# Sol Land Wafer

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TEDDETED

July 1986



Modern farming techniques and today's economics are demanding much more efficiency on the farm.

In ploughing, this can be achieved by utilizing the power transmitted through the wheels to the land — avoiding wheelslip, which wastes time, fuel and energy. The fitting of Trelleborg wide tyres can be the effective answer.

We asked Viv Samuel, the reigning UK and former World Ploughing Champion, to take the plough and prove our claim. "You can't plough in a furrow with **24** inch wide tyres!" was his immediate reaction — "but I'll give it a try..."

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THE MAGAZINE ON SOIL CONDITION AND FERTILITY

Volume 14 No 3, July 1986

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Sail and Water is published quarterly and is SaWMA's principal means of promoting everimproving standards of soil care and management, through the publication of research findings, scientific articles and practical information on 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.

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Front cover: - The ELE Paquaiab in use. A portable water and hygiene testing laboratory providing a unique, flexible solution to the problems of monitoring and controlling water quality from source to supply. See also page 7.

# COMMEN

#### Soil Management – today and for the future

With memories still strong of the difficulties of last year's harvest; the delays in getting seedbeds; the repeated risks of creating compaction and the prospect of future soil management problems, it can readily be understood why we have deemed it appropriate and timely to choose Tillage as the subject of our 1986/87 Conference.

Appropriate and timely, too, because it is now almost twenty years since the events leading up to the Strutt Report and the foundation of SaWMA. It is a good time now to review where we stand; have the ideas and practices introduced over this past twenty years been successful? If not, why not; and where do we go from here?

It must be admitted that many of the problems are still with us-we have learnt a lot but there is still more to learn. Costs, too, are now more than ever a critical factor.

There will be a strong emphasis at the Conference on costs, and cost savings in tillage operations.

So, now is not too soon to be drawing attention to this Conference. We have some good speakers lined up and we are very pleased to have the Earl of Selborne as Chairman.

In the end, however, the ultimate success and value of the Conference will be determined by strong support from the 'user' interests—oarticularly the farmers and the machinery designers. We hope to see you there. Full details will be presented in our next issue—but please make a note now of the date; Thursday, 5th February, 1987.

#### Maintenance for the future

Returning now to the subject of our Comment in April Soil and Water, we are delighted to read the NFU policy document "Farming Trees".

This NFU document takes up and presents detailed proposals on the financial aspects of a farm/forestry policy. It is stressed, and rightly, that for a farmer to change to a crop that may not yield any substantial income for 50 years there is a need for an initial and extended period of support to replace the lost income.

It will be necessary for the EEC, the UK Governement and the public at large to recognise and accept the need to provide realistic and continuing income support for those embarking on this long term activity.

Nevertheless, the actual cost should be more apparent than real. As the NFU document points out – the savings on the agricultural support payments otherwise payable for the area transferred could well amount to double the costs of the actual forestry support.

As we noted in our last issue-converting agricultural land to a forestry use is surely one good way of ensuring the land is well used and maintained for the future.

Another aspect is the preservation and conservation of the countryside for the public at large. We welcome, too, the setting up by the Countryside Commission of a panel of experts to assess the likely impact on the countryside of new farming and foresty policies. SaWMA member, Mr John Quicke, a Countryside Commissioner and past president of the Country Landowners Association is chairing this important panel.

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# PIPELINE...PIPELINE...PIPELINE...PIPELINE...



The **Bomford Dyna-Drive** non PTO. driven **rotary** surface cultivator can now be equipped with a helical coil crumbler (). se on light, but sticky soils. The addition of this crumbler extends rhe uses of the Dyna-Drive from stubble cultivation, straw incorporation to seedbed preparation and even seeding when equipped with the seeder linkage.

# Hydroponic fodder growing

An export success story is reported by Landsaver Ltd., the UK company manufacturing hydroponic fodder growing equipment.

Worth potentially £42m, the Japanese order is for a steady supply of machines, rising to 50 units a month after 1986. These will be sold throughout Japan to farmers and cooperatives and are intended to provide feed for a variety of livestock including horses, beef and dairy cattle, with emphasis on beef. Currently there are 4.6 million dairy cattle in Japan and a large number are zero grazed on hay imported from Australia and America due to a shortage of natural pastureland. This system is not only costly but means that Japan has to rely on overseas feed sources, a problem that can largely be overcome where the Landsaver system is used.

Speaking recently in London, Mr. Geoffrey Lusty, Managing Director of Landsaver, praised the assistance given by the British Agricultural Export Council, The British Overseas **Trade** Board, and The Department of Trade and Industry, who, he said, had helped considerably during the 2 year negotiations leading to the final contract.

