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SOIL and water

THE JOURNAL ON **SOIL** CONDITION AND FERTILITY

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TILLAGE – WHAT NOW AND WHAT NEXT?

SOIL and water
THE MAGAZINE ON SOIL CONDITION AND FERTILITY

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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. The Association is a charity whose main objective is to promote the highest standards in the care of the soil: Britain's basic asset.

Soil and Water is published quarterly and is SaWMA's principal means of promoting ever-improving standards of soil care and management, through the publication of research findings, scientific articles and practical information an the soil, its drainage, cultivation, irrigation and fertility. It is published for the benefit of the farmers and growers, researchers and advisers, consultants, manufacturers, contractors and others making up the membership of SaWMA.

The editor welcomes offers of editorial material and advertising requests; details on application. Soil and Water is generally available only to members of SaWMA or for promotional purposes, but extra back numbers cam sometimes be supplied (£3.00 each plus p&p 30p UK). The annual UK SaWMA membership subscription is £15.50 including VAT. (Overseas £18.00)

COMMENT

This 'bumper' Spring issue comes with an editor's apology – that it is so late in reaching you. In part, this is the result of having, in the early part of the year, the organisation of the Tillage Conference followed by preparation of the Proceedings and, in part, by the extra work involved in pursuing subscriptions from tardy-paying members. It really could save a lot of time and quite a bit of money if members would please pay their annual dues promptly – and without prompting – at the start of the year.

Returning to the subject of the Tillage Conference; this issue includes an extensive report and this we hope gives a good indication of the quality of the speakers and the practical value of the information they presented. However, we think that many of you will want a separate reference copy of the whole proceedings and we are pleased to advise that these Conference Proceedings are now available from the SaWMA office (see page 34 for details).

The broader field is Land Management

Summing up at the Conference, the Chairman, Lord Selborne, declared that, "It is very important to remind ourselves that our basic asset in farming is our soil and a better understanding of our basic asset simply has to be quite the fundamental beginning of our long term consideration of our land management".

And that, as you know, is where SaWMA fits in. So, not surprisingly, in his closing words, Lard Selborne envisaged that SaWMA, in 20 years time, will still be as important as it is now.

Your Council and Management Committee certainly agree on the continuing need for an active and involved Association. Those of you who attended the Annual General Meeting will be aware of the moves being made. In these days we must look at soil and water management not just in isolation but rather as elements of a broader land management approach. This is the broader field to which SaWMA is now addressing itself.

Retirements

Finally, here and elsewhere in this journal, Council would like to record their warmest thanks to two members now retiring from full time activities with the Association. Mike Darbishire and Frank Moore have each worked very hard and given much time to SaWMA over these last several years. Their services will be much missed. We offer them our very hest wishes in their retirement.

Front Cover: "Direct Drilling"–still the preferred system for cereal crop establishment
See Conference report, pages 16-25.

CONTENTS

PIPELINE...PIPELINE...PIPELINE...PIPELINE...

The AFT *W12* pedestrian controlled *trencher.* Features include infinitely variable *hydrostatic* wheel *speeds for trenching;* direct gear drive for road *transport* and lockable fmnt wheel for cutting curved trenches.

The gear driven digging chain offers *trenching capacity* of *10cm to 22cm* width and the standard tyre *traction* allows *depth* to *I* metre. Basic *trencher* cost *(petrol* engine) *is £4700* plus *VAT.*

A F *Trenchers Ltd., Gosbecks* Road, Colchester, Essex C02 *9JS. Tel(0206) 44411.*

Conservation in Agricultural Education

With the conviction that conservation aspects should be incorporated into courses and that conservation should not be taught as a separate subject, a series of Lecture Notes is being compiled by the Conservation in Agricultural Education Guidance Group (CAEGG).

The Group, established in 1981 and composed of practicing farmers, lecturers, conservationists, is supported by the Farming and Wildlife Advisory group (FWAG).

Today, 21 CAE Lecture Notes have been produced. A postal survey conducted last year shows that a high proportion of lecturers are enthusiastic about the notes and they make use of them in their lectures. The section in each, entitled "Further Reading': is especially appreciated. The Agricultural Training Board use the notes extensively for their courses. The ATB, together with some colleges and universities, have made contributions towards the cost of the project.

The CAE cover a wide range of topics – including Slurry, Silage, Watercourses, Economics of Conservation, Hedge Maintenance, Herbicides, Insecticides among others. There are about ten more in various stages of production.

The CAE Lecture Notes are already a proven, sound educational resource. Further information may be obtained from: Mr. R. D. Russell, CAEGG, Kelston, Old Road, Pensford, Bristol BS18 4BB
Tel: (07618) 437.

Pasture Repair Service

Direct drilling into poor quality, thinly established leys offers the opportunity to produce high yielding grass crops at low cost with the minimum loss of land use during emergence.

The BritAg pasture repair service, now available from approved contractors, can achieve effective reseedings at over 20 acres per day.

The machine used to drill the seed is the Aitchison Seedmatic which was specially developed in New Zealand to enable crops to be grown in areas where traditional cultivation methods are not practicable. Fitted with unique inverted 'T' shaped coulters mounted on spring tines, individual mini seed beds are produced without smearing, into which the seed is sown.

A further benefit of the system is that seed and fertiliser can be put in at one operation which additionally is not dependent on perfect weather or the land being dry.

Information pack from BritAg Ltd., Skeldergate Bridge,
York YO1 IDR.

A *BritAg Pasture Repair* Service authorised *contractor* at work with *his* Seedmatic drill.

Anglian Water in Joint Venture

Atlantic Pastics Limited of Cardiff and the Anglian Water Authority have jointly developed a unique reservoir sampling box.

The unit, developed from the Atplas Pavement Box, already widely used throughout the water industry, is claimed greatly to simplify procedure of obtaining water samples and to be frost protected, watertight and virtually vandal-proof. It has been tested and approved by scientists of Anglian Water Authority.

The Sampling Box is jointly marketed by Atlantic Plastics Ltd.
and by Anglian Water.

Diversification and diversion?

Cercol Leisure Products are offering an idea for farm diversification in the shape of their surface pool. Serving as an efficient water storage tank throughout autumn and winter the pool becomes the family (or holiday makers') swimming pool during the summer.

Surface pools can he bought 'off the shelf from one of the Cercol Leisure Products' regional outlets and taken home in the hack of the car at the time of purchase. Even after the pool has been erected on the farm it can easily be moved to another position if required.

Cercol's 15 foot diameter Aquiline pool is said to be 'ideal for the smaller farms' and costs around £550.

Drain Surveying Equipment

The TRACKA drain surveying system for non-metallic pipes has been developed and improved over the last 5 years. Using the latest micro electronic techniques, a wide range of transmitters is now available for use in the harsh environment of underground drains. In conjunction with a receiver the TRACKA can survey all drains to a depth of 10 metres.

The TRACKA transmitters can be attached to either conventional drain rods or drain jetting equipment to enable them to be pushed or jetted along the drain. Powered by two button batteries the signal transmitted can be easily located and the transmitter position pinpointed using the lightweight hand held receiver. The TRACKA equipment can be used for surveying drain routes, locating the position of blockages and locating hidden manhole covers. Typical accuracy of location is within 30cm at a depth of 3 metres.

Further information: Tony Gibson, Woodbridge Electronics Ltd., Deben Way, Melton, Woodbridge, Suffolk, IP12 1RB. Tel: (03943) 6887.

The RECO ANGLEPLOW – a new soil loosener from Ruston Engineering. The trailing leg design ensures that the upper share first loosens the soil nearer the surface and the lower share working at depth has then less resistance to overcome. There is no mixing of the top soil and the soil structure achieved is small fissures on top and coarser drainage fissures lower down.

Maximum depth of work is 660mm (26 ins). The ANGLEPLOW is available in dual or single share version according to depth of work required.

Rustons Engineering Co. Ltd., Huntingdon Tel: (0480) 55151

Still life?

Work at the Hebrew University of Jerusalem has shown that under conditions of winter waterlogging/heavy summer irrigation on poorly drained clay soils, certain fruit trees (apple, peach, apricot), produce more alcohol and less natural growth promoters.

The alcohol, developed in the roots, is transported to the trees' branches, foliage and fruit – with adverse effects. The fruit tends to deteriorate and the branches and foliage die.

However, some trees are more resistant to the adverse conditions and, from a study of these. a technique has been developed of applying in the irrigation water a combination of chemical growth regulators and enzyme inhibitors that block alcohol formation.

Using the preventative technique improvements of 20-25% have been noted in yields, fruit size and vigour of declining trees.

New Manager for Farmers Newsreel

The Farmers Newsreel, a video taped programme for the agricultural industry found immediate popularity following its launch in 1986. Dr. George Forster, formerly Head of the information Services Depanment at AFRC Engineering (the old NIAE), has now been recruited to expand and establish Farmers Newsreel as a major communications vehicle in the agricultural field.

"The video medium means that machines and demonstrations can be shown in action", says Dr. Forster. "We can use exciting graphics to make things clear. We can take farmers to all the shows that they couldn't spare time for. Farmers Newsreel is an entertaining and informative programme of new ideas and of what's on the market to keep farmers up to date in the comfort of their own homes!'

Farmers Newsreel Ltd are at 10 King Street Lane, Winnersh, Wokingham, Berks. RG11 5AS.

The *Grant* Squirrel *meter/data* logger has *established* itself as a market leader in the field of unsupervised logging in remote areas Typical applications include *measuring* growing conditions, monitoring storage of produce, *measuring* pH, water *flow,* dissolved *oxygen* and *conductivity.*

The new generation of squirrels – The *1200* series – introduces many new features and gives increased flexibility. There is a larger choice of inputs, more channels, user *selectable ranges,* 12-bit resolution, *larger memory,* and manv more additional features.

Further *information: Wessex Power* Technology *Ltd.,* 189, *Ashley* Road, *Parkstone,* Poole, Dorset *BH14 9DL. Tel: (0202) 723000*

Douglas Bomford Agricultural Engineering Awards

The Douglas Bomford Trust is pleased to announce its Award of The Douglas Bomford 1987 Agricultural Engineering Travel Scholarship to Mr. Ian Yule. He will be making a tour of Australia later this year to study dryland farming and minimal cultivation techniques.

Mr. Yule, 27 took a Master of Science Degree in Agricultural Engineering at Newcastle University and subsequently joined Durham Agricultural College where he is now Head of Information Technology.

The Douglas Bomford Trust was established in 1972 for the purpose of advancing education, training and research in the science and practice of Agricultural Engineering and Mechanisation.

For 1988, to celebrate the Golden Jubilee of the Institution of Agricultural Engineers, the Douglas Bomford Trust is offering a special Technical Award for Innovation in Agricultural Engineering. This DOUGLAS BOMFORD "GOLDEN JUBILEE" award will be in the sum of up to £10,000. Closing date for applications is 31 January 1988. Rules and Conditions are available from the Secretary, Douglas Bomford Trust, I Manton Spinney Knuston. Wellingborough, Northants NN9 7ER.

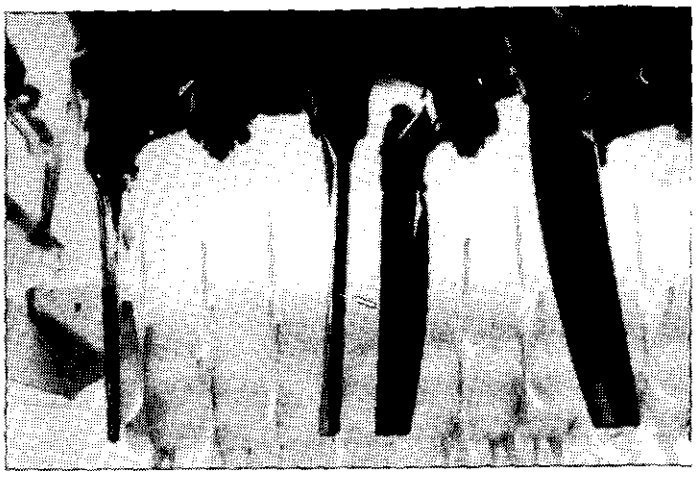
Farmers will play their part on Nitrates

The National Farmers' Union has reiterated its commitment to working with the Government and other interested parties to make every effort to prevent nitrates in water rising to unacceptable levels and has called for more research into ways to minimise leaching into the water supply.

According to NFU Deputy President, David Naish, "We are assured that there is no risk to health at the current levels of nitrates in the water supply. However, the EEC has imposed an arbitrarily low limit on the level of nitrates in drinking water and the British Government has rightly derogated from this limit. There is no justification for setting levels this low.

"Farmers are happy to consider scientifically-based schemes to minimise future increases, but they cannot be expected to be held responsible for actions they and their forbears were encouraged to take in the past. Rising levels of nitrates in groundwater are partly the result of farming practices over the past 30 or 40 years.

"Already farmers have started to implement a number of relatively new practices which are recommended to reduce the amount of nitrate leaching from the soil. These are outlined in the recent DOE report "Nitrate in Water". More research is still needed on the whole question of nitrogen to find out what further positive action farmers could take!'



New blade type tines are now available as an alternative to standard cylindrical tines on the Kronerotor from Bernard Krone (UK) Lld.

Top soil "manufactured" on site

Stockley Park, London, one of Europe's largest domestic refuse tips, is in the process of being reclaimed and landscaped.

Carrying out this considerable project are Bernhard's Landscapes who have developed their own method of manufacturing on site up to 150 acres of first class topsoil.

Topsoil is made from selected clay mixed in strict proportions with dry sewage sludge supplied by the Thames Water Authority. Mixing is done on site by machinery imported from Holland and adapted by Bernhard's Landscapes.

One million cubic metres of topsoil is thus to be textured from inexpensive natural materials and significant saving is claimed over normal reclamation costs, as well as better results.

A classic golf course will be put on the site of the former refuse tip, together with soccer and other sports pitches, to form a new public amenity.

Applying slurry with the Kaskad C100/300S hose reel irrigator

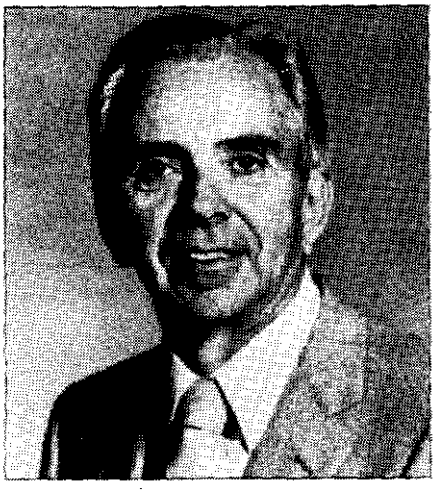
Irrigator for Slurry Application

North Yorkshire based Kaskad Irrigation Ltd recently commissioned one of its C100/300 hose-reel irrigators specially designed for the spreading of sewage sludge at Finedon, near Kettering, Northamptonshire. The machine was purchased by Transorganics Limited, a company which disposes of various effluents under contract to many local authorities nationwide. Transorganics will use the machine all year round to empty 4,500 gallon tanker lorries. The lorries are emptied in about 15-20 minutes with Molex screw p.t.o.–driven pump through the Kaskad irrigator.

Fitted with a galvanised steel boom incorporating two saucer-like deflector plates, a fan shaped low level spray pattern is produced from the outlet nozzles. This low level spreading is essential to minimise wind distortion and to keep down the aerosol effect which would otherwise cause local environmental problems. Accurate wind-in speeds are also essential for the safe application of such effluents.

Kaskad Irrigation sees the slurry/sewage disposal market as a useful complement to its larger activities in the agricultural spray irrigation market.

Further details: Kaskad Irrigation Ltd
Epworth, Doncaster Tel: (0427)873034



Countryside Engineering Award

Congratulations to SaWMA member Melville L. Palmer, winner of the American Society of Agricultural Engineers 1986 Countryside Engineering Award.

The Award has been presented annually since 1973 "to honour outstanding engineering contributions to the healthy climate of the American Countryside and to a viable economy for its small towns!'

Melville Palmer is Professor of Agricultural Engineering at Ohio State University. The citation notes that he has made a significant impact on countryside development through his work in extension and teaching and by developing methods and systems for improving rural water supply and on-site home sewage disposal.

PIPELINE...PIPELINE...PIPELINE... PIPELINE...

Universal Soil Test Kits for Farmers and Growers

Two complete soil analysis kits have been developed by Wilkinson & Simpson to allow farmers and specialist growers to do their own soil testing in the field.

Designed to provide an easy to use alternative to sending soil samples for professional laboratory analysis, the Palintest kits are claimed to give quick and accurate results for use with standard fertilizer calculation tables.

Cereal Quality

Advance notice is received of a Conference to be held in December '87 at Harper Adams Agricultural College. The Conference is being organised by the Association of Applied Biologists and the provisional programme includes such aspects as quality requirements of cereal users; the effects on quality of weed diseases and pests and their control; crop management and nutrition. Full details from Mr. P. S. Kettlewell, Harper Adams Agricultural College, Newport, Shropshire TF10 8NB.

An answer to your problem?

ENAK Ltd are looking for problems. They think they may have an answer already with their range of water-soluble plastics.

The ENAK material, strong, flexible and printable, looks just like ordinary plastic film but immerse it in water and it dissolves before your eyes, "Disappears without trace", say ENAK. So presumably there is no chance of creating a pollution problem in the water.

If you think the ENAK soluble film could answer a problem for you ENAK would like to hear from you. Their address is ENAK Ltd., Foundry Close, Horsham, Sussex RH13 5PX.

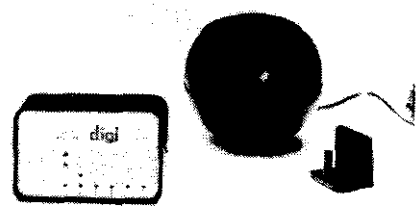
Arable Farming – Planning for Profit

Velcourt Group Plc is inviting anyone with an interest in profitable arable farming to a demonstration of crop production trials at Vine Farm, Wendy, Nr. Royston, Herts on Tuesday, 30th June and Wednesday, 1st July 1987. The demonstration is entitled "Arable Farming – Planning for Profit".

At the trials, visitors will be invited to see how the application of the latest technology in plant protection has enabled Velcourt to achieve an average of 8.6 tonnes per hectare for wheat over the past three years, and a profit before rent and interest of £401 per hectare.

Tickets, available at a cost of £5 per visitor to include lunch, are available from Velcourt Group Plc, c/o 26 Hay Mews, London W1X 7RL.

Remote rainfall recording



The DIGI-RAIN *Electronic Rain* Gouge

Rekord Sales (GB) Limited of Atherstone are pleased to announce that they have secured the sole UK marketing rights for the Danish made DIGI-RAIN fully automatic rain gauge.

The extremely low priced high accuracy Rekord DIGI-RAIN consists of a weather resistant, frost proof gauge unit through which the rainfall passes. Each measured drop falling through the bottom of the unit is electronically counted and the unit never requires any emptying.

A remote monitor/control box, which is located indoors, has a built-in memory which allows both total and periodic rainfall to be measured at the same time (e.g. daily and monthly) and a digital read-out to 1/100m or 1/100 inch as required.

The Rekord DIGI-RAIN operates on two 1.5v batteries and will undoubtedly prove invaluable to farmers, horticulturalists and gardeners. Price of the DIGI-RAIN, Including fixing bracket and 10m cable, is just £26.00 plus VAT.

