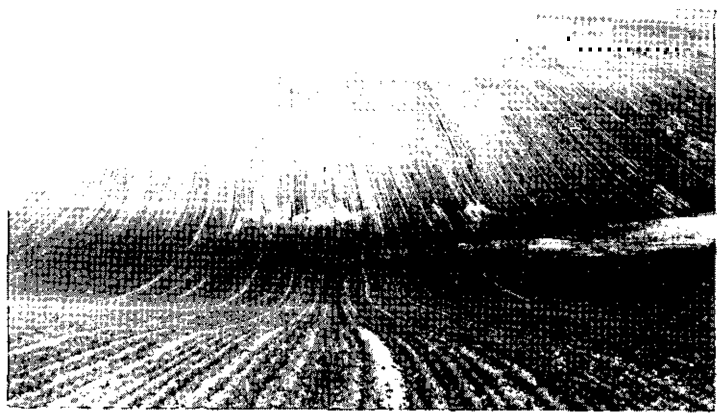
Farming practice interacts with, and modifies, the physical parameters of the catchment. The loss of field boundaries and the creation of a large field draining to one outlet are examples. The direction of drilling and the presence of well-developed wheelings in many parts of the field encourage the rapid and efficient passage of water into the valley bottom. Finally, winter cereals are especially susceptible to erosion because of the lack of vegetation cover throughout the winter and the low value of surface roughness on drilled surfaces, *(Evans, 1980, Fig. 4.4).*

Analysis of the causes of flooding and erosion at Highdown allows recommendations to be made to prevent or reduce the likelihood of repetition in the future:

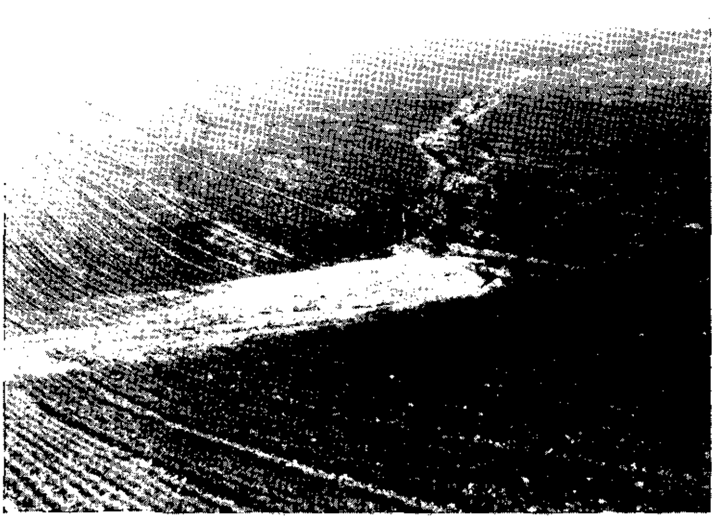
- The size of the catchment may be reduced by division into two or three fields. Hedges or grass strips between the fields will act to reduce run-off, allow infiltration to occur, and inhibit transport of sediment to the valley bottoms *(cf Evans and Norrcliff, 1978).* The value of simple grass strips between fields as a control on water flow and therefore sediment transport has been observed at many sites.
- Drill lines and wheelings should not be directed down the maximum slopes; the feeding of water from headlands into valley heads should similarly be avoided.
- Winter cereals are a high risk crop at Highdown. This risk may be reduced by a change to spring cereals. The length of time during which erosion could occur would be reduced and confined to the drier spring months.

Acknowledgments

I would like to acknowledge helpful discussion of the problems at Highdown with a number of individuals: Mr J. Crabbe (MAFF); Dr R. Evans (Soil Survey of England and Wales); Mr D. Chestney (East Sussex County Council) and Mr R. Stammers (Lewes District Council). Mr S. Oakes (Southern Water Authority) kindly allowed access to rainfall gauge records and the co-operation of the farmer, Mr D. West, is gratefully acknowledged.



Westlain, Falmer. Small fans in valley bottom due to erosion along drill lines in winter cereal. December 1982.



Westlain, Falmer. Gully and fan in shallow dry valley 65 tonnes of soil lost from gully. Survey pole (2m) for scale. December 1982.