Four models of the Landsaver are presently being manufactured; the HD-75, HD-150, HD-500 and the **HD-1000**, which produce 75, 150, 500 and **1000kg** of fodder grass respectively per day.

Production costs in the UK are said to work out at about £25 per tonne.

Overseas demand is growing steadily with machines already supplied to over 20 countries. With automated irrigation system there is a very low water requirement and the machines are particularly suited to providing fresh grass for animals in arid countries.

As a further development, Mr. Lusty envisages Landsaver machines helping with growing food for human consumption. Initial research has shown that rice germination **can** be **accelerated** to achieve growth in 9 days that normally takes 40 days.

Another area of considerable importance is the ability to accelerate trial plant growth and so cut down the **development** time of new strains of plants.

For further information:

Geoffrey Lusty, Managing Director, Landsaver Ltd., 74 Earlstrees Road, Corby. Northants NNI 2AZ Tel: (0536) 61185

### The Bomford Dyna-Drive

Bomfords have produced an attractive and interesting compendium of articles about Dyna-Drive. Farmers from all parts of the country and from overseas talk about their experiences with this versatile tillage machine and the **advantages thev** have found from using it.

The Dyna-Drive, jointly developed by Bomfords with the N.I.A.E., is designed to give speedy preparation of seed beds together with low operating and maintenance costs. Forward speeds can be up to 7.5mph (12 acres an hour fc the 5m model) and the ground driven, upward-breaking and lifting action of the spade-like tines is ciaimed to require less energy and to be far more efficient in converting the tractor's power into useful work.

The experience of Mr. Giles Halfhead, farming predominantly lias and boulder clay near Grantham, is typical of the various reports presented in the Bomford compendium. Mr. Halfhead explains that due to the late harvest in 1985 he was faced with a lot of land that was not drilled and could not be tackled with the farm's normal equipment. Some was ploughed but then, as the weather imoroved, both this and the remaining unploughed land dried hard like a rough concrete road. A Dyna-Drive was purchased in early September and covered over 800 acres direct into stubble and both on ploughing-much of the land requiring only one pass to produce a seed bed.

Besides the user reports, the compendium also includes some useful **information** on setting and maintenanceof the Dyna-Drive and a reminder that the Dyna-Drive has already **won two** important awards—the Design Council Award and the RASE Silver Medal.



The *Landsaver HD-500* capable of producing *500kg* of fodder each day – willfeed *dairy and* beef cattle and horses in *Japan*.

# PIPELINE...PIPELINE...PIPELINE...PIPELINE..

### Early warning system for groundwater pollution

A vastly improved sampling technique that provides early warning for impending pollution of underground water resources has been designed jointly by researchers at the Weizmann Institute of Science and the Israel Water Commission.

Following successful initial tests on Israel's coastal plain, a comprehensive demonstration project is being planned in Europe and the U.S.A.

Reasoning that, since all deep groundwater pollution has percolated down oug the earth, the researchers determined that the ideal place to provide early warning is at the point of first contact with the water—the very too of the water table.

The samples are taken with a dwice comprised of a plastic pipe with multiple slits, inserted into a narrow-bore research well and extending just below the aquifer surface.

It has been found that the concentrations of chemical constituents, such as chloride, nitrate, and sulphate ions, were four times higher in the upper layer than in the depths from which drinking water is extracted. Moreover the dispersion of pollutants within the aquifer is relatively slow, as indicated by a very gradual decrease of their concentration with depth. This means that if plans were made to skim off the top layers of the aquifer (which could be used for irrigation), the deeper, relatively clean water could be protected from further degradation.

Commenting on the significance of their work, Professor Magaritz of the Weizmann Institute says "The slow movement of pollutants both in the soil and the water table beneath cultivated fields provides both a warning and a promise We must be very careful about putting polluting materials into our soils, as these remain there for decades. However, with knowledge of what is coming down into the water table, we can also develop ways of halting their deleterious effects:'

### 

The Fellowship of Engineering, Britain's senior representative body of professional engineers, has published a 'Report on Irrigation'.

A principle recommendation in the Fellowship's Report is that a 'Club' approach should be taken to promote British expertise in the field of irrigation, benefitting not only areas of urgent world need, but also the reputation and ability of British research and engineering experience to meet the need.

Responding to this recommendation, the Fellowhsip has now already received an encouraging offer from the British Hydromechanics Research Association and Silsoe College (Cranfield Institute of Technology) to initiate an 'Irrigation Club'.