Rekord Sales (GB) Ltd., Manor Rd, Mancetter, Atherstone, Warwicks CV9 1RJ Tel: (08277) 2424

The Green Grass of Stoke

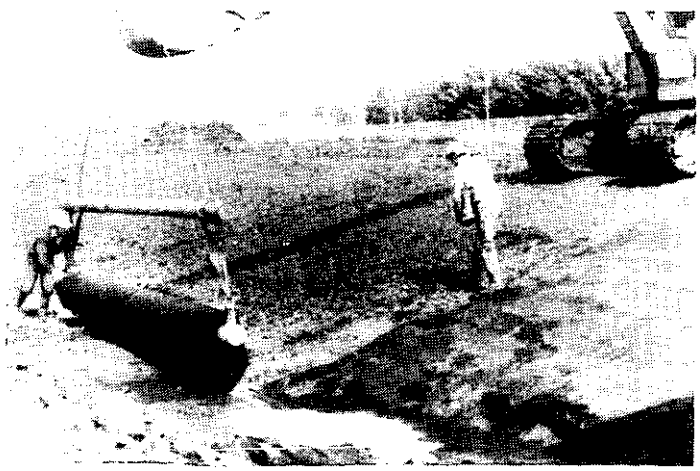
Landscape architects had a first hand opportunity to see the results of a combined erosion control and environmental protection system when they attended their Institute's national conference.

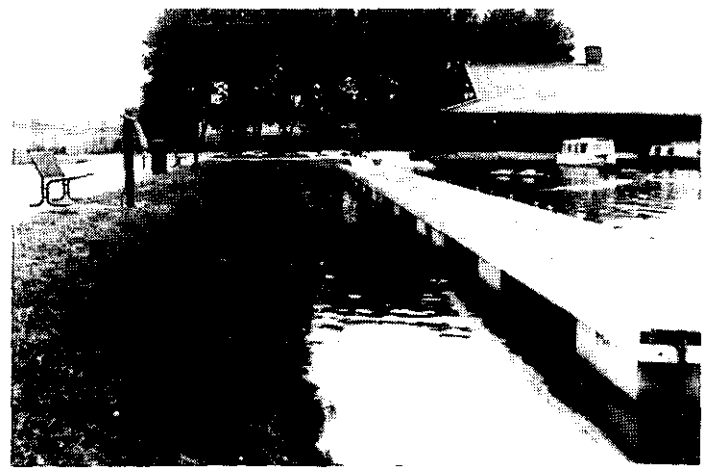
The venue of the conference, Keele University, was chosen because of its proximity to the Stoke Garden Festival where the marina was a green field site 18 months ago.

Because the newly cut earth banks would be vulnerable to the action of the water some protection was needed to avoid causing erosion. MMG's Enkamat A was specified and 1,400 sq. metres of this three-dimensional matting bitumen bound gravel was laid on two sides of the marina and seeded down to normal water level.

By the time the festival opened in May last year the two natural sides of the marina had full grass growth down to the water's edge.

Enkamat A is the product of MMG Civil Engineering Systems, Waterloo House, Kings Lynn, Norfolk PE30 IPA.





Left: Enkamat A being *laid* on *the* site *of the Stoke* Garden Festival *Marina.* Right: thefully *grassed* banks.

Farm waste treatment plant wins pollution abatement award 1986

An Anaerobic Digestion plant, treating cattle and poultry wastes on a farm in Northern Ireland, is one of two winners of the Pollution Abatement Technology Awards for 1986.

Farm Gas Ltd, the Shropshire-based company which designed and built the digester, shares the Award with Our Lady of Bethlehem Abbey, the owners and operators of the plant, and the University of Ulster Freshwater Laboratory, who were closely involved as consultants.

The Award-winning plant on the Abbey farm illustrates just how effective this form of treatment can be. The digester cuts the polluting power of the waste by as much as 80%, greatly reduces the smell, destroys weed seeds and disease organisms, and makes the considerable amount of nutrients in the waste more readily available to plants. Yet it has very low running costs, and produces enough excess gas to have virtually replaced the Abbey's previous combination of wood-burning and oil-fired central heating systems.

After digestion, the waste passes through a separator, which splits it into a thin liquid and a solid. The liquid is spread on fields to help fertilise the farm's organically grown wheat, which is dried at harvest-time using heat from the digester gas. The separated solids are composted and mixed with peat to produce a rich fibrous soil-conditioner and fertilizer, which is sold to market gardeners and garden centres – and has a high potential value as a new farm product.

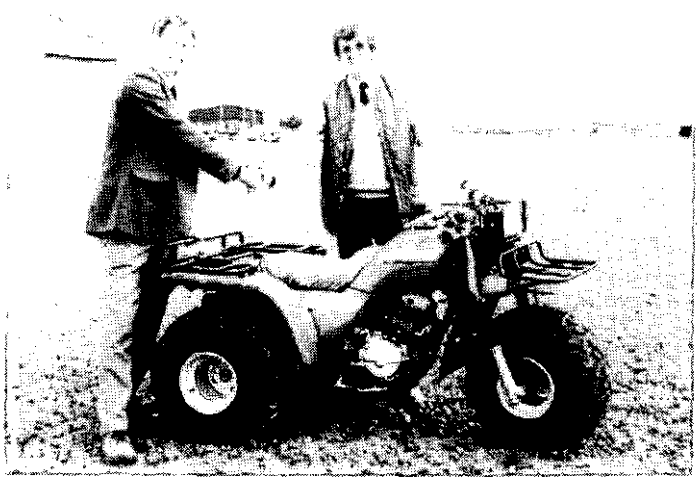
Awards for Pollution Abatement Technology are financed by the Environment Foundation and promoted by the Confederation of British Industry, the Department of the Environment and the Royal Society of Arts.

Farm-bike sales expand

Peacock & Binnington, recently appointed dealers for the full range of Honda ATC motorcycles, are now making extensive sales of these unique 'farm bikes' to all areas of the industry – especially to those people in the contracting and consultancy areas.

Bernard Willson, Arable Crop Consultant of Dunholme, Lincs recently purchased such a 125cc machine from P & B Louth. He sees these machines as a necessity for his business. "Providing a 'consultancy service' to farmers", says Bernard Willson, "involves regularly inspecting crops, covering all areas of the fields".

"Before the ATC, I had to move from one area of a field to another on foot and this wasted a great deal of valuable time, especially in the winter months when both weather and light were against you. Now, the ATC, with its low ground pressure tyres, allows me to move easily across the fields, allowing more time with the crop and to inspect all areas of the field."



Bernard *Willson receiving* his Honda ATC *motorcycle* from F'eacock & *Binnington's Derek* Blow.

Land Management Services join forces

Irrigation Land Management Services (IMS), the independent irrigation scheduling and advisory service run by Atkins Land & Water Management and Silsoe College has joined forces with the Soil Survey of England & Wales.

IMS has been providing irrigation scheduling advice to farmers, mainly in East Anglia, since 1984. During the summer, IMS staff visit farms regularly to measure changes in soil water content. A computer model is then used to predict when to irrigate individual crops. A soil survey is an integral part of this service.

An Irrigation Management *Consultant* measures soil water in the field using a neutron *probe.*

The Soil Survey of England and Wales, based at Rothamsted, has regional offices throughout the country. By joining forces, technical advice can now be provided nationwide on all aspects of irrigation practice. This includes irrigation equipment selection and design in relation to the soil's physical properties, cost-benefit analyses as well as irrigation scheduling.

IMS will continue to be run by Ian Mathieson; Exning (063877) 627.

Wasting Money like Water?

Water Management Services Ltd., is a company specialising in the location of leakage from underground water mains. Their service is particularly valuable to metered water users and it has helped many consumers make substantial savings on their water charges.

In addition to the leakage location survey the Company also provides an electronic monitoring service to profile water consumption over short and long periods for indentifying water loss through leakage and wastage from water using utilities. The follow up survey is then undertaken to pinpoint the water loss.

According to Water Management Services, around 30 per cent of all water distributed by the Water Authorities is lost through underground leakage. Often the figure can be much greater.

In a survey carried out by Water Management Services at a British Gas Administration Centre, a loss of **44.3** per cent of the total consumption was identified. Follow up work on leak detection identified the problem areas and British Gas are now saving about £25,000 per annum.

PIPELINE...PIPELINE...PIPELINE...PIPELINE...

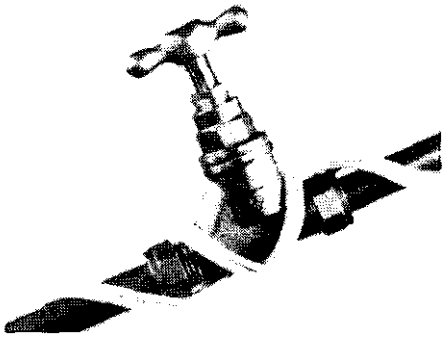
Frozen pipes problem finally beaten

Modern technology has found an inexpensive way to overcome the age-old problems of avoiding frozen pipes.

Pipe specialists Frazer have introduced TRICER, a self-regulating heating tape which operates only when the temperature approaches freezing point.

This offers a number of benefits to farmers; for instance they don't have to remember to switch it on and they won't be using power except when absolutely necessary. (TRICER wen restricts its output, heating only those individual sections of the pipeline liable to freezing – such as an exposed stop-cock for instance).

The availability of TRICER means that it is no longer necessary to drain systems in anticipation of freezing temperatures and that the consequences of the water supply being cut-off – (thirsty livestock, byres, milking parlours which can't be cleaned



properly and general disruption of a working day) – can be confidently avoided.

The installation of TRICER is quite straight forward, enabling the user to cut lengths to suit his system and simply wiring in to a local electricity supply.

Details from Robert Frazer Industrial, Hebburn, Tyne and Wear NE31 IBD. Tel: (091) 483 4616.

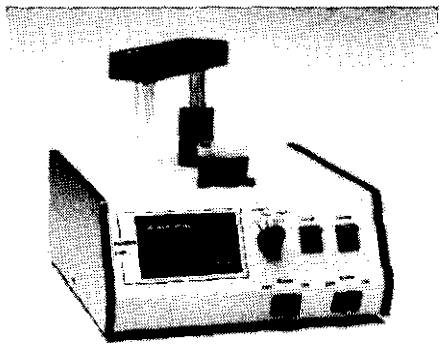
Wild Flower Seeds Brochure

Johnsons Seeds 1987 wild flower seeds brochure has been completely redesigned to simplify mixture selection. The new format presents the JF range of 14 mixtures in 3 distinct groups under clear headings – mixtures recommended for (I) most situations (2) more specialised situations (3) only very specialised conditions.

The Management Summary includes diagramatic visual aids, tables and has been expanded to cover questions which constantly arise relating to Annual Mixtures, the vexed question of Topsoil/Fertiliser use and Management during establishment.

Johnsons Seeds is the only National Seed House currently involved in large scale seed production of wild flowers and grasses, a project which was initiated almost 10 years ago. The product of the early work establishing extensive representative seed collections from hundreds of native wild populations is now bearing fruit, enabling the company to offer unrivalled back-up, advisory and technical services as explained within the brochure.

Copies of the New Mixture Brochure and Price List are available on request, together with the 20 page full colour booklet 'Johnsons Wild Flower Guide' direct from Geoff Taylor, Johnsons Seeds, London Road, Boston, Lincs PE21 8AD.



Channel *Electronics PCLM3* Chloride Meter will provide quick and *accurate determinations of* Chloride in a wide variety *of industrial,* scientific and clinical applications, with a minimum *of* controls to ensure simplicity *of use.*
Further *details: Ron Hatley,*
Channel Electronics *(Sussex)* Ltd.,
P.O. Box 58, SEAFORD, Sussex BN25 3JB
Tel: (0323) 894961

BOOK NOW
the next
Soil Management Course
4th–7th January 1988
Silsoe College, Beds MK45 **4DT**

L D Bourgein produces Dig-Anything Wheel

L D Bourgein Oxford Ltd's latest attachment for the popular Task Force 700 trencher is the OXFORD WHEEL. Developed in their own workshop, it features tungsten carbidecutting tips to deal with the worst of ground conditions including stone, concrete and brick, often found on made-up sports grounds. The Oxford Wheel attachment ensures a fast neat trench with minimum disturbance, the spoil being removed by alloy conveyor at trailer height. Standard trenches are 2" wide by 10", variable to 16" deep if requested.

L D Bourgein Oxford Ltd have offered trencher sales and hire service for more than 20 years. The company specialises in finding solutions to users' problems and will happily advise on correct specification for each job.

Further information: Oxford (0865) 735420.

BIAC says 'No change needed in Planning Controls'

There is no justification for relaxing the present policies protecting agricultural land from irreversible development, according to the British lnstitnte of Agricultural Consultants. In a strongly-worded reply to a Draft Circular from the Department of the Environment, the Institute claims it is not necessary to allow permanent developments on farm land to reduce agricultural production. The future of the industry is still too uncertain and more land may be needed for biomass production or because applications of fertilisers and sprays may be curtailed. Current surpluses may also be of a temporary nature.

BIAC welcomes the Government objective of fostering diversification of the rural economy but would like to see a stronger commitment to conservation and improvement of the landscape and its value for wildlife.

Bourgein *TF700 trencher* with *Oxford* wheel attachment

d on soils i

John Hollis, Soil Survey of England and Wales, reports on the 13th International Soil Science Congress, 1986

The thirteenth Congress of the International Society of Soil Science was held in Hamburg, West Germany in August 1986 with the theme 'Demands on soil–increasing in diversity and intensity'. There were almost 1500 participants from 82 countries and nearly 1000 papers were submitted either as oral presentations or as posters. Pre- and post conference tours also gave good opportunity to see a range of soils and land use throughout Germany.

This report reviews some of the more specific topics covered during the course of the meeting.

World need for greater soils knowledge

Introductory papers from representatives of FAO, UESCO, UNEP, CGIAR (Consultative Group of International Agricultural Research) and German Government Departments stressed the need to cope with increasing demands on the soil resource through an increased knowledge of soil properties and their spatial variation.

In the developing world, soils knowledge is vital for the production of sustainable cropping systems that do not degrade the soil resource. This is particularly true in Africa where, as the UNEP delegate emphasized, work to get the continent feeding itself has hardly begun.

In the developed, and largely temperate, western world on the other hand, soils knowledge is necessary to reduce the risk or effects of environmental pollution, both from agriculture and industry and to maximise the efficient use of land.

Models for soil water relationships

There were many presentations of models for soil water relationships. They varied greatly in approach from very sophisticated models based on large numbers of detailed field measurements, to relatively simple models using good estimates of soil physical properties based on field morphology calibrated from a limited amount of measured data. A. J. Thomasson (Soil Survey of England and Wales) gave a useful summary of these approaches and suggested that before initiating detailed research, workers should have a clear idea of the use to which moisture variation models are to be put.

Where models are needed to predict erosion risk, groundwater recharge or the need for, design of and response to drainage, then only data on the average annual pattern of soil moisture variation is necessary. For irrigation scheduling on the other hand, data on the daily variation of soil moisture is likely to be needed.

There were also several interesting presentations from workers in the Netherlands Soil Survey Institute (J. Bouma and J. H. M. Wosten) on the transformation of soil maps into maps that provide data for predicting seasonal moisture variation. This was achieved using models that predict hydraulic conductivity, groundwater table levels and upward capillary movement from a groundwater table, in major horizons of the different soil types shown on a map.

An international working group under the chairmanship of Dr Bouma was set up to study soil moisture variability in space and time.

Use of Soils as Pollution Barriers

There were two interesting papers on this theme. One reveiwed work in the USA on the measurement and monitoring of the permeability of remoulded or artificially compacted clay subsoils both to water and to organic solvents. The other reported work from West Germany on the use of calcareous subsoil materials to stabilise and reduce the seepage of toxic elements from buried fly ash into groundwater.

New ways needed to map soil data

There were many papers on the problems of mapping soil spatial variability, with much emphasis being placed on the use of modern statistical and computing techniques to quantify and display spatial variation of soil properties. There was however very little information as to the relative costs and economics of traditional soil mapping methods versus modern geostatistical ones.

In his plenary paper, Prof. R. Dudal (FAO, Rome) summarized the present situation by questioning traditional ways of presenting soil data on maps and suggesting the need for alternative methods of mapping and presentation related to the purpose of the survey and the likely spatial variability of soil properties most important to that purpose.

Acid soils in forests but no sign of acid rain damage

On a post conference trip around Southern Germany, 25 soil types were demonstrated, mostly under forest. Almost all the stands were between 60 and 120 years old, with annual growth rates ranging from about 8 to over $14 m^3$ per year. Growth rates were often well correlated with soil types.

It was of interest that none of the forests visited showed signs of damage from 'acid deposition' and in the view of most forest managers at the sites, such damage, whilst severe in some cases, was very localized with factors such as slope, aspect and severity of winters playing an important role.

However, it was striking to see the very acid nature of the forest litter and upper layers of most soils, with pH's (in $CaCl_2$) commonly between 2.7 and 3.2 on the coarser textured soils.

Importance of soil studies and Government backing

The overall impression gained from the meeting was that the study of soils, whilst a relatively young science, has made great strides forward, particularly in the last few decades. Future developments are likely to be based on more interdisciplinary studies in which the present somewhat fragmented approach of physicists, chemists, biologists and mineralogists are combined in truly 'pedological' studies of the soil as a whole.

Additionally, there is increasing emphasis on the need to demonstrate the wide practical and economic importance of soil studies and to communicate this importance in meaningful terms to both politicians and the general public.

The conference was well organised and it was impressive also to see the efficient organisation of German soil research with its multidisciplinary approach and constructive dialogue between researchers, land owners and local or regional government bodies.

In contrast with many other countries, there appears to be in West Germany an impressive level of Governmental support, the Ministry of Research and Technology having recently made available 10 million DM (about £3.5m) over the next few years for research into the preservation of the nation's soil resources.

The next ISSS congress will be held in **1990** in Kyoto, Japan with proposed field excursions around Japan and to China. Start saving now!

The Hamble Series

Soil Assessment—M. G. Jams, Soil Survey of England and Wales

Hamble series consists of well-drained silty soils developed in stoneless silty drift or brickearth found principally in south east and eastern England. The soils are domiuant over some 370 sq km in England and this includes some of the most valued land for agriculture and horticulture in Essex, Kent and Sussex.

The distribution of the Hamble soils can be seen on the National Soil Map Sheets 4 and 6 mainly in associations 571y and 571z (Hodge et *al* 1984, Jarvis *el al* 1984). Hamble soils occur most extensively on flat or gently sloping low lying land over river terraces or raised beach sands and gravel at altitutdes between 4 and 18m OD, for example around Chichester in West Sussex, on high ground as on the North Downs in east Kent where patches of silty drift are found at 135-150m OD, and on the gently undulating lower part of the North Downs in Kent.

The large proportion of silt in brickearth suggests that it was orginally windblown material or loess laid down during cold periods when ice sheets covered much of England and Wales. However, it has subseouentlv been disturbed and redistributed by various agencies including frost action, solifluction and stream erosion d deposition.

The Hamble series was first identified in south Hampshire (Kay 1939) and the soils occur extensively on the West Sussex coastal plain (Hodgson 1967). Here and elsewhere Hamble soils are associated with other, wetter brickearth soils. The wettest are Park Gate soils which are affected by high groundwater and are seasonally waterlogged. Hook soils are only occasionally waterlogged, however, with grey and ochreous mottling confined to the subsoil below 40cm.

Hamble soils are brown throughout, unmottled and never affected by groundwater or impeded drainage although faint rusty mottling may occur in topsoils compacted by excessive trampling by stock.

Permeability is improved by the presence of large vertical earthworm channels which can extend to depths of 1.5m or more. A brief profile description of a Hamble soil is given below.

cm	
0-25	Dark brown, stoneless silt loam or silty clay loam.
25-50	Brown, stoneless silt loam or silty clay loam; weak fine subangular blocky structure
50-80	Brown, stoneless silty clay loam, moderate medium orismatic structure.
80-100	Brown. stoneless silt loam or siltv clay loam; moderate medium prismatic structure.