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e t and omics of l drainage

The first three years of a 10-year experiment assessing the performance of drainage in grassland are described and assessed by Mr Alan Parker, Principal Field Engineering Adviser, Land & Water Service, ADAS Bristol, and Mr M. V. Jackson, Agronomist, Agriculture Service, ADAS Bristol.

It is generally recognised that drainage of grassland has several beneficial effects on the sward: reduction of poaching; extending the grazing season at both ends; increase in yield; better growth and response to nitrogen due to better rwt development which also produces better drought resistance; improvement in and/or maintenance of botanical composition and greater flexibility in management.

In the late 1970s. ADAS set up an experiment to quantify these benefits and in 1979, a site was acquired on a grassland farm where it was reasonably certain that the cropping programme would not be altered within the 10-year life of the experiment. As the soil is a poorly drained clay. the drainage treatment chosen was moling over permeable backfilled drains. The total experimental area of 4.68ha allowed for three replicates.

Soil description

Oxford clay (Jurassic period) predominates in the area, with minor intrusions of glacial drift, terrace gravel and river alluvium.

A coarse structured prismatic and angular hlocky clay loam soil, with a few small flints lies up to 200mm from ground level. From 200mm to 550mm the soil changes to clay and this in turn lies on calcareous Oxford clay: the clay horizons are similar in structure to the clay loam. Below 200mm, the soil changes to a silty clay with a weakly developed prismaticl platy structure.

Soil stability was checked at the moling depth of 600mm, which recorded stability indices of 0.36 and 0.40. On interpretation. this suggests a fairly stable class with a reasonably good moling potential.

Plot layout

Originally, it had been intended to install both a traditional layout and one based on scientific computation ie mole drainage. However, as the type of drainage traditionally carried out in the area is moling it was found unncessary to consider any duplication. Pipe drain spacings were to be such that the maximum uninterrupted length of any mole channel would be 40m.

Drainage installation

The drains were laid in a trench made with an automatic grading system. Apart from the 225mm and 150mm diameter pipes, which were in clayware, the remainder of the pipework was corrugated PVC.

Permeable fill was washed gravel, laid to a depth of 380mm below ground level, except where required to plot separation purposes, when it was laid to ground level.

Moling was carried out using a long beam plough soon after the drains were installed (9.8.79), but before the ridge and furrow system was eliminated. Direction of moling is shown on the plan at a depth of 600mm with a spacing of 2m.

Soil moisture content at two sampling points at the time of moling was:

Mean — 28.12 per cent of water by volume.
Plastic limit — 21.00 per cent of water by weight.
Mean — 37.74 per cent of water by volume.
Plastic limit — 25.00 per cent of water by weight.

Soil moisture deficit prevailing was 95mm and the mean dry bulk densities at moling depth were 1.68 and 1.56g/cm^3 respectively for the same sampling points.

Measurement techniques

Soil water regimes form a base line against which other recorded data relating to crop response are assessed. To this end, 31 dipwells (60mm diameter x 650mm deep) were sunk in a prescribed pattern as indicated on the plan. These were read weekly, with other instrumented data.

Chemical analysis of the soil was recorded annually, as were D value, nitrogen content of herbage cut from within large open-topped cages and changes in the botanical composition of the sward. Yield was assessed and recorded monthly.

One of rhe *three* cages used *to* isolate *the* experimental plots used to compare drained and undrained conditions on grassland.

Farming operations

On completion of the drainage work in August 1979, the ridge and furrow system was obliterated except for one or two major undulations which were still in evidence. Reseeding over the whole area including the undrained plots with a perennial ryegrass/timothy/white clover mixture, was completed by the third week of September, 1979.

On 10 April, 1980, the field was harrowed, but due to the very soft nature of the ground in the undrained areas, heavy rutting occurred. Following these cultivations. 90 to 100 young stock grazed the field until the end of June, when it was shut up for forage conservation.

Between 21 and 28 August. the area was cut for silage but was not stocked again until the end of October. The grassland management has followed a similar pattern in subsequent years.

Results

The results from the first three years' data are encouraging. From both the agronomy and hydrological aspects, there are clear indications that the drained plots out-perform the undrained ones. A point to note is that during this period, there were about 100 per cent more unsown grass species present in the undrained area; (UD) than in the drained (D) area.