If the increasing world demand for food is to be met, as well as the expansion of irrigation in arid climates in particular, states the Report, there is not only a need for greater productivity from existing irrigated land, through new higher yielding crops, but also for ensuring the optimum efficiency of new irrigation schemes as they are created. It is this latter requirement which is at the heart of the Fellowship of Engineering's Report which identifies the urgent need for the effective co-ordination of the **UK's** research and development effort into all aspects of irrigation, whether for application at home and abroad.

#### **Britain's position**

Although the latest figures indicate that British consultants and contractors are engaged on 81 irrigation projects overseas, valued at some £5 billion, the British contribution to basic research is very small, with only two to three per cent of world bibliography emanating from the UK. Even if this cannot be improved upon, suggests the Fellowship, every effort should be made to maintain Britain's reputation for high quality.

Apart from stressing the needs of developing countries, the Fellowship's Report recognises that irrigation in the UK is also of growing importance and is seen by many farmers as a means of increasing productivity to protect farm incomes and as a response to market forces which reward quality, uniformity, regularity and reliability of supplies. This is particularly so for such crops as potatoes, sugar beet, vegetables, cereals and grass, with more than 100,000 hectares (390sq. miles) currently under irrigation during the summer months in England and Wales. The present rate of investment in irrigation in Britain exceeds £20 million per annum.

#### New versatile Rotaspike from Howard-Farmhand

Howard-Farmhand have introduced a new range of Howard Rotaspikes at the Royal **Show**. The Rotaspike, a spike version of the famous Howard **Rotavator**, is an ideal tool for stubble cultivations and deep secondary tillage for both cereal and **rootcrop** seedbeds. Its action is to 'burst' the soil whilst effectively helping to push the tractor along, making it a high speed machine requiring relatively low power and causing no tractor wheel slippage or smear.

Rotaspikes, in widths from 80" to 120", are suitable for tractors from 45 to 125hp. Prices start at £3,070 complete with crumble roller.



New Howard Rotaspike from Howard-Farmhand.

# PIPELINE...PIPELINE...PIPELINE...PIPELINE...

## Farming and the Countryside

#### Seven million trees planted in England and Wales

The Spring 1986 issue of the Massey Ferguson journal "Modern Farming" publishes some interesting data derived from a Ministry of Agriculture survey on environmental topics.

Carried out in 1985 on farms in England and Wales the survey shows how much farmers are already doing to help keep Britain a green and pleasant land. Facts are:

- More than 7 million trees were planted on farms in England and Wales in the 12 months to 1985.
- About 20 per cent of farmers planted trees, averaging 240 each.
- More broadleaved trees than conifers were planted 3.95 million broadleaves to 3.39 million conifers.
- In the four previous years, at least 22 million trees were planted on farms.
- The total area of trees in woodland and smaller groups on farms is 300,000 ha almost 3 per cent of the total farm area.
- Only one-fifth of the broadleaf and two-fifths of the conifer area were regarded by farmers as being primarily for economic use.
- More than 60 per cent of farmers saw significant benefits of woods and trees on farms for landscape, general amenity and wildlife conservation. Woods also provided shelter and game cover.

However, while some farmers have been busy planting trees, woodlands on other farms have become neglected. The Ministry of Agriculture points out that leaving woodland untouched is not conservation. Every woodland, however large or small, needs management. It will need sympathetic re-planting with native species, weeding and careful thinning to make sure it remains a pleasure for future generations.

The Land and Water Service of ADAS has advisors who can assess the value of a wood, advise on its management and draw up a working plan. They will advise about sources of grant aid and whether a Forestry Commission felling licence is required for removal of trees when renovating neglected woodland.

## **Environment Year**

Quoting from the Farmers Weekly (30 May, 1986) we are pleased to report that "leading UK farmers and conservation experts are helping to plan European environment year.

"Environment Minister William Waldegrave has appointed the following to a committee co-ordinating the UK's input during 1987: Sir Derek Barber, Countryside Commission chairman; Sidney Fawcett, former NFU vice-president; William Wilkinson, Nature Conservancy Council chairman; and Roger Carr, chairman of the Countryside Commission for Scotland."

The decision to nominate the year March 1987 to March 1988 as the European Year of the Environment (EYE) was taken by the heads of Government of the members of the European Economic Community when they met in March, 1985.

At the inaugural meeting of the steering committee, the Chairman, Mr. Clinton Davis, said "The European Year has to be seen as a launching pad for a long term effort to protect and improve our environment. This involves no less than bringing about a new way of thinking – such a change of behaviour that it becomes a habitual phenomenon that, when we make policy decisions, we automatically concern ourselves with the environmental consequences".