Opportunities for landwork

Topsoil and upper subsoil structure is usually weak especially on cultivated land where organic matter contents are small and cultivations need careful timing to avoid compaction. Bare soil slakes and caps if exposed to heavy rain and water erosion is a risk on sloping sit . especially wh cron rows and wheelings run up and down the slope. There are ample opportunities for cultivation in autumn and spring over most of the land in average years although in wet seasons there are fewer days when machinery can safely be used particularly in spring.

Cropping

Hamble soils have good reserves of available water and are only slightly droughty for cereals. Potato and grass yields are commonly reduced by lack of moisture however, and irrigation is beneficial for these and other crops in most years, particularly in direr districts such as the Isle of Thanet and the Essex coast around Shoeburyness. The soils are naturally acid and regular liming is necessary in some districts to avoid patchy acidity.

A wide range of crops is grown on this fertile land. In north Kent it is mainly these soils that are used for theextensive top fruit and soft fruit orchards and hop gardens. Elsewhere cereals predominate with ley grassland where there are dairy herds. The land is also suitable for roots and other vegetabl including e rly and maincrop potatoes, the early crop being ticu y favoured in locations like the Isle of Thanet which has over 200 frost free days a year. Vining peas, beans, bulb onions, brassicas and flower bulb crops can also be grown successfully but exposure restricts some crops in coastal districts.

The glasshouse production of tomatoes, cucumbers and lettuces in West Sussex is concentrated on Hamble soils.

Almost all of the land is in agricultural use. The association of some Hamble soils with sand and gravel desnosits means that there is pressure in some places for extraction. Brickearth is itself worked in North Kent between Faversham and Gillingham. If handled and stored carefully, the soils are easily replaced, however, and the land can often be cropped as before.

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Harpenden, Herts, AL5 2JQ.

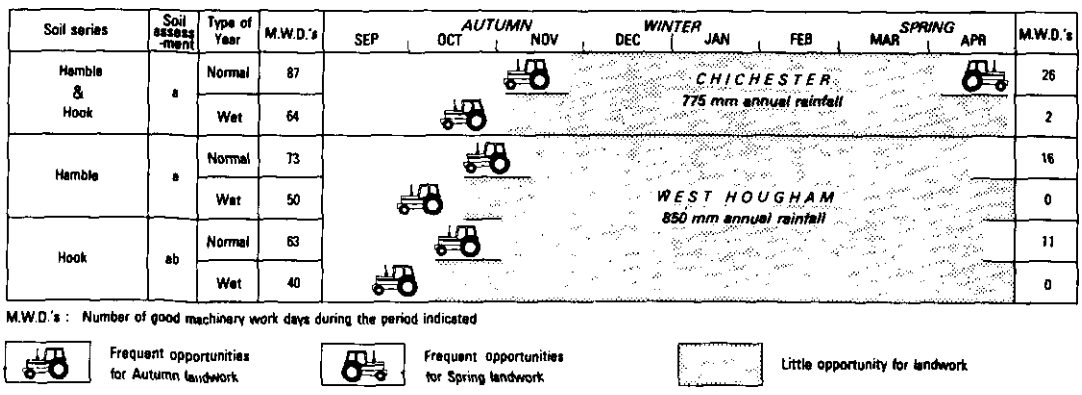


Fig I. The effects of soil and climate on opportunities for tillage and other work on land with Hamble and Hook soils around Chichester, West Sussex and West Hougham, Kent.

Field Drainage 1940 – 1984 – A success! But where to now?

Chris Stansfield* surveys achievements and developments but expresses concern that in the drive to contain and reduce costs not enough attention is now being paid to the benefits of field drainage. Effective field drainage gives better soil conditions offering more efficient use of seeds, fertilisers and sprays, reduced machinery costs and better timeliness of operations.

Field drainage from 1940-1984 has been a success story based on the combined efforts of the Ministry of Agriculture, manufacturers, suppliers and contractors responding to the nation's need in helping the farming industry achieve its targets.

Food from our own resources

At the onset of the war it was clear that extra production from our own resources was needed and from then on expansion in food production was the name of the game. The "War Ag" contracting services, grant aid and a state advisory service all combined to stimulate many important developments which enabled crop production to advance. The drainage of land long-neglected was of prime importance in the race to self-sufficiency and the often-used phrase "you can't farm with water" was as true then as it is now.

Rule of thumb to science

In the wake of these early efforts, design has changed from the local rule of thumb – "what was good enough for Dad is good enough for me" attitude – to scientific design based on proven principles as a result of intensive research and development.

Today, design balances soil texture, structure and depth with the topographical features, rainfall amount, duration and intensity, type and value of cropping, and degree of risk. All these are considered together with farming practices to arrive at design options which can be evaluated in relation to cost and benefit. Such calculations can now be done in the farm office on a portable computer. For larger projects, computer modelling which can predict day-to-day water levels can also be used.

Permeable backfill, virtually unheard of in 1940, is now used as a necessity on about 75% of all systems and, coupled with mole drainage and subsoiling, speeds the movement of water through the soil.

Plastic pipes developed in the late 1960s now account for about 90% of the pipe market. Trenchless drainage developed in conjunction with plastic pipe offers a viable and economical alternative to open trenching methods. In addition a variety of filter materials are available for use in soils where sedimentation is a risk. More recently, lightweight Glass Reinforced Cement outfall, inspection chambers and silt traps have been introduced which are easier to install with less waste

Vital role of Water Authorities, IDBs and Ministry

All of the work on field drainage would have had little effect without the improvements carried out to the arterial drainage channels and pumping systems by Water Authorities and IDBs. These works have provided the vital outfalls that the field drainage depends upon and have reduced the incidence of flooding to acceptable levels.

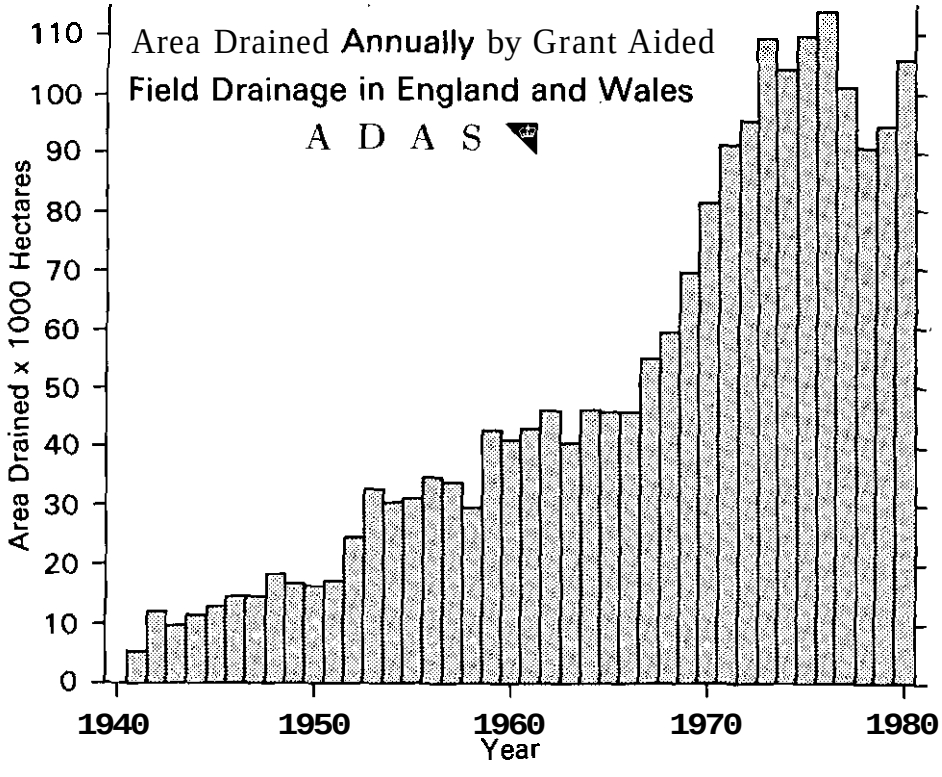
The minimum technical standards developed by the Ministry of Agriculture for grant aid have been adopted by both the National Association of Agricultural Contractors and the Land Drainage Contractors' Association and form a basis for all work carried out in the UK. The Ministry of Agriculture's education programme has enabled farmers to appreciate the need for, and the financial value of, field drainage.

In addition, by pulling out of contracting in the 1950s, the Ministry assisted the establishment of the present highly skilled contracting businesses which has encouraged the development of an innovative manufacturing and supply industry.

Throughout this period, research and development work has helped all involved with drainage to understand what happens to water in the soil, how it can be controlled and the benefits available.

Golden age past, but still two million hectares could show benefit

The past forty years have ssen the annual



*ADAS, *Deputy Senior* Soil and *Water Engineering Adviser,* London

area drained rise from 6000 hectares a year in 1941 to over 100,000 hectares in the late 1970s. Unfortunately area statistics have not been available since 1980 hut the value of investment in grant aid from 1979 onwards shows that by 1984 over £86m was ploughed into grant-aided farm and public sector drainage works, the indications are that the industry would have a capital output of around £100m.

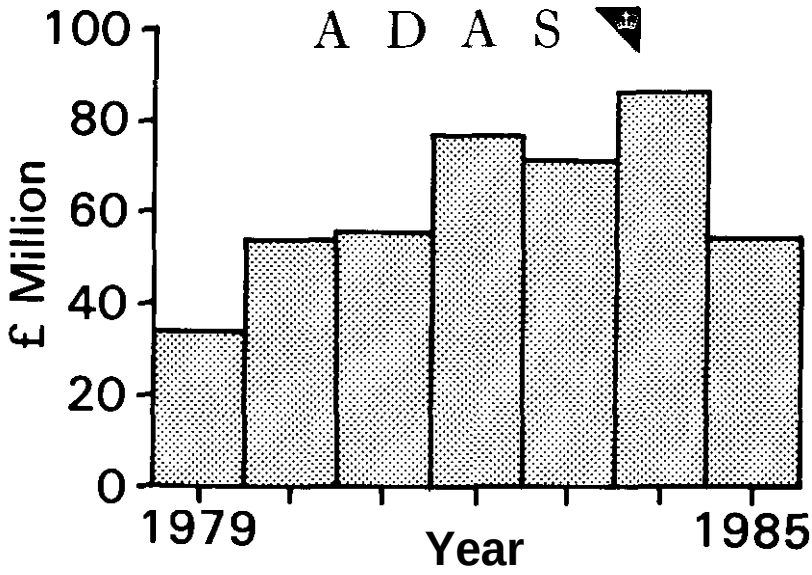
Although the area of field drainage carried out in the 40 years from 1940 is impressive at just over 2m hectares, it pales into insignificance when compared with the golden age of agriculture from 1840-1880 when double this area was drained and all by hand. This also puts into perspective some of the criticism levelled at field drainage by conservation bodies that modern drainage is decimating the wildlife of the countryside. Our continuing rate of progress has been slow and the majority of the area drained since the war had already been drained 100 years earlier.

BY the early 1980s the farming industry had paradoxically become too successful and the problem of EEC surpluses was with us. This, coupled with lack of confidence in the future by farmers, reduced farm incomes, shortage of capital, reductions in grant aid and cuts in capital taxation, have seen the annual area drained cut by well over half in two years. A gloomy picture at present but what of the future?

The MAFF Survey in 1968/69 indicated that over half the agricultural land in England and Wales relied on field drainage for economical production and that a quarter, or 2.9m hectares, still needed drainage. Even with the high rate of drainage in the 1970s and early 1980s. reliable estimates would indicate that some 2.3m hectares would still benefit economically from drainage.

Although modern, properly-designed systems last longer, field drainage, like machinery or buildings, deteriorates with time and estimates indicate that approximately 50,000 hectares of existing drainage ceases to function for various reasons each year. With the area drained each year being less than this figure no in-roads are being made into the backlog.

Value of Grant Aided Investment – Field Drainage in England and Wales



Field Drainage Necessary for Good Land Management

Field drainage is recognised as an activity which prudent farmers ought to under-take in the interests of good land management. In addition, the investment in drainage returns a substantial benefit.

On impermeable fine-textured soils, which make up 60% of the farmland in England and Wales, field drainage is an essential factor maximising efficiency and flexibility of land use

The role of drainage is seen by uninformed people as a means of maximising production but this is much too simplistic. The true benefits of drainage are seen in better soil conditions which enable more efficient use of seeds, fertilisers and sprays, reduction in wear and tear on machinery and better timeliness of cultivations so that work on the land is done at the right time.

On top quality land, a high standard of drainage is necessary to permit a wide range of crops to he grown; it is necessary to ensure that drilling/planting and harvesting can be carried out to suit the market requirements. With the consumer expecting a consistent standard of high quality produce for as long as possible, drainage is neglected at the farmer's peril.

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Field Management **for** Effective Drainage
Short **course**
4th–7th January 1988
Silsoe College, Beds MK45 4DT

Drainage Reduces Costs

On poorer quality land, the farmer maintains his income by containing and reducing his costs. Better soil water control enables early turn out for stock, reducing expensive purchased feed hills and saving on health care. With farmers' production under close scrutiny, the way to ensure profitability is to get the basics right. Field drainage is a prerequisite of economic farming.

Whatever happens during the next few years with alternative crops – many requiring exacting standards of drainage, set aside, or fallowing, field drainage has its part to play. The requirement will be for hetter-designed systems to match cost, risk and value, cheaper and more effective systems that will remove excess water quickly, systems which are easy to maintain and long-lasting, systems that farmers can install with low-cost machinery, making use of farm labour.

As well as drainage work on agricultural land there are many opportunities on land which is taken out of farming for short periods such as opencast coal sites, mineral extraction, waste disposal sites and pipeline installations. Further work, although limited, is available on land used for recreational purposes, such as sports fields, golf-courses and the like.

Field Drainage – a Fundamental Investment

Field drainage is of primary importance as a fundamental operation and investment on which over half of the farm crops in England and Wales rely.

All sectors of the drainage industry have pulled together in the past to achieve what we have today. A few years ago the UK was top of the league for drainage activity in Europe but this has now been taken over by France.

Our rate of drainage at present is not keeping up with the old systems going out of use. We must not be complacent. It would be foolish and short-sighted to let our hard-won advantage slip away.

The strength of the drainage industry has developed because of its common aim and manufacturers, suppliers, contractors and the Ministry have worked closely together. This central core, coupled with the research and development work by ADAS' Field Drainage Experimental Unit, Agriculture and Food Research Council, Silsoe College and other organisations, should enable a reduced but healthy industry to look forward to a reasonable future.

One-pass tillage to avoid recompaction

Dick Godwin reports on the results of recent trials at Silsoe College

A common tillage practice on deeply compacted soils is deep loosening followed by one or more shallow cultivations to prepare a seedbed.

Whilst such treatments have given good yields in carefully managed small plot experiments it has, however, often been found that in larger scale field trials yields have shown generally little and frequently no improvement over that obtainable with the compacted soil.

This lack of response is possibly due to the soil being recompacted during the field operations following the deep loosening and evidence that this occurs has already been established by earlier research workers.

With the need to reassess cultivation nractices not least to seek ways for eventual cost reductions, the writer, together with colleagues G. C. Soane and G. Spoor at Silsoe College, has carried out comparative trials of different deep loosening and surface cultivation techniques and their effect on the soil*. These trials were conducted within a research contract on Deep Soil Loosening, working in conjunction with ADAS and with financial support from the Ministry of Agriculture, Fisheries and Food.

In the trials, three alternative treatments were investigated. These were:

- Deep loosening followed by mouldboard ploughing (Treatment A)
- Mouldboard ploughing followed by deep loosening (Treatment B)
- Simultaneous deep loosening and mouldboard ploughing – one-pass operation (Treatment C)

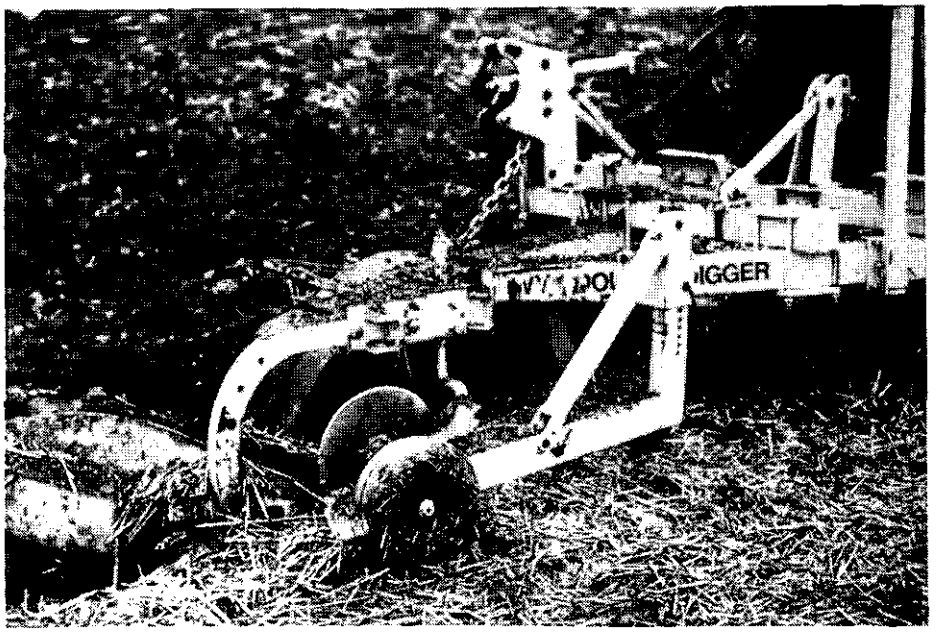
All the resulting soil conditions were then subjected to further tractor traffic on both high and low pressure tyres to simulate subsequent seedbed preparation working.

The equipment used for the separate deep loosening and surface cultivation treatments was a winged subsoiler and a three furrow fully mounted mouldboard plough. The winged subsoiler equipped with leading shallow winged tines was operated at a working depth of 450mm. The shallower tines were spaced 280mm either side of the deep tines. The plough operated at 225mm depth with one tractor wheel in the furrow bottom.

For the simultaneous deep loosening and ploughing the equipment used was a Wye Double Digger (see photo). This comprises a rotary cultivator operating to a depth of 450mm in a 300mm deep open plough furrow followed by a single furrow plough body mounted to the same frame (one pass operation).

The same tractor was used for all cultivation treatments – a 3.5t, 2-wheel drive model, equipped with conventional front and rear tyres inflated to 2 bar and 1 bar respectively.

The loading effect of subsequent wheel traffic was obtained by driving this same tractor over the loosened profiles equipped with either (a) conventional, high ground pressure tyres or (b) wide section, low around oressure (0.3 bar) tyres.



The Wye double diggerfor one-pass tillage.

The soil type chosen for the trials was a loamy sand (Cottenham Series) in a heavily wheeled condition, compacted to a depth of 0.35m. The previous crop was onions and the cultivations were carried out in June, 1985.

Soil conditions measured included penetration resistance, using a Bush recording penetrometer and dry hulk density using a dual probe gamma ray density meter. Measurements were made to a depth of 0.5m across a 1m wide section for the loosened zone and along the wheel centres for the trafficked areas.

Influence of deep loosening and mouldboard ploughing

The results of the trials are presented graphically in Fig. l showing the variation in dry bulk density and penetration resistance at different depths down to 0.5 metres. The undisturbed profile is typical of this soil type, where the upper zone is compact to a depth of 325mm.

As can be seen from Fig. 1 the systems of mouldboard ploughing followed by deep loosening (Treatment B) and simultaneous deep loosening and mouldboard ploughing (Treatment C) reduced the undisturbed soil bulk density to a depth of 400mm.

Where deep loosening was followed by mouldhoard ploughing (Treatment A), however, both the resulting bulk density and penetration resistance at depth were significantly greater than in the other two treatments.