Growth on the undrained grassland *plot*

Agronomic points
1980

The largest differences in yield of herbage were seen at the first and third cuts. The difference at the first cut is fairly readily explained by the better growing conditions on the drained land in early spring. The July cut followed a total rainfall of 139mm during the latter part of June and July. The yield of nitrogen was appreciably higher on the drained land.

Fertiliser application in mid-April caused rutting in the undrained areas and this was subsequently aggravated by poaching. The ensuing poor weather conditions did nothing to ameliorate soil conditions. However it should be remembered that the surfaces of the fields had been considerably altered when the ridge and furrow svstem was levelled, and soft areas could be expected where furrows once existed.

Apart from two weeks in January, when there was a hard frost, ground conditions on the drained plots varied between damp and firm and damp and soft from January to April. In contrast, conditions on the undrained plots were mostly waterlogged.

1981

A visual assessment of ground conditions in spring showed evidence of more poaching by stock and/or machinery on undrained than on drained land.

There was little difference in yield between undrained and drained land at almost every cut in this year. The reasons for this are not clear, particularly since at the time of the botanical assessment on 10 April, it was estimated that there was an advantage, in terms of earliness of growth, of up to three weeks in favour of draining. In spite of a lack of difference in terms of drv matter yield, the nitrogen yield was higher in *total* and in *spring* (first three cuts) was higher on drained than on undrained land.

From late July to early September was very dry, apart from two days in early August. The yields from a cut taken on 26 August showed a 34 per cent advantage to the drained area. This could indicate that the drained sward was somewhat more drought resistant than the undrained, hut there may well be other reasons.

1982

On a purely visual assessment of ground conditions on plots with comparative treatments. there was again evidence of more poaching by stock and/or machinery on undrained land than on drained land. In 1982, grass yields were measured on six occasions betwen 5 May and 26 October. Growth was both earlier and greater on the drained plots and this difference was maintained until late June. DM yield for the first three cuts, at 11.46 tonneslhectare, was 4.01t/ha greater than on the undrained areas.

Nitrogen yield was appreciably greater on the drained than on the undrained land. This, coupled with the data from the previous two years, indicated that nitrogen was being used more efficientlv on the drained land.

Table I: Etrect of drainage on botanical **composition** (%*)

	Sown *ryegrass*		Grasses *timothy*		*Unsown grasses*		*Broadleaved* weeds		White clover		Bare ground	
	UD	D	UD	D	UD	D	UD	D	UD	D	UD	D
1980	59.0	68.0	14.5	13.0	18.8	9.6	2.7	5.2	0.5	0.4	4.5	3.8
1981	63.8	69.5	11.2	10.5	15.5	8.0	2.7	4.0	2.2	2.8	4.5	5.2
1982	65.2	72.4	10.2	12.8	10.6	6.8	3.4	2.6	0.2	1.6	10.4	3.8

*Using a point quadrat

Table II: **Effect** of drainage on annual dry matter yield **(t/ha)**

	1980	*1981*	*1982*	*Mean*
Undrained	13.9	14.5	11.6	13.3
Drained	15.8	15.0	15.2	15.3
No of cuts	5	6	6	
Date of first cut	12 May	23 May	5 May	
Increase in OM yield (%) (First 3 cuts only)	36	nil	108	48

Table III: Etrect of drainage on nitrogen yield **(Kg/ha)**

Year	*Applied*	*Total N yield Kg/*		*Extra N*
1980	215	402	484	144
1981	269	373	426	109
1982	351	304	388	132

Data on soil chemical analysis and herbage *disgestibility are* not *presented* in *this* interim report.

**Percentage increase* in *spring N* uptake, *first three* curs.

Economic points

Using costs and grant rates in force when the drainage works were carried out the annual cost of the installation is estimated as follows:

Annual **costs**	£h a
Gross capital cost	280
Less 50% grant	140
	140
Annual charge: 20yr life, 12% interest plus: annual charge for re-moling in years 5.10, 15 & 20 @ **£30/ha**	18.76
Average annual cost	3.88
Total annual cost	22.64

continued on page *25*

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Benefits and economics of grassland drainage

from page 23

Estimated returns

	'80	'81	'82	Av
Extra dry matter. t/ha	1.9	0.5	3.6	2.0
Estimated silage. equivalent. *t/ha	6.1	1.6	11.5	6.4
Estimated silage value @ f15/tonne. f	91	24	172	96

**Incorporating* a 20% *ensiling* loss.

Conclusions

● Drainage of grassland can bring forward the date in spring when fertiliser application and subsequent grazing become possible. Yields of first cut silage may be higher and/or the cut may be taken earlier.