As a further element of British participation in Environment Year, there is to be a major new exhibition sponsored by the Department of the Environment and supported by the Confederation of British Industry. This INTERNATIONAL POLLUTION ABAT-EMENT FAIR will be held at The National Exhibition Centre, Birmingham, from 6th to 9th April, 1987.

# English Translations of German Standards

The catalogue\* of English translations of German standards is now in its 22nd edition. The 1986 volume contains about 4,000 entries, covering a wide range of products and practices. The index lists ten items under 'Soil' and thirteen under 'Drainage' besides many other categories of possible relevance to Soil and Water.



#### Sub-soiler is easy on the power

A sub-soiler specially designed for the smaller tractor is being launched by tillage equipment manufacturers J. W. Blench of Whittlesey, Cambs.

The single-leg implement is fitted with an 'easy-lift' foot which tackles the task of panbusting while causing minimum surface disturbance, making the unit particularly suitable for working in grassland.

Tractors with just 40hp can pull the compact sub-soiler in appropriate conditions while it is equally suitable for machines with twice the power.



The Blench "Compact" sub-soiler.

The panbusting foot is divided into two sections, both simple to replace when necessary. The single-leg shin is reversible. A shear bolt avoids damage from excessive pressure and two easy-to-fit support-legs are supplied so the sub-soiler can stand on its own.

The Blench 'Compact' is economically priced at £298 plus VAT ex works-with special discounts to farmers who buy direct. Further information: Tel: (0733) 204455

\*Published by: Beuth Verlag GmbH, Postfach 1145, 1000 Berlin 30. Price DM36.00.

## Soil Investigation Kit

KMI, KeyMed Industrial, are introducing a borescope specially designed for use in soil investigations. The KMI Soil Investigation Kit contains a 10mm diameter borescope with fibre light guide and a KLS-301 industrial light source and is supplied in a robust carrying case.

With a 90° direction of view and a  $60^{\circ}$  field of view, the KMI borescope enables the observation of soil in voids formed underground, such as in mole drainage.

Further details: Customer Liaison, KeyMed House, Stock Road, Southend-on-Sea, Essex SS2 5QH. Tel: (0702) 616333.

# PELINE...PIPELINE...PIPELINE...PIPE

## **ICI Plant Protection sponsor ATB** farming and wildlife conservation training

Conservation training on the farm is to be boosted by a grant from ICI Plant Protection over the next 12 months. The money is to he used by the Agricultural 'Raining Board towards the development of a comprehensive farming and wildlife conservation training programme and the training of instructors to provide the necessary onfarm expertise throughout the country.

Commenting on the grant, Board Director, Richard Swan, said: "As the industry has become aware of the importance of conservation there has been a marked increase in the demand for practical on-farm training. This excellent gesture by ICI Plant Protection will enable the Board to develoo more fully this important area of its work and to continue a meaningful dialogue with various other interested countryside organisations in order to establish the areas where training is required. Initially the funding will he used to employ a training designer to develop the range of courses and we expect that he or she will be liaising closely with FWAG (Farming & Wildlife Advisory Group):

The initial task of the training designer will be to identify the areas of conservation which are not already covered by ATB courses and then to develop the necessary training programmes to provide comprehensive training packages for every aspect of the subject. It is planned to have the person in post by July and for new courses to he piloted through the winter and spring of next year.



water management.

uj 10

#### A New portable approach to water and hygiene testing

This is the International Water and Sanitation Decade (1980-90). Interest in water quality has never been greater, yet more peoplestill die from water borne diseases than any other cause

At the heart of any test of drinking water is a microbiological examination of the bacteria present. If any faecal bacteria are detected in a 100 ml sample, the water is declared unfit for human consumption. ELE International Limited of Hemel Hempstead is now able to offer the first completely portable water and hygiene testing laboratory.

The ELE Paqualab, weighing just 13 kg, provides a unique, flexible solution to the problems of monitoring and controlling water quality from source to supply.

The Paqualab kit includes all the essential items of equipment necessary to analyse the key microbiological and physio-chemical indicators of water quality as specified by the WHO. Its portability allows the operator to measure water contamination directly in the field, providing vital information.

Detailed specifications for the Paqualab have **recently** blished by ELE in their 2nd edition Agronomics Catalogue. The new 256 page, full colour edition is available free of charge and ore > information of more than 1100 items ranging from the most practical aids for farmers and erowers to the more sophisticated devices required for research and education. Major test areas include soil physics, irrigation and drainage, field analysis, field sampling, physical survey, agrometeorology and crop science.