The average soil hulk density after loosening followed by ploughing (Treatment A) was also found to he significantly greater than in the undisturbed soil. It was considered that this greater density may have been due to the compacting effect of the tractor wheels during the mouldboard ploughing operation and a subsidiary experiment was carried out to confirm this. Measurements taken under the tractor land and furrow wheels showed that the dry bulk density at depth was similar to that of the

*Soane, G. C. Godwin, R. J., and Spoor, G. 1986. Influence of deep loosening techniques and subsequent wheel traffic on soil structure. Soil Tillage Res. 8: 231-237.

undisturbed profile. Further analysis showed that with a three furrow plough all of the soil below 0.3m was re-compacted by the combination of both tractor wheel positions.

Recompaction by subsequent wheel traffic

The effect of one tractor pass with either high or low ground pressure tyres is shown in Fig. 2. This further wheeling (simulating tractor wheelings during seedbed preparation work) is seen to result in considerable recompaction in both the case of deep loosening after ploughing (Treatment A) and ploughing after deep loosening (Treatment B) regardless of whether the tractor was fitted with high or low pressure tyres.

Only in Treatment C where deep loosening and ploughing were conducted simultaneously did contact pressure have any significant effect on the final density profile. In this case the profile remained relatively loose following the low ground pressure wheeling, but compacted significantly under the high ground pressure loading with significant differences in the penetration resistance between the two.

One pass tillage and lpg tyres

Comparison of the results of the high and low ground pressure tyres shows that when the bearing capacity of the ploughed surface layer has been reduced by the action of the subsoiler legs (Treatment B—ploughing followed by loosening) both high and low pressure tyres can cause recompaction. Where, however, the ploughed surface layer remains intact, as with simultaneous loosening and ploughing, there is sufficient strength to support the low ground pressure tyres.

Comparison of the depth of sinkage of the front wheels using low pressure tyres further confirmed this effect. The sinkage increased from 65mm on the undisturbed ploughed surface to 100mm after the ploughed surface layer had been disturbed by the subsoiler legs. These measurements also indicate a possible lack of adequate consolidation in the disturbed surface.

Summarising the results of these trials it can be concluded that:

- The practice of deep loosening followed by mouldboard ploughing and subsequent random surface wheelings can cause significant recompaction of the subsoil zone on coarse textured soils, regardless of whether the wheels operate on the surface or in the furrow.
- The action of a subsoiler leg moving through a ploughed surface layer was sufficient to lower the bearing capacity to a point where the surface could not support even the low pressure tyre.
- Possible methods of ensuring that the effect of deep loosening remains to benefit the next crop are: (a) adoption on a one-pass system incorporating deep loosening, surface cultivation and drilling; (b) using controlled wheelings in a bed management system: (c) using lightly loaded tractors equipped with low ground pressure tyres on simultaneously ploughed and deep loosened surfaces. This could be achieved using a mouldboard plough equipped with underbuster tines.

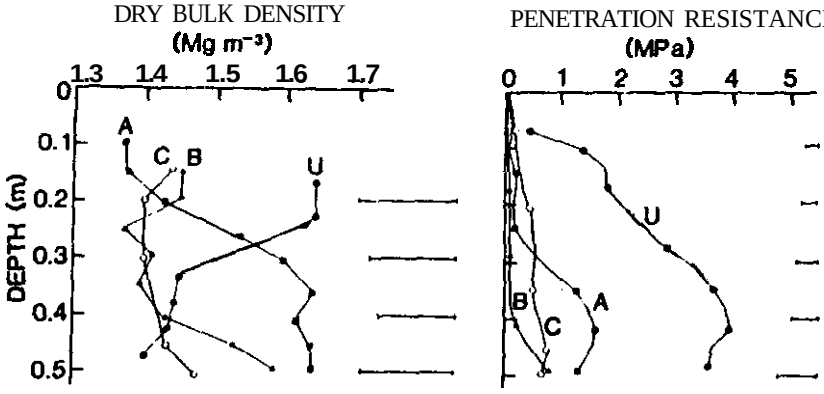


Fig. 1. Dry bulk density and penetration resistance profiles following alternative methods of deep loosening (A, B, C) in comparison to the undisturbed profile (U).

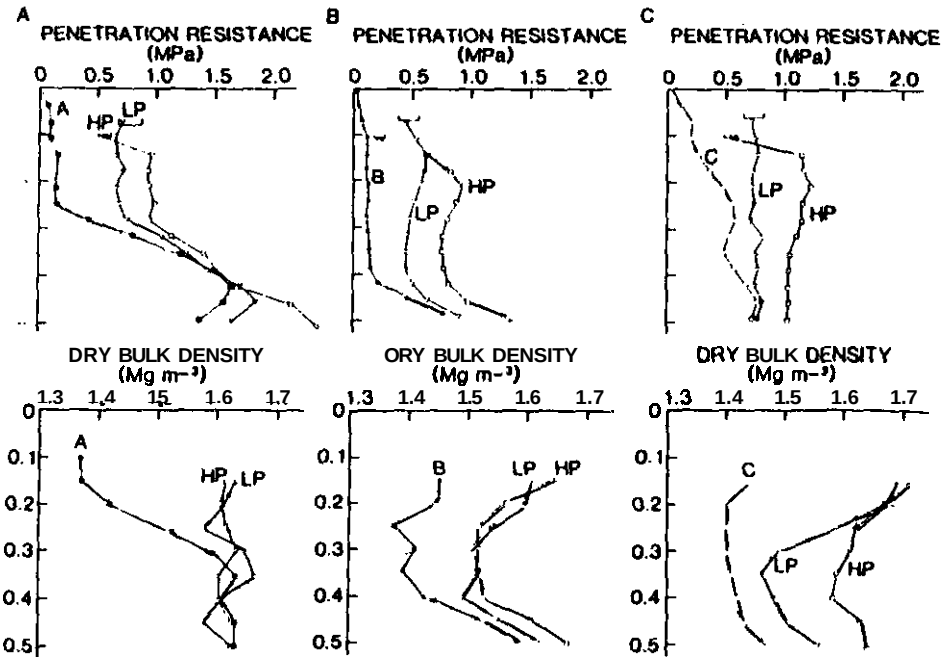


Fig 2. The effect of both high (HP) and low (LP) ground pressure wheel systems on the loosened profiles (A, B, C) for the A, B and C treatments.

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Tillage –What now and what next?

Conference verdict is–"Direct drilling still preferred, but now with occasional ploughing."

The Association's 1987 Conference "Tillage–What now and what next?", jointly sponsored with **ADAS** and **ICI** Plant Protection, attracted nearly 200 delegates, with the new Conference Hall at Rothamsted providing excellent facilities for the event.

Chairman of the Conference, Lord **Selborne,** summing up the day's proceedings referred particularly to the emphasis that had been placed **on "precision"– the** need to have a more precise knowledge of the condition of the soil and the need to be more precise in working the soil only when and where tillage was needed.

Quotes from the Conference...

"Many cereal farms are failing to take advantage of the savings in machinery and cultivation costs which shallow tillage can provide:' *Dr Bryan Davies*

"Don't waste money. First diagnose that there is a real need for sub-soiling:' Dr Bryan Davies

"We decided that inversion was necessary, and so, in autumn 1982–after ten years direct drilling – we started a plough system." Mr *Richard Dawson*

"If we didn't have to combine our laud we really wouldn't have to cultivate to loosen the soil to remove the compaction:' *Mr Anthony Forsyth*

"Perhaps the biggest surprise is that shallow ploughing, operating at 75-100mm, which both reduces energy and gives good inversion, has been taken up much less than it would appear to deserve!' *Mr* John *Matthews*

"There should be a better way of breaking up soil than dragging a blunt instrument through it. What is needed is a power-driven tool that consistently produces the inversion and surface burial of a well-set plough:' *Mr* John *Hawkins*

"Lack of consolidation–looseness– has probably now surpassed compaction as a major problem of soil management?' *Dr Bryan* Davies

"Until we have developed precision in our tillage operations we shall continue to do damage without knowing it and we shall continue to spend money–unnecessary money, that is–without knowing it and we shall not know what operations we should be eliminating:' Lord Selborne

First speaker was Dr. Bryan Davies, ADAS Regional Soil Scientist. Setting the scene for the Conference he reviewed the ideas and developments that have emerged over the past 20 years or so since the Strutt Report first pinpointed the need for better soil management.

Farmer speakers, Messrs Richard Dawson, Anthony *Forsyth* and Peter Thorogood–all long term practitioners of minimum tillage–described their experiences with the system. They all still favour direct drilling but they explained how over the years they have found an occasional ploughing necessary as a means of checking, if not absolutely controlling, sterile *brome.*

Some wide ranging discussion followed but with particular emphasis on the role of the combine, the need for lighter weight machines and the importance of unloading on the headlands.

In the afternoon, Mr. John Hawkins, Agricultural Engineering Consultant, dealt with the needs of current research. An urgent requirement is for engineers to come up with a power drive tillage tool which can produce a good seedbed in one operation. Longer term, soil scientists should be working to bring out an instrument to measure soil properties and indicate what, if any, cultivations are necessary.

Professor John Nix, Head of the Farm Business Unit, Wye College, University of London, presented a detailed analysis of tillage costs. The balance shows heavily in favour of minimum cultivation and direct drilling.

The final speaker, Mr John Matthews, Director of AFRC Engineering (the former NIAE) reviewed the potential for further development in cultivations and mechanisms. He spoke of ways of reducing energy requirements (shallow ploughing could he an early prospect) greater use of electronics, higher tractor speeds, gantry systems and many other possible developments.

The afternoon discussion explored the need for sprung suspensions, energy savings with gantry systems, the possibility of direct drilling under chopped straw and also a last minute reference to the new 'ball game' that might be introduced by genetic engineering.

Chairman of the conference–the *Earl of Selborne*. Besides being a *considerable* landowner and farmer in *his* own right, Lord Selborne is also chairman of AFRC the country's guiding and *controlling* body for *research* in *all* branches and in *all aspects* of farming and farm *product processing*.

Continuing role for SaWMA

Lord Selborne then drew all the various threads of the Conference together in his final summing up. With the prospect of our needing still greater precision of our tillages he envisaged an ever continuing need for SaWMA as a spur in achieving the necessary greater knowledge of our soil and in mastering the new technology appropriate to future practices.

Report of Proceedings now available

The following pages cover only extracts from the contributions of some of the speakers. Further extracts will he included in a future issue of Soil and Water. In the meantime a full report of the proceedings of the Conference, including discussion and Chairman's summing up has now been published and is available at £6.00 per copy plus 50p UK postage See page 34 for details.

THE SPEAKERS

Bryan Davies: The ADAS Regional Soil Scientist at Cambridge – HQ for the Eastern Counties. His main interest is the management of soils to achiwe the full potential of crops. He has wide experience in the UK and abroad both in advisory and research work, and has taken part in the development of reduced cultivation systems during their formative years. More recently he has been active in the National MAFF Evaluation of Straw Incorporation as an alternative to burning and is therefore well placed to take an overall view of soil management in the UK.

Richard Dawson: Studied Agriculture at Cambridge University and since then has farmed the 750 acre Kings Farm on heavy boulder clay at Pebmarsh, Essex. Started mainly with livestock but now all arable. Progression from traditional farming to direct drilling to continous wheat to total straw incorporation.

Anthony Forsyth: Farms, directly and on share cropping basis, some 5,500 acres of heavy clay land in Warwickshire. Pioneered direct drilling and no ploughing policy in his area. Tried helicopters for minimum ground pressure for fertiliser application and spraying but now reverted to improved low ground pressure wheeled traffic. Founder member of SaWMA and Chairman of Council since 1983. Chairman of FWAG Advisor's Steering Committee. Host farm for NAC Cereals 81. Winner of Farming and Wildlife Award, 1983.

Peter Thorogood: Farmer and agricultural consultant. Former founder Chairman of the Cotswolds Direct Drilling Group and currently Chairman of the North Bucks Soil Management Group. Currently farming 550 acres; intensive winter cereals and milking 180 cows with associated followers.

John Hawkins: Now a partner on a 300 acre farm. Was a founder member of the National Institute of Agricultural Engineering and on the staff there for 35 years. Researched in tillage tools and their effect on soil properties. Inventor of the wavy-edged disc coulter. Awarded RASE Research Medal in 1969 and the Award of Merit of the Institution of Agricultural Engineers in 1983. Has travelled widely overseas advising on cultivation problems and has been the British representative on EEC Expert Committees.

John Nix: Joined the Farm Economics Branch at Cambridge University in 1951 where he was mainly engaged on research into the economics of labour use, mechanisation and crop production. Moved to Wye College, (University of London) in 1961 and is now Professor of Farm Business Management and Head of the Farm Business Unit. Author of several books including the Farm Management Pocketbook, now in 17th edition. Chairman, 1979-81, of the Centre for Management in Agriculture and currently a member of the Board and Chairman of the editorial committee. Programme advisor to Southern Television for fifteen years.

John Matthews: Studied physics at London University and joined National Institute of Agricultural Engineering in 1959 to work on grain moisture content measurements and grain dryer control. Appointed Head of Tractor and Cultivation Division in 1973. In 1983, awarded the RASE Research medal for work leading to practical benefits for the farmer and also gained the I.Ag.E award for a paper on cultivation techniques. Appointed Director of NIAE (now known as AFRC Engineering) in 1984. Travelled extensively overseas and carried out consultancy work in India and China. Maintains strong interest in the link between research and development and the manufacturing industry.

TILLAGE

The past 20 years–Ideas and developments, successes and failures

Dr Bryan Davies

In 1968, arable agriculture was at a very low ebb. At that time, a run of adverse weather had wreaked substantial damage on soils and crops and compacted, sodden soils were everywhere.

The situation aroused so much concern that the then Minister of Agriculture asked his Advisory Council urgently to enquire into "the extent to which current practices are having adverse effects on soil fertility and soil structure!'

Sir Nigel Strutt chaired the Inquiry and extracts from his report "Modern Farming and the Soil" make interesting reading. He said first, "the Council has been deeply concerned about the flattening graph of increasing yields in recent years!' He then perceived that "there uld b a :abl response fr m the s f th country, if al forces combined to treat them with respect" and he finished by stating that, "he therefore sincerely hoped that the report would help to tip the graph of yields upwards again!'

There is not much doubt that that wish has materialised in practice–and has perhaps precipitated an even more difficult problem than the original.

	Per cent yield *increase*
Wheat	89
Barley	52
Potatoes	47
Sugar beet	17

Percentage increase in yields between 1968-70 and 1983-85.

The extent to which "Modern Farming and the Soil" was responsible for the improvement is obviously open to debate but I believe that it served as an excellent catalyst to progress in soil management and that the money from the Common Agricultural Policy did the rest.

Primary Tillage–to plough or not to plough

Twenty years ago the plough was nearly universal as a primary tillage tool, as it had been for centuries. However, the advent of grass/weed herbicides, Gramoxone in particular, permitted minimum tillage to be introduced and to expand rapidly. This had the dramatic effect of allowing farmers, particularly clayland farmers to switch a major part of their effort into the newer high yielding autumn cereals and to drill them earlier in the autumn.

Shallow tillage–savings not being realised

However, despite the progress that this change in tillage allowed, by the 1980s indifferent weed control, problems of straw burning and compaction in the top soil have moved the equilibrium again and on many farms this has moved towards much more tillage, particularly ploughing, at the expense of much greater investment in machinery without generally commensurate returns to compensate.

The Chairman introduces Dr Bryan Davies.

Cambridge University Farm Economics department in their publication "Farming in the Eastern Counties" 1984/5 version support this claim and they believe that the average over-expenditure on machinery and cultivations on-the mainly cereal farms of East Anglia is of the order o f100 a hectare.

I maintain that many cereal farms, in the dryer parts of the country at least, are failing to take advantaee of the savings in machinery and cultivation costs which shallow tillage can orovide; with the likely further decline in'real prices for grain, serious re-consideration is I believe needed.

The Evesham clay found in the Lias and Oxford Clay vales when it's in good structure and the weeds are under control is an excellent example for minimum tillage. By any standards, a satisfactory safe system on this sort of soil is to have two years' shallow cultivation (that is less than 4"), followed by one year's ploughing or deep cultivation to no more than 8". This is a safe system provided the straw is burned and that herbicides with rather less soil and more of a f action are used. For wet harvests the h must have some fc of low pressure system to minimise risk of compaction.

On the better clays, like the Hanslope series at Boxworth and the chalky boulder clays longer runs without deep tillage are very acceptable and have worked well over the years, provided hrome can be controlled.

Soil not cultivated for ten years still shows excellent structure and rooting and there are obvious advantages in time and energy saving. There is also much better seedbed as a result of the fine tilth being maintained on the surface.

Subsoiling–he sure it is necessary

Turning now to restorative tillage, the tillage necessary to improve soils with naturally, or acquired compact structure in the sub-soil and/or the top soil. This is particularly common in clays.

There have been four developments which are very important during the period we are discussing. However, subsoil loosening is still a very inefficient operation–probably the most inefficient tillage ooeration on farms–and it is very power consuming. Over the period 1978 to 1985, ADAS and Silsoe College have carried out trials on deep sub-soil loosening on 16 sites throughout the country. The results are very salutary.

In these trials, there never was any response in autumn crops, even where they were growing on soils with substantial panning in the sub-soil. Silty soils on several occasions actually gave depressed yields and only spring crops on some sandy sites with obvious sub-soil compaction responded positively to sub-soiling.

The moral here is: Don't waste money. First diagnose that there is a real need for sub-soiling.

Best restorative tillage–high-yielding u crops a tramlines

The last items under this heading of restorative tillage, are I believe the most effective of all. The drying and cracking of soil to depth achieved by high yielding autumn sown crops has done much to put the soils of this country into a good state; and the concept of tramlines from Northern Europe has been a further potent factor in reducing soil damage in fields.

Management of light soils–controlled traffic and plough/press

It would be misleading to neglect the very significant improvements in tillage of light

land which have taken place. A classical series of experiments run jointly by the Norfolk Agriculture station and by ADAS Soil Science, Cambridge in the early 1970s following the Strutt Report showed unambiguously that the less spring seed-bed work that was done on sugar beet land, the better was the emergence of beet and sugar yield. Recently British Sugar have been giving wide publicity to the need not only for minimum spring work, but for controlled traffic to avoid any crop from having to grow on wheeled land.

The plough and press system has been coupled with the improvements on spring seed-bed work and it has gained almost universal acceptance for the primary cultivation of light soil. Thus, after many years the excellent qualities of the press have been rediscovered. Besides preventing blowing, other benefits of the plough/press system are:

- virtual elimination of seedbed work in spring
- reduction in headland compaction
- reduction in under-consolidation (always a problem of light land farming).

Weak structured soils–tillage is only a partial answer

The weak-structured light soils are a particular problem in their own right. The silts, the brick earths and the sandy clay loams fall into this category. The soils are prone to capping, slaking and loss of structure through slumping.

Good tillage is only half the answer to these problems. The other half, and maybe it is much more than half, is root action and organic matter.

Tillage in moist weak structured soils weakens already weak aggregation further, and winter harvesting on these soils knocks hell out of them. Hence the importance of having rest crops like winter wheat and short-term grass. A good case can be made for chopping and incorporating all the straw from cereals that are grown on these soils and, even better, for returning the straw as farmyard manure.

In this context, the Rothamsted findings, that the advantages of organic matter cannot be fully accounted for by nutrients, is pertinent.

Water erosion–a problem on the increase

It is not possible to be certain, but the evidence does suggest, that degradation of soil by water erosion is more active now than it was in previous agricultural periods. Factors which may have aggravated the situation could be more controlled traffic with tram-lines up and down hills, sometimes larger fields with strategic hedges removed and a greater area of winter cereals growing in fine seed-beds.