● Drainage can increase total annual yield of grass and improves the nitrogen utilisation by the sward.

● Drainage favours the retention of desirable species in the sward.

Growth on the drained *grassland* plor.

The response times of drained and undrained land are not signficantly different. Thus rainfall is moving as quickly through the soil to the mole channels and then interceptor drains as by the surfacelinterflow route on the control plot. Moling by lowering the water table has created greater storage capacity in the soil, which allows for longer recession flows and attenuated peak flows in comparison to the undrained situation.

On the economics side of the experiment it can be concluded that:

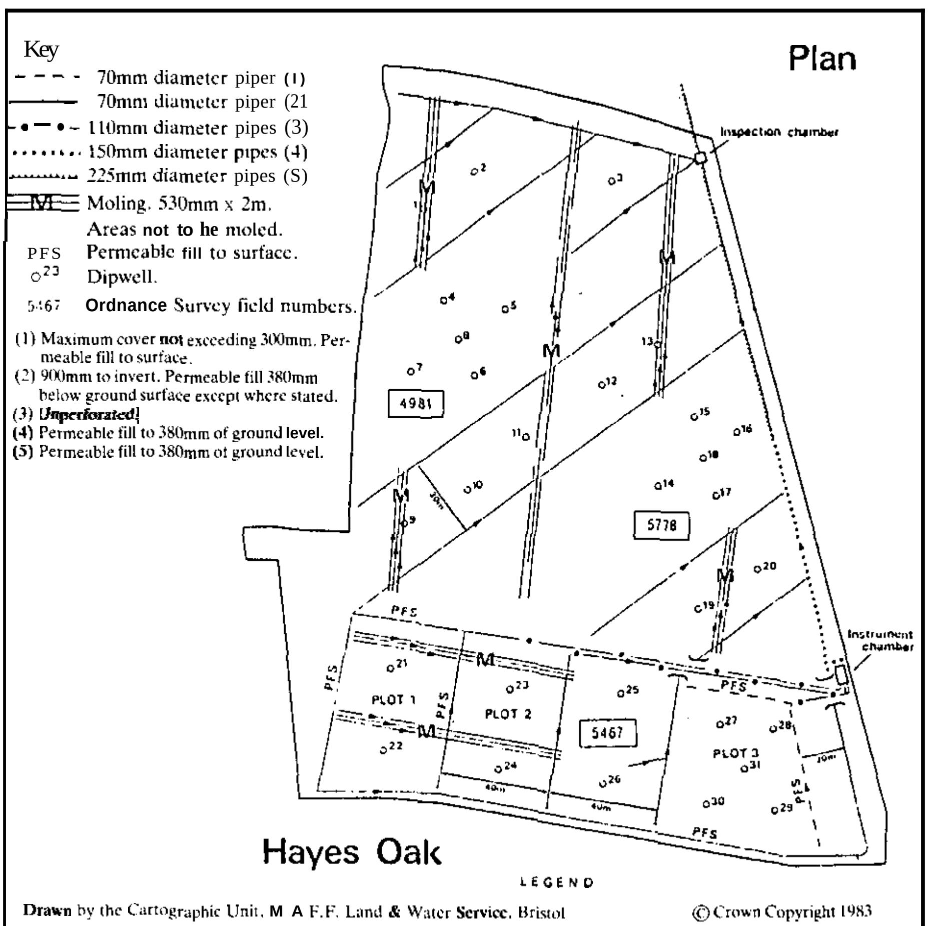
● The net capital cost is recovered in the first two years.

● The average annual net benefit is £96/ha compared with an average annual cost of approx £23.

● To break even, extra dry matter yield would have only needed to be 0.38 tonnes/ha, equivalent to 12 tonnes/ha of silage.

Results so far are from the first three years, and in an experiment that has a planned 10-year life it is right that ADAS should acknowledge its debt to the farmer, Mr Arthur Webh, for use of the site and his help in ensuring its success.

Plan of the Hayes Oak Study area.



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