Work (funded by the Sugar Beet Research and Education Committee) has already started to study methods for controlling water erosion–seeking techniques which are compatible with economically

viable farming systems. It is not an easy task but I think it should be pursued with persistence and the positive results widely publicised.

Straw incorporation–a problem exaggerated

Next, a few words about straw disposal. A few years ago suggestions of incorporation of straw rather than burning were met with predictions of severe yield penalties. This was in spite of the fact that historical evidence 'from Rotbamsted and ADAS long-term experiments gave little credance to these predictions, that yield reductions from straw incorporation are at worst, minimal.

Today, much of the steam has rightly gone out of the issue, but it is still a very important one for clayland farms. The recommendations on disposal of straw (excess straw) can today be summarised:

- on all soils other than clays–chop and plough in without premixing
- on clays–burn where acceptable otherwise:

if the remaining area is large–alternate plough with disc and tine (to keep down costs)
if the remaining area is small–plough

It should be noted that for the light soils chopping and incorporating straw can give some small advantages in yields and some improvement in workability.

Tillage and weed control– a continuing priority for R & D

Finally, there are three points I would like to make.

The first is about weeds. There was an earlier hope that herbicides would eliminate cultivations as a necessary adjunct of weed control and that they would achieve this right across the board. This has certainly not materialised in practice.

Consequently, the interaction between tillage and weed control is still one of major importance to the commercial scene. This should remain as a high priority in future development work on tillage.

Get skilled advice–avoid unncessary tillage

Secondly, perhaps it is not generally realised that provided good establishment is achieved, a wide range of soil conditions are acceptable to autumn sown cereals without any detectable effect on yield.

Such tolerance indicates a large opportunity for saving–savings in what I call unnecessary insurance tillage. Other people call it recreational tillage.

Equally though it requires that adequate skills in soil examination are available to identify and intepret the soil conditions. May I remind you that ADAS has these skills and they are available to individual farmers.

Today's problem – lack of consolidation

And now to my final point. The last twenty years has seen a virtual revolution in soil management compared with what went before. It is the result of an intensive input from all sides; research, advice, industry, farmers–all working together. In most respects the outcome has been very satisfactory with the exception of water erosion.

I think the result of this is that in general the state of the nation's soils as far as their ability to grow good crops are concerned is very much more healthy that it was twenty years ago, and probably ever has been in the past.

However, we now have a new problem. The general improvement in conditions of soils, particularly the cereal growing soils, has now brought about the situation that lack of consolidation–looseness–has probably now surpassed compaction as a major problem of soil management.

Individual Experience – Ideas in Practice
Mr Richard Dawson – farmer, Essex

I farm 300 hectares in North Essex. About a third is chalky boulder clay (Hanslope series); a third is decalcified boulder clay (Oak or hornbeam series) and the last third is a range of lighter soils, right down to almost pure sand; but including some areas of heavy clay.

In older terms, most is two horse land, with some one and some three.

We suffer from a high degree of soil variation – in one field the drill passes from clay to sand and back three times in a single run across the field and accordingly we need equipment which will take such change in its stride.

We all have rotations hut ours is perhaps simpler than most:
wheat–wheat–wheat–wheat–wheat.

Early drilling essential for good yields

I believe, and have believed for many years, that early drilling is essential for good yields, and good profits, and this view is only slightly modified by forward budgeting for much lower cereal prices. We aim to complete drilling in September, and usually only go 2 or 3 days into October, at most.

Obviously fixed costs have to be contained; and I now operate our 700 acres with a son and no other regular help, though we do employ students at harvest time.

From the early 1970's we direct drilled, spreading the straw and then burning and finally drilling with Bettinson or, later on, Tasker drills.

Problems with direct drilling

Direct drilling was reasonably successful to start with, but over the years problems arose:

- the increasing public dislike of burning.
- increasing levels of sterile brome (and our brome did not seem to realise it is meant to be a headland weed).
- the usual problems with direct drill slots.
- penetration difficult in dry weather.
- seed slots often flooded in wet weather.
- seed slots easily identifiable to birds.
- some loss of surface structure in the top inch or so.
- acidity in the top inch or two of the soil. (This could only be detected by sampling in inch slices. A normal six-inch sample showed a pH of around 7–even when taken by a lime salesman; whereas we were finding pH of 5 or even less in the top inch–precisely where the seed was germinating.)
- diminishing herbicide performance– (at a time when the role of ash was not as well understood as it is now and when there were not as many alternatives as there are now).
- harvest wheelings (however well disciplined the trailers were in keeping to the headlands the combine still had to go over the field).
- incomplete burning (especially on the headlands, but sometimes also in the field; resulting in erratic and uneven establishment).

Autumn 1982–ploughing again after ten years

It was to get away from the precisely defined triple-disc slot that we changed from the Bettinson to the Tasker but that change in itself was inadequate to allow us to retain direct drilling as the problems arising from not inverting were the most serious.

We decided that inversion was necessary, and so, in autumn 1982–after ten years direct drilling–we started a plough system; this was highly successful but it did increase our three passes with direct drilling to seven.

Most of the direct drilling problems seemed to be cured. The exceptions were:

- brome, whose spread was curtailed, but which was not eliminated.
- oand–most critically–timing became harder. We had two ploughs and sufficient students to keep the ploughs going at the same time as the combine but the difficulty was in burning just enough in front of the plough so that the ploughs did not have to stop, and yet not so much that the land dried out and became unploughable.

Pre-cultivation–a doubtful advantage – now eliminated

Apart from the tillage sequencing problem mentioned earlier there were no real problems.

There was a problem of the loosened stubble blocking-the ploughs–a problem which disappeared once we stopped pre-cultivating.

The idea of mixing the straw in before ploughing was to give a surface layer of about four inches free of straw. However, examination of the soil profile showed we were not really getting this effect; and this cast doubt on the advantage of cultivating before ploughing; a doubt confirmed by the ADAS trials.

So we decided to eliminate this pre-cultivation and arrived at our present system.

- We still chop the straw, but we now have a chaff spreader, which reduces the large concentration of dry matter directly behind the combine.
- We do nothing before ploughing and we plough, six furrows with 145 hp, pulling a heavy packer–which in its turn pulls a lighter packer.
- Finally, we roll yet again.
- We then leave it until drilling time.
- A t drilling, we use combination outfits, a reciprocating harrow first, with a heavy crumbler/packer and then the drill.
- And finally we roll again.

This sytem only needs two passes, though we do add two rollings as well.

The mid-day discussion panel. Left to right: Mr Anthony Forsyth, Mr Peter Thorogood, Dr *Bryan Davies,* Mr Richard Dawson, Lord Selborne at the microphone.

Incorporation–a cure to the timeliness problem?

It seemed to us that if we were to incorporate the straw rather than burn it this would cure the timeliness problem–and would give some useful environmental advantages too.

So in autumn 1983 we started straw incorporation:

We solved most of our timeliness problems–after all, timeliness is not a function of the system, but of the resources applied to the system. However we now had a series of eleven operations, all of which had to be carried out in sequence and we were very vulnerable to a breakdown of any link in the chain.

One major problem – possible under-consolidation

The system is timely, and economic; but there is one major problem, and that is getting effective establishment in dry autumns.

Although the soil is very firm at the completion of the ploughing stage; and indeed quite firm after the post-drillinn roll, it seems to fluff up and become puffy in a few days. I think this is simply due to the short period available for the soil to settle and stabilise, and that it would settle if we gave it longer to do so. However any delay would I am sure reduce yields, and might prejudice getting winter crops in without soil damage.

In order to plough all the land and finish drilling in September we have to →

Individual Experience – Ideas in Practice
Mr Anthony Forsyth – fanner, Warwickshire

Our soil type is lias clay, Evesham series–quite a strong soil. They used to have five horses to pull a single furrow plough. It is a self-structuring soil and it will re-structure itself given time and weather, the correct weather.

Our product is wheat, our main income. We have been growing five wheats and one oil seed rape over the last decade. We used to grow beans and we have now returned to growing beans and we are now going to grow two wheats, a rape, two wheats, beans, two wheats–to up our yield so that we have more first wheats.

Introduction of direct drilling

We gave up the plough in 1968 and sadly returned to it in 1985, because we got ourselves a little muddled and put straw choppers on our combne and we could not burn the straw so we had to plough most of our land in 1985. But normally, we do not plough.

Actually we stumbled onto a no ploughing technique by the fact of making combine ruts and we got a little Bomford Superflo on a small tractor to level the ruts and then we discovered that we had quite a good seed-bed and we further discovered that it was the cheapest seed-bed and the best seed-bed we had on the farm.

Then we decided that we must get the burning better and we put spreaders on the combines. We also went from the Bomford Superflo to the Bomford Powertrak and then we went pigtail and we alternated these and went towards direct drilling in the early '70s. For us, the only problem with direc: drilling is that if we plant our wheat too early at Kineton we are in big trouble. We must not plant any second wheats before the 5th October or we have got far too many weeds and we are in big problems.

So our later drilling requirements put us into the wet, and so the minimum tillage system is more suitable and we can get a natural green-up. The idea is; a burn and a green-up – knocked out with the cultivator or, if it is wet – knock it out with a sprayer. We were going for crumb and we did not get it when it was wet.

Combines fitted with Terratires or duals

If we did not have to combine our land we really would not have to cultivate to loosen the soil to remove the compaction.

Normally we do not finish the wheat harvest until the end of August and in latter years it has been nearer 7th September finish–and we can get a lot of rain in August. So we were getting a great deal of compaction with our clays from the harvesters.

So, what have we done? We have put Terras on the combines or duals to try and reduce compaction and we hope to work towards eventually a bed system where we can actually identify the damage in the field where the combines go.

Incidentally, those tyres can be utilised for drilling, or whatever, on our normal tractors; we just have centres that you can take in and out.

Organise the bum to save expense

Ploughing I believe is a wonderful thing – but not for clay, or at least, only occasionally on clay.

We want to chop the straw round the headland to incorporate the straw there but in the centre of the field we want to get as good a burn as passible so it is a compromise situation or we are going to be changing from chopper to spreader or we have spreaders on the combines and have tractor mounted choppers and students in the workshop with broken tractor mounted choppers and you know all the problems we shall get.

In the good old days when we did not have bye-laws, we used to burn quite happily without burning hedges, and without upsetting anybody. The answer is motorise it, because if you motorise it, then you can get your man to put in as many back fires as you like because he will be quite happy to. If you have got a hike and you can ride around the field it makes it quite fun. So you can organise the fire according to the wind.

Now, our cultivation system goes quite well with incorporation and we think we have got this fairly well solved. A 12 metre cultivator on a 200hp tractor, at about 4 miles an hour, and you can get a lovely tilth and bury the ash well.

We have in fact created what we were trying to do many years ago–we have created a mini-tilth and we can drill it – not with a direct drill–we can drill it with a conventional drill. So what is simpler than that?

If it rains, we can spray with Gramoxone to kill off the greenery. So that is how we have finally organised it at the moment.

Compounding compaction of combines

Of course, we have to do some soil loosening and we will have to do some mole draining. Mole draining is very important on our clay land and we are sure that we must do it about every four to six years. It needs a lot of power and it's very expensive so we must try and get it done right.

Now, the lifting as we call it–we went into euphoric lifting of soil as we were told that we had created pigtail pans. Well, I disputed that we had pigtail pans, I said that we had created a compacted layer from compounding compaction of combines.

We have modified things now with our lifting. We have gone for combination – disc, tine, tine, roller.

Minimum ground pressure: minimum traffic

Now that we have got the soil hopefully in the right situation–we have spent our money–we have got to look after it. The soil is very susceptible to rain compaction. And do not forget the damage the boss can do from driving about in his Land Rover. We also keep the trucks on the headlands and that saves compaction.

For the future we are going to try and make the tractors last longer, put less diesel through them, spend less hours on them. It was a big investment and to replace it soon it is going to cost money. We must make it last longer. And then having done that we might be able to replace some of the combines because we are going to need money to replace them.

And then we might have some money to plant some more hedges and to build some more roads, replace the motor car, enjoy the countryside and leave it looking quite pretty.

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plough while we are combining; and once the land is ploughed we dare not risk waiting for rain and so we have to drill however dry it is.

I have not yet been able to find anyone who knows how or why this deconsolidation occurs. Perhaps we can have it researched?

Rotational ploughing

Yields are particularly good the first year of direct drilling after ploughing; and our own experience has shown they are particularly good the first year of ploughing after direct drilling. So there appears to be agronomic virtues in alternating direct drilling and ploughing.

Such a move would reduce our big tractor requirements from two to one, and hence reduce costs to some extent.

This rotational ploughing, already referred to by Bryan Davies, seems to offer many attractions. The main decision to make is on the frequency of ploughing because, if we can plough less frequently than one year in three then I think we can leave ploughing till after we have finished harvest. That reduces our student requirements, decreases our labour costs – and decreases our repair costs too.

Individual experience–ideas in practice
Mr Peter Thorogood–farmer, Buckinghamshire

The formation of the North Bucks Soil Management Group at the beginning of 1981 was the outcome of discussions between a group of six farmers whose yield levels had been generally unsatisfactory for some time despite conscientious attempts to apply modern, intensive cereal management techniques. They were using 3 ton inputs and getting 2 ton outputs.

There was no evidence to suggest that input levels of seed, fertiliser, or agrochemicals were insufficient: or that husbandry techniques were inadequate in terms of timeliness of application. We were tending to use more of these resources while failing to recognise the real underlying problem–the need for better soil management.

It rapidly became clear that our difficult, unstable soils were suffering from lack of structure and severe compaction. The emphasis previously placed on the development of the crop above the ground now needed to be applied to the function of the roots, and the medium in which they exist below the ground.

Examination of the soils in North Bucks by the Soil Survey of England & Wales has identified four predominant decalcified soil series, namely; the Gleyed-Hanslopes, Ragdale, Denchworth and Lawford–all more commonly known as Stagnogleys and all found at the lower end of Grade 3 on the MAFF Soil Classification.

Such soils have about 60cms of naturally acid, poorly structured imperfectly drained silty clay overlying poorly structured calcareous clay.

Soil structure problems identified

As we continued through the autumn of 1981 and into 1982 it became clear that the Ragdale and Denchworth series soils, classified by Cannell at Letcombe in 1978 as unsuitable for zero or shallow tillage, were likely to have built up soil structure problems as a consequence of growing continuous cereals under minimal tillage husbandry regimes which were fashionable over the last decade.

Frequent examination of the soil within the Group revealed, in many cases, poor internal drainage, compaction, and very weakly developed soil structure from 10cms downwards, with a tendency for slaking in the surface horizon. Some fields showed signs of water-logging, surface pooling and, not surprisingly, plant rooting particularly below 20cms was observed to be poor. However. soil analysis showed above average levels of P&K and corrected pH. due to regular liming. The conclusion was that perched root systems were seriously reducing the amount of water available to the crop during dry periods.

It was therefore decided to take a fresh look at soil management techniques and cultivation.

Programme of soil loosening and moling

With the soil being compact from 10cm downwards and poorly drained, a combined programme of soil loosening and mole drainage was decided upon. Most fields had tile drainage systems at 40 metre spacings, with permeable backfill up to 35cms–ideal for moling. The frequency of moling was therefore increased from once in seven years to once in three years, and spacing reduced from 3 metres to-2 metres apart.

The soil was loosened where possible to a depth of 30cms or as limited by the presence of the plastic layer taking into account our higher rainfall level than in the Eastern Counties. We were not wholly successful in this approach because in order to select the machine to achieve the desired soil condition we needed to know a little about soil physics and the interaction between the soil and the implement. Many farmers and machine operators know what to do, but are puzzled as to why certain machines achieve a particular result.

Study and trials show two-pass loosening operation superior

Members of the Group therefore have studied soil mechanics and its application to their own particular soils.

Now we loosen the top soil first prior to deep loosening and this reduces the downward load on the deeper soil by allowing the top soil to move freely upwards. The result is more soil is disturbed, less clods are created and the draft of the following deep loosening operation is reduced, with consequent savings in fuel and machinery costs. Other advantages are the more even seed bed created without the effect of heave, and less bunching of seed in the drill runs.

Minimum tillage still preferred, but increasing use of plough.

However, the re-emergence of rotations and straw burning restrictions have resulted in increasing use of the plough to remove crop residue. This in turn brings with it new problems for maintaining soil structure. Ploughing was the beginning of our soil structure problems; followed by minimum tillage without benefit of deep soil loosening.

Where straw and other residues are incorporated it is largely by plough. For us, this is a hazardous exercise as in a dry year penetration is almost impossible and clod production is inevitable; whilst in a wet year smearing of the furrow and furrow bottom undoes any previous restructuring advantage. Loosening after ploughing has become an increasing activity but is still in some doubt.

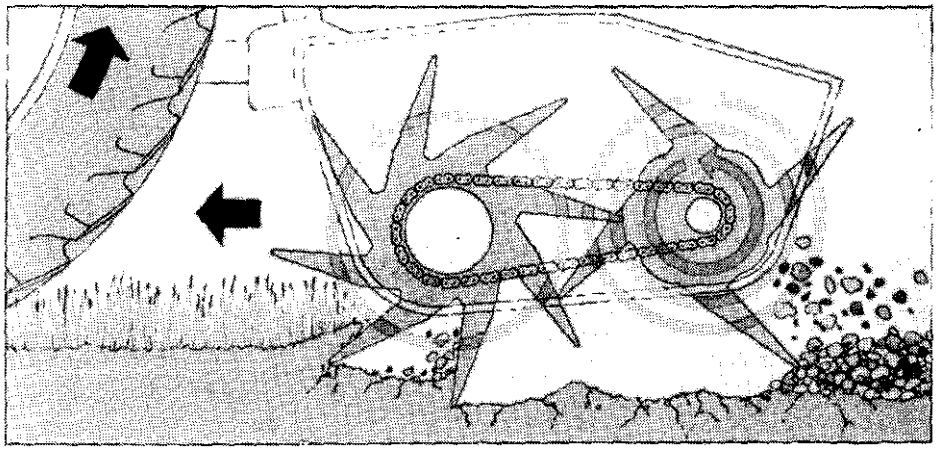
The drilling time window available to us is narrower than on most soils and the increasing dependence on ploughing and its associated problems is inevitably leading to later establishment due to necessary extra cultivations. A likely consequence is yield decline. Therefore, for us. mimimum tillage is still the preferred route but it is not without its risks of poor incorporation, straw in the seed bed, and subsequent weak crop establishment.

Changes in soil management bring increase in yields

Comparisons before and after any change in farming practiceare difficult to make objectively when there is no control treatment. However, in this case soil management was changed drastically after harvest 1981, while all other inputs remained constant.

The Group's three year average winter wheat yield rose from 5.6 tons per hectare for the period 1979/81 to 7.6 tons per hectare for the period 1984/86. This represents an improvement in yield of 2 tons per hectare or about 16cwt per acre. The national average yield for the same period rose by 1.4 tons per hectare leaving an advantage to the Group members of 0.6 tons per hectare or 5.0cwt per acre.

We believe this better performance was achieved in some part by improved soil management techiques and in assessing our results the comparison we have made is of three-year averages of yields before and after the change in soil management.



Operating principle of the DYNADRIVE cultivator showing soil failure principle
see page 25.

Ideas for the future–what now?–the needs for current research
Mr John Hawkins, Consultant Agricultural Engineer

Mr John *Hawkins*

There is increasing evidence that the effects of traffic on soils are having an adverse effect on yields. The result is that farmers are tending to play safe and carry out extra cultivations just to make sure, and in so doing they add to their costs.

Tramlining and bed systems go some way towards avoiding the ill-effects of wheels, but deciding on the amount of tillage that is required, to be sure that soil physical conditions will not be limiting, is still largely a matter of guesswork.

Instrument needed for field measurement of soil

What is really needed (and this was pointed out over 30 years ago) is a practical way of making measurements in the field that will tell a farmer or grower whether further cultivations or indeed whether any cultivations at all are needed. Of the soil properties which can be affected by cultivations, such field measurements are likely to take account of soil permeability to air and water and the resistance that it offers to roots growth.

A suitable instrument to measure such soil properties is, however, still a long way off and so in the meantime there is work for agricultural engineers to do to develop lighter equipment and power units with wheels or tracks that can produce the traction required without imposing high loads on the soil.

Specification for future tillage equipment

If the main short-comings of current methods of cultivation have been correctly identified, it becomes possible to specify that the ideal tillage equipment of the future will have the following features:

- a high output with a low labour demand
- producing a satisfactory seedbed in one operation
- dealing with crop residues on the surface
- control of weeds
- fulfilling all the foregoing requirements

over a wide range of soil conditions without damage to soil structure.

This is a tall order, but not unattainable. A suitable tillage tool might well take the form of a two-depth rotary cultivator, with a shallow rotor ahead of a deeper one. The leading rotor would then cultivate a surface layer, moving it sideways so that it can be covered with soil from below by the second rotor.

The Economics of Tillage – the scope for cost savings
Professor John Nix – Professor of Farm Business Management, Wye College, University of London

Professor John Nix

Then there is the question of drilling date There is quite a lot of evidence to say that the yield benefit by earlier drilling is quite substantial–about 2 tonnes per hectare per week (1.5-wt per acre per week) and that is worth about £17.50 per hectare (£7 per acre).

So, on the basis that the reduced cultivation system can advance drilling date by say, two weeks we are talking of £35 per hectare (£14 per acre) benefit.

Factors favouring direct drilling

The factors especially favouring systems of reduced cultivation and direct drilling are as follows:

- Large farm
- Large percentage of cereals
- Limited autumn labour available
- Wish to minimise labour force
- Wish to minimise capital investment
- Heavy/medium heavy soil (timeliness)
- Suitable soil type generally (for direct drilling)
- Autumn cereal yields well above spring cereals
- Not much barley going for malting; much of the wheat goes for milling
- OK to burn (most of) the straw

- If chemical costs fall (in real terms)
- If cer al prices (do) fall (in real terms)

Potential for further developments–Cultivations and Mechanisms
Mr John Matthews, Director, AFRC Engineering

Mr John *Matthews.*

MY task is to review the medium and longer term trends in the development of tillage practices and machinery. I have taken my target as the years to the end of this century–14 years away–although some of the ideas will peak beyond that time.

Reduced cultivation systems. Shallow ploughing

Although direct drilling has generally been found to be insufficiently "robust" (subject to failures under conditions occurring with sufficient commonness) due largely to inability with the system to control certain weed types, detailed work in the 1960s and 1970s studying the power requirements and consequent yields from a variety of non-plough methods has nevertheless left agriculture with a broad range of reduced cultivation practices.

Alternatives to conventional ploughing have mainly featured tines and discs and, when used in appropriate conditions, or intermittently, have given first class yields with increased margins due to lower tillage costs.

Perhaps the biggest surprise is that shallow ploughing, operating at 75-100mm, which both reduces energy and gives good inversion, has been taken up much less than it would appear to deserve, both by farmers and by machinery manufacturers who have been slow both to manufacture and to promote such ploughs.

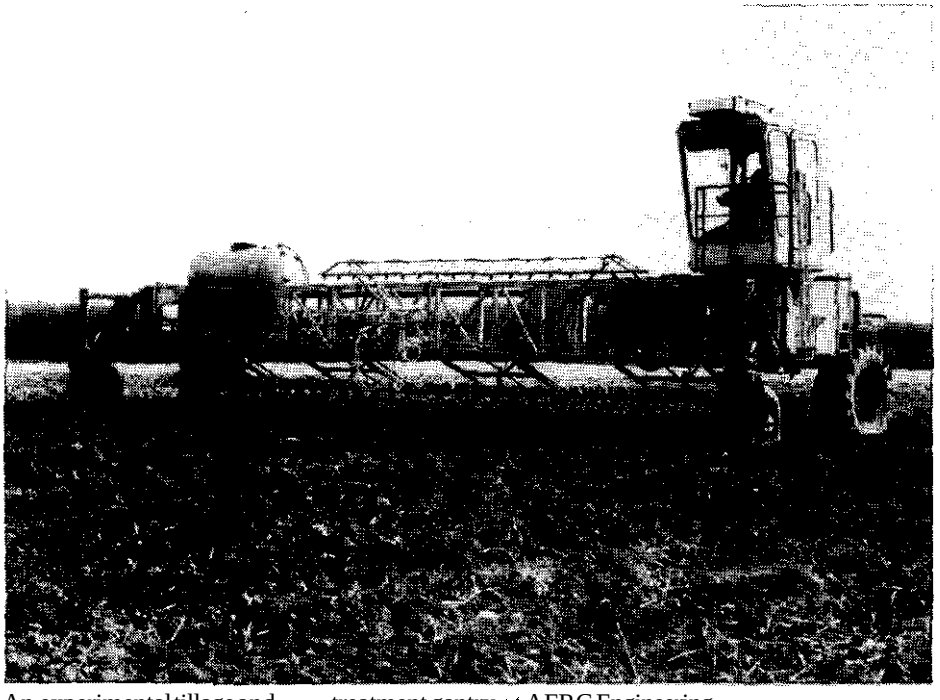
Reducing compaction; lower ground pressure: higher forward speeds

Following the adoption by many farmers of reduced cultivation techniques, the main focus of researchers' attention is currently controlled trafficsystems. "Controlled traffic" can have various meanings and should be seen as the evolution and employment of systems in which the effect of vehicle wheeling is minimised with consequent reduction in the energy needed to remove their soil compacting and smearing effects and at the same time a move to greater soil uniformity.

Gantry systems: reduced energy requirements

The ultimate controlled traffic system is travel minimisation based on gantry systems. Work is in progress in many parts of the world on gantry mechanisation including that at our Institute, and one can visualise both economically and practically acceptable systems of gantry mechanisation for intensive cropping, for example of cauliflowers. Cotton and certain other sensitive crops are being grown experimentally with gantry systems to good effect.

For cereals one naturally studies the highly commendable example set by Mr David Dowler who claims very substantial fuel reductions using his mechanisation systems which is largely gantry-based although coupled with low soil pressure measures for primary cultivation and for harvesting. Chamen has also shown reductions of 40% in tillage energy requirement and it may well be that gantry-based systems will come into relatively common use over the next two or three decades although probably only after greater experience in their use on the intensive crops.



An experimental tillage and *crop* treatment gantry *at* AFRC Engineering.

Faster, more intelligent tractors

Less dramatic but nevertheless important are likely design trends in tractors. It is my belief that the faster, more intelligent tractor will b a major feature of the last decade of this century. Tractor design for higher speeds involves some sort of suspension for driver comfort and machine mobility, attention to steering and the implement control systems, and the production of a lighter weight vehicle with implements also specifically designed for high-speed functioning. At this stage each of these technologies is ripe for further development and exploitation.

The advantages are:

- Lower vehicle weight and hence less soil damage.
- Lower soil compaction from a faster vehicle which generates its power by increased speed rather than increased draught.
- a Better tractive efficiency by speed increase.
- More driver challenge and fulfilment as the vehicle moves faster across the field.

Properly designed, durability and cost do not appear to be major penalties.

High speed straw incorporation

Future cultivation systems will depend also on harvest-related factors. Developments are likely to make the incorporation of straw both more functionally effective in a full range of weather conditions, and also more cost effective.

At this stage we have available machines capable of incorporating the straw in a layer at tillage depth at relatively high speeds, including of course the conventional mouldboard plough, whilst other machines such as the SCAE-developed implement give better straw mixing but have a lower output. There is scope for further optimisation to combine higher speed of operation with better mixing, particularly if the straw is chopped shorter.

One must also question the possible influence of changes & harvesting, specifically the adoption of stripping harvesting, on the subsequent tillage techniques. Although stripping may be followed by separate cutting and chopping of the standing straw or by the direct incorporation of rooted straw into the ploughing process, I would suspect that if stripping becomes the common harvesting method, the straw chopping and tillage processes are likely to be combined perhaps even to the extent of straw being chopped as it is buried.

Fuel economy and efficiency

The fuel economy of tractor engines has advanced over the last few years and at typically 220g/kWh is part way between that of highspeed motor car engines (260g/kWh) and larger low speed diesel engines used in ships (160g/kWh). We are likely to see further slow advances but overall efficiency is still very much constrained by the typical tractive efficiencies of tractors which throughout a British winter on an arable farm may average at 60-70% and will in worse cases be as low as 30-40%.

The following table summarises some of the individual variables showing the advantage of four wheel drive, adequate tyre size, correct matching of tractor and implement, higher speeds of operation and perhaps, most significantly, the use of power through the pto rather than by draught.

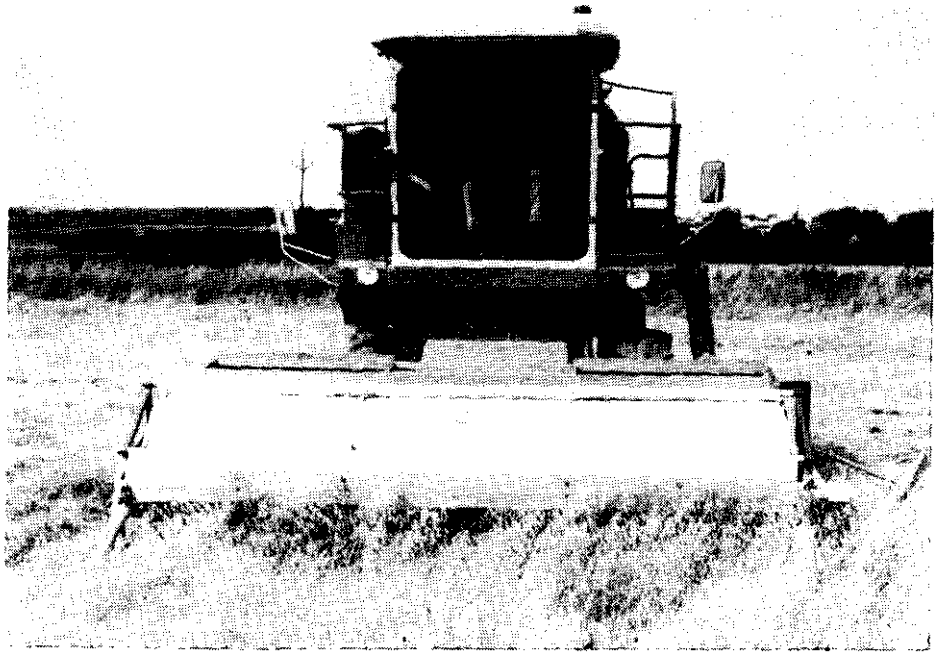
Typical tractive efficiency	60
Optimisation of tyre choi	+3
Optimum matching of tractor & implement	+2
Four wheel drive (unequal wheels)	+4
Four wheel drive (equal wheels)	+8
Eighty per cent of power through pto	+25

Increasing energy costs will imply increases also in the costs of fertiliser and protective chemicals. In response to the latter, mechanical treatment of weeds either by burial or by mechanical hoeing and chopping will increase in importance. The overall influence will be towards more complete soil inversion and weed and debris burial in an attempt to save both herbicide and fungicide.

Reducing energy requirements

Theoretically, tillage mechanisms are still a very long way from attaining high working efficiency. For example, the plough mouldboard, still the dominant processor and estimated to be moving 1.4 billion tons of soil per annum, has an efficiency of only about 30% in terms of breaking up soii. Substantial power losses occur in friction between soil and mouldboard and another component of power is lost in raising against gravity the furrow slice to a level at which it can be turned over.

The question must also be raised of the greater use of shallow ploughing. Limitations cited include inability to maintain depth to a sufficiently fine tolerance. The depth variability which might be acceptable at perhaps 200mm becomes unacceptable at 100mm due to inadequate inversion when the furrow slice reaches the shallower extremes. Technology is available, however, to further improve tractor implement control systems with consequent reduction in depth variation and there may well be other means of ensuring that the furrow slice is always inverted, even with some variation in depth and in extraneous factors such as



Grain harvesting by *'stripper' leaves straw* for incorporation late,:

plant clumps.

Although the intention in cultivation is to shear soil to reduce the aggregate size, the majority of tillage elements in creating the shear tend at the same time to compress the soil with the resultant increase in the shearing force. A theoretically ideal cultivator would be a tensile type in which the soil structure would be failed in tension. The "Dynadrive" cultivator (see illustration, page 22) exhibits some of the benefits of tensile failure in that the main shearing elements work upwards towards the soil surface, hence minimising soil compaction. The principle of the coupled rotors avoids pto operation in this implement and has led to considerable commercial success.

Many manufacturers of tillage equipment can see the benefit of mechanisms not requiring draught and the concept of a zero draught tillage device is an attractive target. The ideal device would bury surface debris, break up and loosen soil to a depth of 100-150mm and he sufficiently wide in action that a minimum number of power transmissions or motors would be needed on an implement.

Electronics–for measurement of tilth, for implement contrnl and for cultivation management

The increasing power and decreasing cost of microelectronics, particularly the cost of computational devices, is permitting and will increasingly encourage the ability to monitor and control devices within the cultivation processes. One potential advantage is, where areas of a field are at the moment overworked, to achieve the correct tilth or seed bed for the most difficult areas of the field. The fundamental need therefore for electronic control systems is for sensors of tilth or seed bed characteristics.

For example, by optical image analysis techniques it should be possible to indicate tilth in terms of the dimensions of aggregates appearing on the surface.

An alternative need, particularly in connection with the seed bed, may be for a measure of mechanical resistance to root growth or of the permeability of the soil to air or to nutrients in solution. Although developments have yet to be undertaken one could envisage the resistance to root elongation being assessed, albeit rather crudely, by the force measured on a fine element drawn through the soil. Permeability might be measured by the rate of gas leakage from small holes in a blade drawn through the soil. In both cases there will be a significant development challenge but prospects will hinge on the accuracv level required for seed bed characterisation.

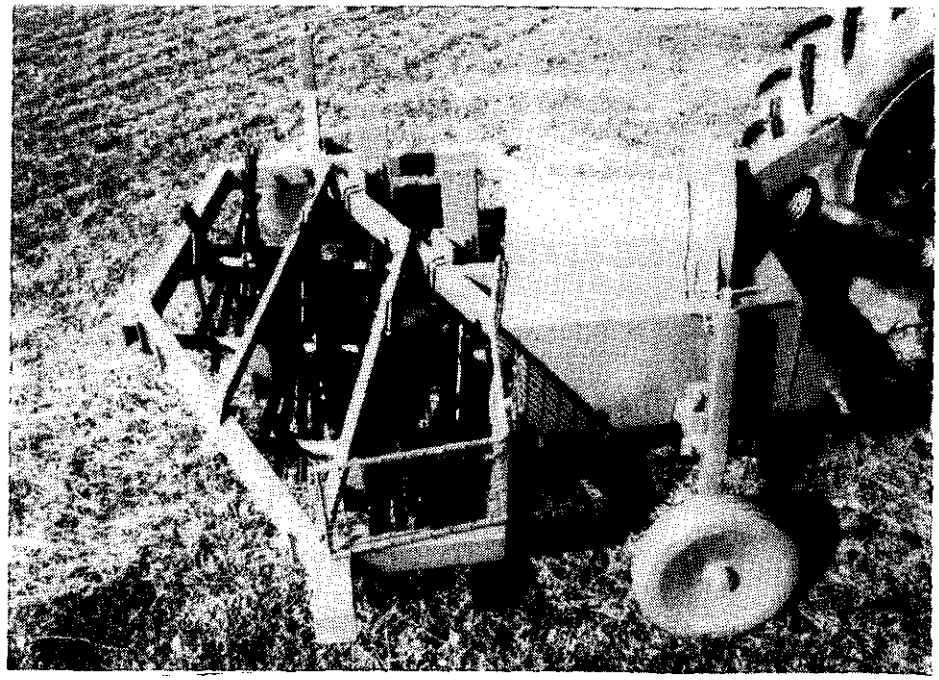
One further sensor requirement is for indicating the nature c the moisture > > in the soil surface. This would be employed, for example, in adjusting seed planting depth to an appropriate soil moisture content level.

With the availability of a means of sensing the state of the tilled soil, automatic control systems may be developed to regulate the tillage effect to the desired level, for example, by altering pto speed to adjust the level of action of a powered tillage element, by adjusting the forward speed of the tractor, or by altering the geometry of the tillage machine.

An alternative type of feedback control system on a tillage machine and one which may be introduced earlier, is a system for the automatic setting of a plough to minimise draught.

On a more stragetic level of cultivation management, computer based expert systems will be developed to advise the farmer of best tillage strategies taking into account the soils and crops of the farm, the date and weather conditions, and machinery and staff available for work. These systems may be employed for example:

- for decisions on field cropping;
- for optimising the purchase and availability of tractors and machines;
- to make daily decisions on which work to carry out to give optimal employment of men and machines and to maximise timeliness factors;
- to choose tillage practices to suit soil, crop and weather conditions to an optimal extent.



The *SCAE/Falcon* Engineering *straw incorporation* and *mixing* machine.

REVIEWS

Soil Erosion in Britain

by R. D. Hodges, Wye College, University of *London,* and C. Arden-Clarke, *Political Ecology Research Group.*
Available *from* Dr R. *D. Hodges,* Wye College, University of *London, Ashford,* Kent *TM25 5AH. 1986, 45pp* £3.50 *(incl UK* postage).

This 45-page review contains a comprehensive examination of the literature of recent and oast erosion studies in Britain. The early sections are technical in nature dealing with historical and present evidence for erosion and the physical and management factors contributing to it.

One of the questions the authors have attempted to answer is whether or not soil erosion by water has become more common during the last 20-30 years. The conclusion they reach is that the gradual change from traditional techniques to more specialised production systems has resulted in a slow but significant deterioration in soil structure to which the Strutt report first drew attention in 1970. This presumed deterioration is then associated with the enhanced erosion which the authors state most of the evidence supports.

I submit that this is gross oversimplification which the authors have failed to substantiate. In the first place it is evident that in many sandy and light loamy areas where erosion is now active soil loss was also active in the past. For example on the Bridgenorth sands orevious soil orofiles buried under colluvium are not uncommon and stepwise changes of surface height at hedgerows are commonplace in many areas including the sand lands of northern Norfolk, Nottinghamshire, the West Midlands and the Yeovil sands in Somerset.

However, this argument cannot be extended to erosion instance in formerly pastoral landscape such as the South Downs where strongly undulating ground has been ploughed up since World War II and erosion is occurring in once stable landscapes. The authors quite rightly identify such occurrences as a worrying departure.

The authors reach the general conclusion that rates of erosion in Britain across a wide range of investigations are commonly in excess of natural soil renewal rates which they consider range from 0.1-0.5 t/ha/year. This statement should be treated with caution. Nobody actually knows what are the rates of natural soil renewal but the very low range quoted probably applies only to soils on hard rock and not to the majority of British arable soils which are underlain by soft pre-weathered materials.

Statements in the report about the long term destruction of productive agricultural capacity must therefore be considered highly dubious.

Furthermore although the erosion rates quoted are often high these rates are for susceptible sections of fields and have not been averaged out over whole field or landscape units in which erosion is only active in some parts. Even where erosion is active *recent analysis of MAFF survey data by Dr R* Evans shows clearly that the frequency of small events (less than 1 t/ha) far exceeds the incidents of wents greater than 10 t/ha.

To date many researchers have put too much emphasis on the comparatively *rare* and serious events and by doing this have successfully raised the level of awareness and concern. They now need to present their data more objectively so that readers may judge the overall significance of the problem without the propaganda element.

It is interesting that the authors of this review connect the Strutt report's account of structural problems in soils with the increase in erosion that they deduce has taken place subsequently. The circumstantial l does not support ir content Significant developments in soil management have helped to improve the national average yield of all crops particularly but not exclusively for cereals. As far as it is possible to judge, the incidence of soil structural problems caused by management is noticeably less prevalent than at the time of the Strutt report and substantial progress has been made by farmers to minimise the compaction effects of large vehicles.

If occurrence of erosion is indeed more commonplace than previously, and I believe this to be the case, then the extension of winter cereal growing at the expense of grass and spring cereals, and the universal use of tramlines to avoid haphazard compaction in fields would seem to be the major causes.

Conclusions not substantiated

The later stages of the report cease to be a review but rather promote the 'soil enhancing' features of organic farming as a remedy for Britain's soil erosion roblems. O rl king th lubi clai tl organic farming would have any beneficial effects in reducing erosion, there is no wav in which the financial i f n y c o ar farming can be widely absorbed by the farming industry, without enormous subsidies.

Although this report makes a useful contribution in drawing together the current investigations on erosion in Britain, its value is diminished by four flaws. First the absence of a balanced appreciation of the significance of erosion in Britain, second the absence of any valid comment on erosion control, third the assertion without evidence that modern farming has degraded soil potential and lastly the unsubstantiated assertion that organic farming would decrease erosion.

D. B. D.

Soils of the Lizard Peninsula: Soil Survey Record No.79

Publications Officer, Soil Survey of England and Wales, Rothamsted Experimental Station, Harpenden, Herts ALS 2IQ.
260pp £9 with map, £5 without map (p & p included).

This newly published Record describes the soils of the Lizard Peninsula in Cornwall, the only district in England and Wales having major outcrops of serpentine, gabbro and hornblende schist; much of which is thinly covered with aeolian drift.

After introductory sections on the physical environment, vegetation and soil classification, there is a detailed account of the unusual soils of the peninsula. In final chapters land capability, drainage and analytical results are considered.

The book, extending to 260 pages, is illustrated with seven plates and twenty-six text figures. The soil map, in colour at 1:25,000, is conveniently packaged with the book in an attractive slip case.

Although it is mainly of value to farmers, advisers and others in the agricultural industry, the Report also provides background information for naturalists, conservationists, planners and others on this fascinating and unique district.

Soils and Foundations

by Cheng Liu and Jack B. Evett, North *Carolina University,* USA
Prentice-Hall International, 66 Wood Lane End, Hemel Hempstead, Herts HP2 4RG.
438pp, £34.25

The principles of soil mechanics have not changed much since the days of Terzaghi, but the methods of presentation have. In this book, a completely re-vamped 2nd edition, the text, diagrams, graphs and tables are laid out particularly clearly. This and its comprehensiveness for solving problems are its main virtues.

It needs to be dear, if only to deal with the fact that the technology of soil mechanics (one cannot call it a science) can now be serviced in three kinds of unit—which this book endeavours to do.

There are the so-called 'English' units as used more in USA than elsewhere and generally favoured in this book, and which include such anomalies as a ton of 2000 lbs. Pressure in English Units is measured lbs. per square inch. Then there are Metric units (pressure appears as kilograms per square centimeter), and finally the S.I. or International System of Units, (kilonewtons per square meter).

The reader needs to have all these units well channelled in the grey matter in order to be able to utilise the text to the full as the examples and data flip from one to the other.

Just for good measure the tonne doesn't seem to have penetrated as far as North Carolina.

In fact, whilst marvellous for getting walls, banks, foundations, piles, etc actually to stay put, and no doubt for helping engineering students in USA mug up for their exams, with numerous worked ex-

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The last ditch?

The impact of a drainage scheme on the wildlife of the river Blackwater, which flows along the border between Northern Ireland and the Republic, has been even greater than feared by environmentalists.

The Royal Society for the Protection of Birds advise that they are now making a last ditch attempt to save wildlife habitats from further destruction.

Part financed by the EEC, the Blackwater Catchment Drainage Scheme is being carried out to improve the drainage of 7900 acres of farmland, so as to increase agricultural production. In Northern Ireland it includes the dredging of 351 kilometres (218 miles) of water courses at a total cost of £19 million. Work started in 1984 and is phased to last over six years.

Initial phases of the work—on the main river Blackwater and a major tributary, the Oona—have involved deepening the river bed by some two metres, widening the channel and removing meanders. But, the newly excavated channel is reportedly unstable, trees have been washed out, banks have slumped and are being eroded, and bank protection has failed. Additional works to try and stabilise the river have caused further ecological disturbance.

Dismayed at the environmental damage caused by the drainage works so far, the RSPB has called upon the Government to halt the scheme so its impact can be reviewed.

Dinah Browne, the RSPB's Northern Ireland regional officer, emphasises that the Society is not u y ipa to the i ficulties faced by the farming community in Northern Ireland, particularly in border areas. However, the promotion of major arterial drainage schemes is not considered to provide an effective or environmentally acceotable attemot to alleviate these problems.

"The best course", say the RSPB. "would be to designate these rivers and the wetlands associated with them as Environmentally Sensitive Areas, so that farmers could be encouraged to farm in a manner sympathetic to the needs of conservation."

Game Birds Research

A new demonstration site in the NAC Arable Unit is examining the work of the Cereals and Game Birds Research Project which is funded by the Game Conservancy

The demonstration of headland management looks at the headland before and after coming under the Project and illustrates the selective use of herbicides. The aim is to leave non-pernicious weeds as a convenient source of food for game chicks so that they are encouraged not to forage into the crop and cause damage.

Approaching the subject from perhaps a different point of view, Laurent Perrier (UK) Ltd are this year offering a special prize of £5000 to the inventor who can come up with a practical means of keeping game birds and deer safe from agricultural machinery. The problem is that partridges and pheasants, as well as some larger animals, are now denied safer cover by the grubbing out of hedges and are becoming at considerable risk through nesting or nursing in silage crops.

Closing date for receipt of initial proposals is the 31st October, 1987. A jury will then select the six most promising proposals and these six contestants will be asked to take their ideas forward to a prototype stage. Besides the prospect of £5000 for any outright winner there will he a case of Laurent Perrier champagne for each of the six selected finalists.

This is a special award being offered by Laurent Perrier and comes in addition to their normal annual £5000 award for, improvements and advances in the general field of wild life conservation.

Lime research

The Agricultural Lime Producers Council (ALPC) has reached agreement with ADAS on a two-year sponsored research project to demonstrate the impact of liming on modern crop varieties and to highlight the effect of agricultural lime on the efficiency of farm inputs, particularly fertilisers. ADAS has agreed to make available data from grassland research projects, which will be publicised by ALPC.

According to *BACMI* in 1986. the annual review of BACMI, the national aggregates trade federation (ALPC operates within its framework), there has been an 'insidious increase' in soil acidity over the past fifteen years in many parts of the country. The technical requirement for lime can usually be clearly demonstrated; but in view of the current economic uncertainties, farmers tend to reduce all inputs. ALPC therefore continues to emphasise the importance of soil pH in the growing cycle and the value of liming.

Research Consultative Committee on Soil Science

The Agricultural and Food Research Council and the Agriculture Departments in Great Britain have set up an independent short-term consultative committee on soil science R & D.

The Committee, under the chairmanship of Dr. P. B. Tinker of the Natural Environment Council, will report its findings by 31 July 1987.

The Committee's remit is:

- to advise the Sponsors on objectives, opportunities and priorities for R & D in soil science with particular emphasis on:
  - soil acidity and its control by liming and other means in lowland and upland soils.
  - the consequences of applying potential pollutants to soil, e.g. sewage sludge, farm wastes, herbicides, nematicides and other pesticides.
  - soil conservation and monitoring
  - field drainage
- to identify areas appropriate for government funding and areas in which industry might be expected to contribute funding.

The Committee has been inviting views on matters covered by its remit from organisations and individuals in the relevant fields.

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amples, this book is not particularly up to date on the European scene. It has numerous end of chapter references, but these include only four from European work, dated 1911 to 1953, and three of these are Skempton. It is not therefore the way to get a comprehensive look at recent research advances worldwide.

Soil mechanics is based very much on a series of empirical tests, classifications and assumed failure modes. This book passes quickly over the subject of the making of natural soils and gets down to such basic things as grain size, plasticity, shear strength, compaction and the like. Then we get into stresses, consolidation, settlement and strength of soils.

The reader is then ready to take on board the various engineering systems (and these include all kinds of foundations, drilled caissons and piles), before launching into lateral earth pressures and retaining structures.

For good measure, we then get another dose of soil characteristics in terms of soil compaction, and how to achieve it with machines, before finally opening up a whole new can of worms—stability analysis—(the lack of which explains all those embankment slips we keep on seeing g the motorways). The book does not deal at all with earthdam construction, tunnelling, bad ground problems, dewatering or water movement control.

This is a book for the technologist with good basic training. Each page is packed with information. Its 438 pages would be very useful too for an all-rounder working in the third world on urban developments to have in his pocket.

Also recommended for libraries.

A. N. E.

A Survey of Water Erosion

Soil Erosion in Britain is already widespread say Robert Evans* and Dick Skinner*. They report here on a survey they have been carrying out to assess the full extent of the problem.

'Soil and Water' has done a good job bringing to farmers' notice that water erosion does occur in the British Isles. See especially Alan Harrison Reed's and John Boardman's articles in previous issues. Indeed, the farming press as a whole has not been slow to discuss erosion in a responsible manner. The Ministry of Agriculture has responded by publishing in 1984 a leaflet on water erosion to raise further the general awareness of the topic

Erosion already widespread

We find now that, contrary to what most people used to believe, erosion is widespread.

We know of 2250 fields scattered throughout England and Wales which have suffered erosion in the last two decades. Alan Harrison Reed, over the same length of time has noted a similar number just in the West Midlands.

Additionally, a further 1500 fields showing evidence of water erosion have now also been identified from a systematic survey over the five-year period 1982-1986.

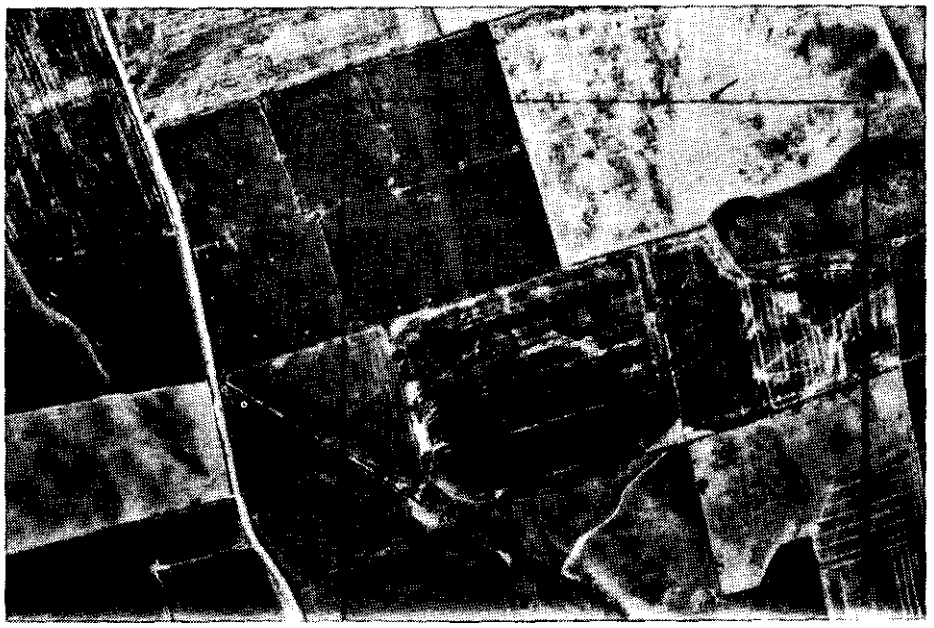
Systematic survey to assess the problem

This five-year survey, carried out in 12 localities in England and Wales was prompted by the need to access the extent of the erosion problem throughout the country.

It had become obvious that erosion was widespread, and most agricultural advisers and farmers interviewed knew of at least a few eroded fields (in the case of farmers, usually their neighbour's!).

Erosion is an emotive topic and the sight of a large gully is enough to persuade anyone that here is a problem that should be tackled. But how typical is this gully? It may not matter much if it only happens once in a lifetime. In other words, the problem needed to be assessed and put into perspective and this could only be done by some kind of systematic survey which would give information on areas affected by erosion, how often it occurs and how much soil is moved.

Surveys of any kind are a time-consuming and costly business, especially if the size of the problem is not known in the first place. So a survey based on sound statistical principles may not be the most cost-effective way of assessing erosion, at least in the initial stage. So, in 1982, 17 localities were chosen scattered throughout England and Wales; in some of these erosion was known to occur.



Air photograph token *May 1986 shows a field* of *eroding rape adjacent* to the *old A6* between *Penrith* and Carlisle in Cumbria. *ADAS* Aerial *Photography Unit: Crown* Copyright.

Air photographs were taken of these localities, mostly between May and July, by the Ministry of Agriculture's Aerial Photography Unit based at Cambridge. The strips of land photographed varied between 10-30km in length and were just over 2km wide. The total area was about 800km², although this area was not photographed every year because of poor weather.

Gully *erosion* and the *tributary* rills.

The photographs were interpreted to identify eroded fields and the interpretations checked in the field in August to September. At the same time measurements were made of volumes of soil moved. Later, ADAS soil scientists asked farmers who owned selected eroded fields about their agricultural practicesand, for example, how long the field had been out of grass and also were they aware of erosion on their farm and if so were they doing anything about it?

The survey has run its five year course (1982-86) and the data analysis stage reached. This is no small task as for each of the 1500 fields the rates of erosion have to be estimated, and these related to, for example, crop and soil types, rainfall and the shape of the land within the field, as well as to the results of the ADAS questionnaire.

So far rates have been worked out fully only for 1982. Some provisional results are given here which we hope will be of interest.

Some results of the survey

In the two years when water erosion was widespread—1983 and 1986, it occurred in fields covering about 4% of the landscapes photographed. But within individual localities this figure ranged from 1% to about 20%.

In vears when erosion was less common no eroded fields were located in some

*Co-authors; R *Evans,* Soil *Erosion Research, Cambridge and* R *J* Skinner, *ADAS* Soil *Scientist, Cardiff.*

localities, but up to about 5% in others.

It is likely that in some localities up to 40% of the fields have suffered erosion in 5 years, and about a third of these will have eroded twice or more. These are areas of sands or light loams, for example, in Shropshire, Staffordshire, where Alan Harrison Reed worked, and in Nottinghamshire.

On heavier textured soils in a bad year erosion affects only about 5% of the fields whereas on chalk Downland, like sandland, the figure can be about 20%.

Winter cereals to blame

Water erosion occurs mostly in winter cereals, wen on light land where other crops are grown. As the winter cereal acreage has increased bv three times since 1969. mostlv at the expense of spring cereals or grass, so erosion has become more prevalent.

Alan Frost and Ron Speirs of the Edinburgh School of Agriculture have found this–to be true also in southern and central eastern Scotland. Erosion has increased markedly here since 1980 corresponding to a rapid increase in the acreage sown to winter cereals. As this expansion into winter cereals has progressed north in Tayside and Grampian regions so, since 1983/84, erosion has followed, and is now being monitored by Adam Watson of the Institute of Terrestrial Ecology's Research Station at Banchory.

With help from power cultivators and tramlines

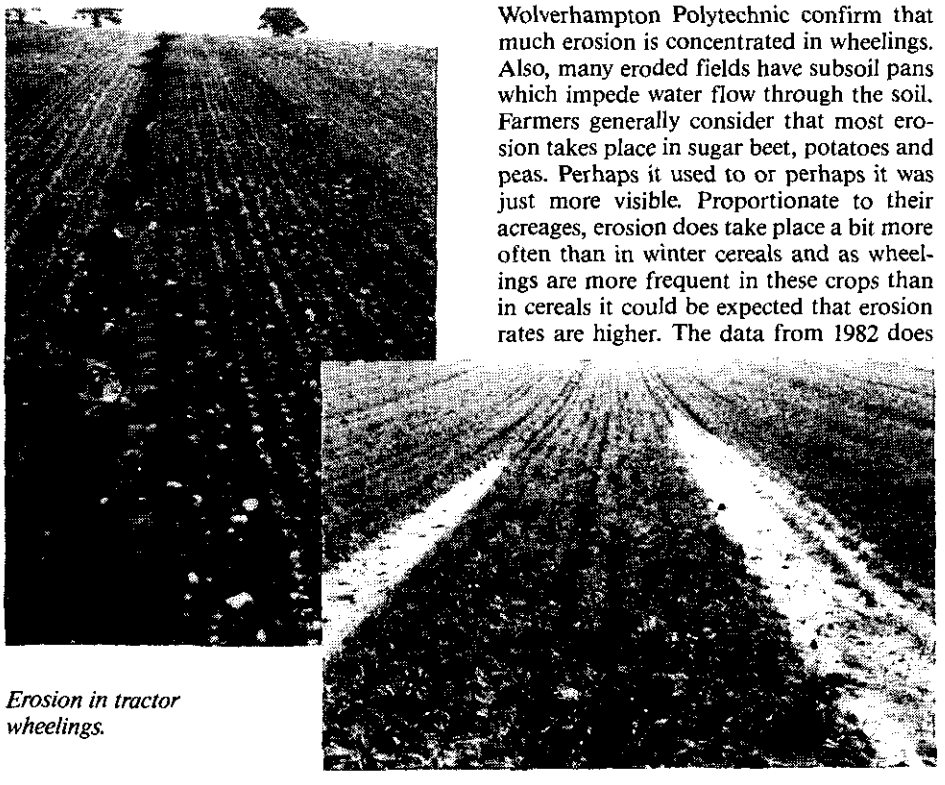
Most farmers consider winter cereals not at risk of erosion so why should there be so much wash in winter cereals?

For a start, winter is the time when soils are wettest and 10mm of rain falling on a saturated soil is enough to start water flowing over the surface.

Ditch *infilled with sediment.*

Also, as Ron Speirs and Alan Frost show, smoother tilths produced by power cultivators have exacerbated the problem, as have tramlines, especially since they are now put in at the start of the season so that wheelings are liable to erode throughout the winter.

Alan Harrison Reed and Mike Fullen of Wolverhampton Polytechnic confirm that much erosion is concentrated in wheelings. Also, many eroded fields have subsoil pans which impede water flow through the soil. Farmers generally consider that most erosion takes place in sugar beet, potatoes and peas. Perhaps it used to or perhaps it was just more visible. Proportionate to their acreages, erosion does take place a bit more often than in winter cereals and as wheelings are more frequent in these crops than in cereals it could be expected that erosion rates are higher. The data from 1982 does not support this, but that year there were few fields eroded by summer rains.



Erosion in tractor wheelings.

Erosion–little by little

Rates of erosion aregenerally low, often less than 1-2m³ per hectare. However, in one field in Staffordshire in 1982 nearly 80m³ of soil per hectare was transported, equivalent to a lowering of the surface of the whole field by almost 8mm.

The mean size of 224 eroded fields was 7.6ha and it is estimated that in 1982 less than 7.5-15m³, say 6-12 tonnes, of soil was moved in manv of these fields. much of this however, going out of the field. Most often erosion takes the form of a swathe down the valley floor, in many fields this being where the hedge and ditch used to be.

Rates of erosion are highest where slopes too are rilled and often these fields have sandy or light textured soils.

In general, crop losses are small, often less than 1% of the field's area. This figure incidentally, is much lower than that estimated by many farmers.

In the short term, then, erosion does not e much effect on the farmers' yields. Indeed, unless a large gully forms in his field neither does erosion affect his agricultural operations. It is not unknown however for the front wheel of the combine to break when driven into a crop-hidden gully!

Farmers already concerned and taking action

Is erosion a problem worth tackling'! Many

farmers think it is. The survey of farmers' attitudes carried out in 1983, a bad year for erosion, shows that 40% of farmers questioned thought it a moderate problem or worse, and in Nottinghamshire where erosion was widespread 55% considered it a major problem. Nationally 17% of farmers asked considered erosion had cost them money, in Nottinghamshire the figure was 32%. Surveys carried out by students in the South Downs, the Isle of Wight, North Norfolk and Strathclyde also show that some farmers are concerned about erosion.

This concern has led farmers to take measures to combat erosion. Often these measures are related to trying to improve the flow of water into and through the soil, by draining the field, subsoiling or moling. It is questionable if these techniques are very effective, as soils prone to erosion often slake and cap easily because of raindrop impact and wetting-up of the surface.

Some farmers have put their hedges or ditches back to shorten the slope length over which water collects and then flows, or they have started working along the contour. Others have found leaving cloddy tilths beneficial.

In Shropshire, one of the reasons for keeping grass in the rotation is to improve the soil's structure and increase its organic matter content. While the land is under grass it will not erode, although the very smooth seedbed can suffer wash, and sometimes severely so, in a summer storm.

Long term effects – reduced productivity, higher inputs

Farmers are mostly responding to what is mainly perceived as a short term problem, the longer term is often not considered. However it is likely that in parts of England much of the topsoil has already gone. For instance, on the southern chalk Downlands, which have been settled and farmed for at least 4000 years, the valley floors are filled with soil from the adjacent slopes, often equivalent to a plough layer's depth from the hillsides. These soils do not often contain chalkstones. However, because most of the productive topsoil has gone, rills down valley-sides may now cut into the chalk subsoil and large gravel fans are deposited in the valley floor.

In Nottinghamshire, Shropshire and Staffordshire, on the sandy lands there, the browner subsoil is often exposed on valley sides. and it seems likelv that this has happened largely since the First World War, as before then it is likely much of this land was under grass. On air photographs the poorer crop growth is clearly visible on these slopes, and in the field it is seen that sugar beet wilts much earlier on these thinner soils. For cereals it is likely that yields are one-quarter less, or more, than they are on the deeper soils.

So we should also be thinking more of the long term effects of erosion on crop productivity and the higher inputs of fertilisers and water that will be needed to maintain yields.

Off-farm effects may be even more serious

Soil eroded from one farmer's field often ends up in another farmer's field. Worse still runoff generated in a field with relatively little effect in that field can severely gully a neightbour's field, to everyone's embarassment.

It is this aspect which farmers are going to have to bear in mind. Soil carried out of the field becomes someone else's problem, and often it costs money to sort it out.

There are many instances of houses and roads being flooded in Sussex, Kent, Somerset and parts of the Midlands and East Anglia, as well as eastern Scotland. Insurance companies may hear the brunt of the cost for householders, but Highway Authorities have a statutory duty to remove soil deposited on roads or blocking roadside drains, and this comes out of the ratepayer's pocket. We know of two instances where Highway Authorities have tried to take farmers to court to claim back their costs. Instances such as these damage the farmer/Local Authority relationships.

The survey has shown that the most fertile components of the soil, its silt, clay and organic matter are often transported out of the field into streams. Silting of gravel beds in our southern chalklands streams is killing fish hatcheries and erosion is the likely source of the silt. Nitrogen fertiliser especially, but also potash and phosphate will be flushed from the land into streams causing algal blooms. And do we know that the pesticides bound to the fine soil particles are inert and will not damage the stream's environment? Have floods become more frequent or damaging in the last decade or so with the expansion of the winter cereal acreage? At least one Water Authority thinks it may have. And this increased runoff can cause rapid river-bank erosion.

These off-farm effects need to be considered by the agricultural community, indeed in the United States it is considered that they cost more to remedy than does the on-farm erosion. It is likely then that pressure to combat erosion will come from organisations outside agriculture.

So how should the farmer go about reducing the effects of erosion?

Crop lossfrom deposition of *eroded material.*

Combating water erosion

Some of the ways to combat erosion are outlined above and in the Ministry leaflet. We need to devise cheap techniques which farmers will use. We must not expect the farmer to work along the slope, something he seems to abhor.

A technique suggested by Mike Darbishire of SAWMA has been tried successfully on a farm in Norfolk. This is to run a tine in wheelings to roughen them up so inhibiting runoff and erosion. It stopped erosion last year, hut then the rainfall was not too heavy. However, it does look promising.

Can farmers reduce the number of wheelings put in a crop, especially sugar beet? ADAS soil scientists have begun looking at ways to reduce erosion in sugar beet.

Can headlands be left grassed – the conservationists will like that, and is it possible not to leave an exposed downslope plough furrow adjacent to the headland?

Get winter cereals away early in all fields so they give a good protective nd cover (>30%) before winter sets in.

Putting wheelings through the cereal crop rather than leaving tramlines will also inhibit runoff.

There must be other soil and crop management techniques which will cut down erosion, perhaps Professors Spoor and Morgan and their co-workers at Silsoe College will come up with something?

Measuring *erosion* – the depth and width of the erosion rill.

Where should our efforts be concentrated? First, measure the **erosion**

Erosion occurs frequently and predictably only in certain localities usually those with sandy or light soils; here many fields erode every year. These are the localities where something needs to be done now.

The choice of whether to do something or not is the individual farmer's, but how should he decide? He can check every year to see if his fields are eroding and estimate the amounts of soil moved. This is not difficult to do.

Firstly, estimate the lengths of a representative number of rills by pacing and at intervals measure their cross-sections. Then work out the volume moved for the whole field and remember that a rate of $10m^3$ per hectare is equivalent to a lowering of the surface of 1mm. In other words, if that rate happens every year an inch of topsoil will disappear in 25 years.

It may also be worth considering that this rate of removal is probably 100 times faster than the subsoil is forming.

Conclusions

The survey of water erosion is showing several things:

- erosion occurs frequently on light land and in those areas something should be done about it.
- the effects on crop productivity in the short term are small, but may not be so in the longer term.
- farmers are often aware of the problem and some consider it costs .them money; some have tried to combat erosion.

pressures to tackle erosion are more likely to come not from the farmer but from sources outwith the farm such as Water and Highway Authorities and other concerned individuals and organisations.

In our long term interests, which most people seem to ignore these days, we ought to be tackling the problem of erosion.

ADAS/MAFF leaflet 890 "Soil erosion by water" is available free from the Ministry of Agriculture, Fisheries and Food (Publications), Lion House, Willowburn Estate, Alnwick, Northumberland NE66 2PF.

FIELD MEETING

Redesdale EHF, Northumberland

Non-tillage management for soil improvement; hill farming and conservation.

Visitors to the Redesdale Experimental Husbandry Farm at our May Field Meeting had the benefit of a personally-guided tour by the Acting Director, Mr. Maurice Wilkinson.

This EHF extends to some 3900 acres, largely of hill grazing at around 1000 feet. Less than 10 per cent of the area is on mineral soil, the greater part being on shallow peat.

By direct re-seeding of some small acreage of the peat and so giving much improved herbage, the overall stocking capacity has now been spectacularly improved.

In our tour of the farm, Mr. Wilkinson explained how different improvement methods had been devised and applied according to the dominant species in the original sward.

The stagnohumic gleys (peaty topsoil with slowly permeable, fine texture subsoil), are the subject of special investigation by the Soil Survey and Newcastle University. Field trials are in progress studying selenium uptake and nitrogen transformation.

Mr. Maurice Wilkinson explains the *grassland* improvement techniques at *Redesdale.*

Farmers Weekly International Drainage Event

At the time of going to press Farmers Weekly have not yet announced any details of their plans for the 1988 International Drainage Event.

This important went in the calendar for good soil management is now to be held every other year (no event in 1987) and will be built around a new format to provide conditions ideally suited to proper presentation of the various sectors of the industry.

A straightforward farm site may no longer provide the necessary scope and compactness. Farmers Weekly envisage the possibility that they will need to adapt and plan a special demonstration site. They have earlier been inviting suggestions from the industry to help them ensure that all requirements are comprehensively covered. Andrew Wickenden at Farmers Weekly (01 661 3500) is the man to contact.

Manufacture of Tillage Machinery

SaWMA's Annual General Meeting was hosted this year by Messrs Dowdeswell Engineering Company at their Blue Lias Works, Stockton, Warwickshire.

Mrs. *Diana* Dowderwell very kindly took *a personal interest* in *ensuring* that *SaWMA visitors* were well received and entertained.

Members attending the AGM also had the opportunity to see at first hand the complexities of modern equipment manufacturing and the detailed care and attention given to every aspect of production and assembly at the Dowdeswell Works.

Asked about the company's product policy, Mrs. Dowdeswell explained that an essential part of their Sales Representatives responsibilities is to feed back information on what the farmer customers are looking for. The late Mr Roger Dowdeswell's plan had been for his company to supply a full range of British-made soil preparation equipment. That aim is still at the forefront of Dowdeswell product policy.

Mr. Geoff *Todd,* Sales *Manager,* answers a question *from* SaWMA President Sir *Nigel Strutt* on the *application* of the computer-controlled copy miller: The miller is used for *preparation* of tightly tolemnced tools used in *Dowdeswell* plough manufacture.

The SaWMA visitors expressed their warmest thanks to Mrs. Dowdeswell, her co-Directors and all members of the company for their very kind reception and for their patient explanations and helpful attention to questions throughout the visit.

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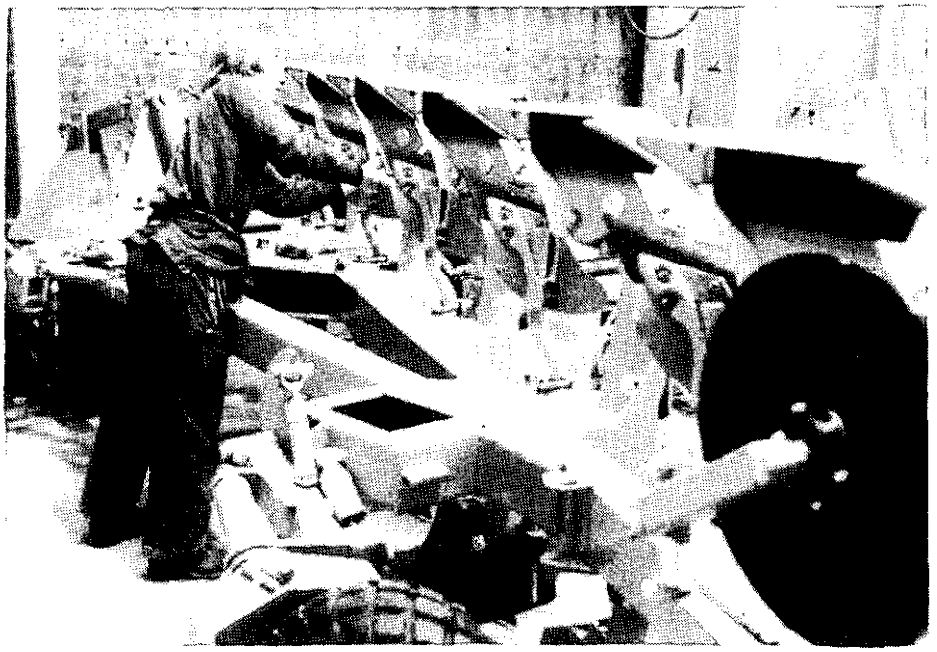
4th–7th January 1988
Silsoe College, Beds MK45 4DT



A Dowdeswell sir-furrow mounted reversible plough receives finishing touches in *the fitting* shop

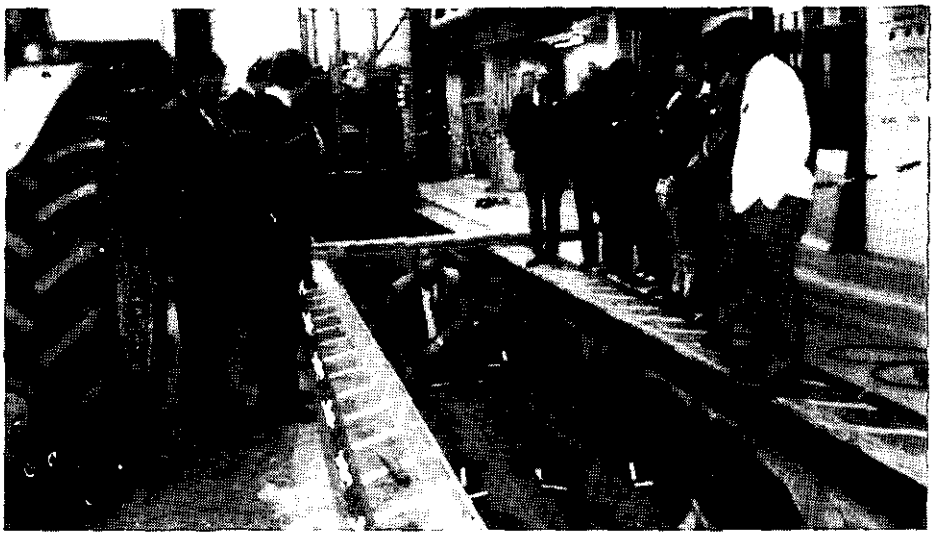
S d your and p down your costs

Another successful soil Management Course held at Silsoe College this year.

As in previous years, the Silsoe Soil Management course combines an element of theoretical and laboratory work with a good proportion of practical application and example.

Course leader, Dick Godwin stresses that the needs of the soil should be properly studied. "Look after the soil". For example, restrict grain trailers to the headlands and avoid random field damage. "It is much easier and much cheaper just to repair limited damage in small areas rather than having to work over the whole field. Only subsoil where you are sure there is a need."

A further Soil Management Short Course will be held in January, 1988. For details, get in touch with Mr. James Tupper, Professional Development Executive, Silsoe College, Beds MK45 4DT. Tel: (0525) 60428. There is a reduced rate for SaWMA members.



Above The new *enlarged* soil bin at *Silsoe* College allows *full scale* trials *to* be carried out on deep soil work and compaction *effects* at *faster forward* speeds with *actual* tractor operation Dick *Godwin demonstrates* the importance of *correct setting* and spacing *of* winged *cultivator points.*

Left: Course members visit nearby *Hexton* Manor Farm where Mr. Bill *Pickup* manages *1400* acres for Mr. *Ashley Cooper.* Bill *Pickup,* centre *left,* shows how *the* application of Silsoe College soil management techniques has developed good structure in their heavy clay soil. *"Regular* monitoring *of* soil *and crop* condition is essential," he says.

Field Meeting – Land Restoration

at Bush Farm, Hornchurch, Essex and Amwell Reserve, Harlow by kind permission of St. Albans Sand & Gravel Co Ltd

Monday 13th July, 1987 – 10.00am Bush Farm. Disperse around 4.15pm.
The St. Albans Sand & Gravel company is doing some notable work on the comprehensive restoration of former extraction sites and quarries, returning them to amenity use and conservation areas.

On hand to tell us about the projects and results will be Mr. W. J. Spreull, Director, St. Albans Sand & Gravel; Dr. S. G. McRae, Soil Science Dept, Wye College, University of London and the Reverend Tom Gladwin, Conservation Consultant for Amwell.

The visit is arranged in conjunction with two other Groupings so participation by SaWMA must be limited to not more than 15 members and friends.

If you wish to join the visit, get in touch straight away with:
Geoff Baldwin, 22 Mgerton Grove Road, Huddersfield HDI 5QX.

Plea for sponsors

MSc Course – Conservation of Soil Fertility

This one-year, post graduate course for study of soil fertility conservation attracted a considerable interest last year from a number of well qualified prospective students.

The only difficulty is that several students seeking to take the course last year were unable to do so for lack of funds.

Commercial sponsors are needed – firms with an interest in promoting and developing their expertise at home and abroad. There could be money in it – for the student and for the company.

If you think your firm could benefit by sponsoring a student on this Soil Fertility Conservation course please contact Dr. Burns, Universtiy of Kent, without delay. (See p. 35, this issue of Soil and Water).

Dr. *Jans Wesseling* (right) receives The *Drainage* Hull of Fume *Award from Professor Warren* L. Roller, *Agricultural* Engineering *Dept.,* Ohio *State* University.

Drainage Hall of Fame

Dr. Jans Wesseling, now retired after 30 years service with the Netherlands Institute for Land and Water Management Research, is the **1987** enrolment to the Drainage Hall of Fame at Ohio State University in the USA.

The Drainage Hall of Fame was established in **1979** and is located at the Ohio University's new Agricultural Engineering building. Nomination to the Hall of Fame is open to anyone working in any aspect of land drainage but only one individual is selected by the jury in any one year.

Dr. Wesseling is the second European to be honoured. An earlier enrolment to the Drainage Hall of Fame was Mr. Brian Trafford, Head of Environmental and Land Management Services, ADAS.

Council and Management Committee Members retire

It is with much regret that we have accepted the resignation from Council and Management Committee of two valued and active supporters of the Association.

Both Mike Darbishire and Frank Moore have been tireless in their efforts on behalf of SaWMA and apart from their Council and Committee service have frequently represented the Association at outside functions. SaWMA has benefitted not only from their sustained efforts, but also from the wealth of their knowledge, experience and contacts throughout the industry.

Besides his membership of Council and the Management Committee, Mike Darbishire in recent years has also been Chairman of the Technical Committee and on top of this has still made time to fill the role of Hon. Secretary of the Association. Both he and Frank Moore have also put in valuable support as members of the Editorial Committee and on the administrative Committees for Workshops and Conferences.

Frank Moore

Clearly, with this range of their participation and support they are both going to be sorely missed and difficult to replace. We wish them both and their families every happiness in their retirement.

Mike *Darbishire*
Working for SaWMA. As organiser of the SaWMA *Drainage* Workshop, Mike Darbishire (left) greets overseas visitor Mr Liebrecht of *the* Nelherlonds.

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APPOINTMENTS

ADVERTISERS INDEX

DIARY

JULY 1987

6-9 Royal Show—NAC, Kenilworth, Warwicks.
Arable Unit demonstrations include: effects of soil acidity, headlands management.

13' SaWMA Field Meeting—Restoration to Conservation
St. Albans Sand & Gravel Co Ltd at Bush Farm, Essex (see panel announcement page 33)

14-16 Great YorkshireShow—Showground, Hookstone Oval, Harrogate.

SEPTEMBER 1987

9-10 Autumn Action 1987—Demonstration of after-harvest cultivations—Shropshire and West Midlands Ag. Soc., Eyton House Farm, Telford, Shropshire

14-17 Soil Management and Land Use—BSSS Autumn Meeting—West of Scotland Agricultural College

OCTOBER 1987

30-31 Farming and the Countryside—a practical presentation of farming and conservation needs—NAC Kenilworth

DECEMBER 1987

7-11 Third International Workshop on Land Drainage—Ohio State University, Columbus, Ohio, USA.

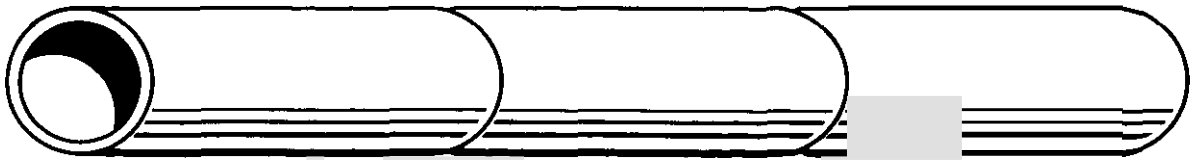
16-18 Irrigation: Principles and Practices—Short Course, Silsoe College, Beds.

JANUARY 1988

4-7* Soil Management—Short Course, Silsoe College

4-7* Field Management for Effective Drainage—Short Course, Silsoe College, Beds.

*Denotes events at which SaWMA is participating.



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