#### Model DM4500 Recotiller with hydraulic drill attachment and transport kit.

## **New Range of RECOtillers**

#### Ruston's Engineering announce their new 'D' range of Maschio RECOtillers.

Pointing out that already in recent years the Maschio power harrows have accounted for over 40% of the UK market share of power harrows, Rustons stress this is no reason for them to rest on their laurels and the new range embodies several major engineering improvements.

The key to the new 'D' range is the achievement of an exact 4 metre power harrow to meet market demand for this width of power harrow/drill combination. Rotor spacing has therefore been increased to give an even number of rotors on a 4 metre machine with a spacing of 246mm and this rotor design and spacing is then maintained throughout the whole range.

Blade length has been increased by 27 per cent and many other new features have also been incorporated to add to the strength of this new 'D' range of RECOtillers.

Equipment for training in imgation water management

possible demonstrations, evaluations and test procedures to the maximum benefit of the

> trainee. The brochure now available from Arm-

> The worldwide expansion of irrigated

agriculture in recent years has demanded in-

creasing numbers of personnel properly

trained in modern techniques of irrigation

prompted the establishment of water

management centres to implement project-

related training schemes. This, in turn, has

shown the need for more field and laboratory

pany has responded to this need and offersa

range of equipment specially designed to

meet the practical training requirements of

professional, technical and vocational people

working in irrigation. Furthermore, each item

of Armfield training equipment is supported

1 : Armfield Technical Education Com

suitable for use in a study course

Recognition of this training need has

field carefully presents, with clear illustrations and explanations, the wide range of equipment they offer for Demonstration, Training and Project work in irrigation management. The brochure could itself form the basis for a training curriculum.

Detailed in the **brochure** is equipment for: assessment of soils and crop water re-quirements; assessment of water resources; abstraction, storage and distribution of water; operation of canal and surface irrigatrickle irrigation; sprinkler tie ti irrigation and, finally, land drainage and reclamation.

The company also offers to originate specialised equipment for research work and, in conjunction with specialist irrigation consultants, to provide support services for irrigation training.

Armfield Technical Education Co Ltd. is at Bridge House, West Street, Ringwood, Hants BH24 1DY. Tel: (0425) 478781

# SOILS

# **The Manod Series**

#### Soil Assessment - R Hartnup, Soil Survey of England and Wales

These **moderately deep** medium **loamv** well drained snils are developed over the shaly **or** medium textured sedimentary rocks of western England and **Wales**, **often** on **steep or moderate** slopes, generally at altitudes **of** between 200 and **400m**. The National soil maps show that Mannd snils are dominant **over some 3740km**<sup>2</sup> in Wales, **1125km**<sup>2</sup> in south west England and are **also common** in north west **England**. They **occupy 3.5%** of the total area **of** England and Wales.

Manod profiles are distinguished by having well developed and strongly structured brightly coloured subsoils below topsoils rich in organic matter. Under semi-natural woodland or grassland there is a thin humose surface (mor) layer. The bright subsoil colours are caused by relatively large quantities of amorphous oxides of iron and aluminium, which also endow the soil with an excellent fine aggregate structure.

The following is a brief profile description.

#### cm

0-25 Dark brown, slightly stony clay AD loam.

25-60 Strong brown, moderately stony clay Bs loam; moderate medium granular or subangular blocky structure.

At 60 Slaty mudstone in situ or extremely R or stony clay loam or sandy silt loam. Cu

#### Few areas under arable

Most of the land is in permanent grass and includes much of the "ffridd" or middle pasture land of Wales. Pastures on steep land arc frequently infested with bracken, which thrives on these deep acid soils. Grazed seminatural bent-fescue grassland also occurs. Manv of the characteristic vallev-side woodlands of western Britain are on Manod soils and in places abandoned farmland has also reverted to scrub or woodland. The combination of steep slopes and the many varied forms of semi-natural vegetation ensure that the scenery is often very attractive. There are few areas under arable crops, but some cereals are grown where gentle slopes and a sufficiently dry climate permit. Early potatoes are grown on these soils in south west Dyfed.

Soil and land management in agriculture

Manod soils are well drained and permeable so they are very rarely waterlogged and there is little risk of poaching. In most places the moist climate ensures there is little risk of crop yields being affected by drought, but in dry districts, or on south facing slopes, soil moisture reserves are depleted in most years, reducing the grass yields, and maximum rates of nitrogen application are not recommended here. Aspect is an important consideration in planning the use of the land, since where slopes are steep, plant growth on a north facing field will be some three weeks later than on one facing south. The soils are naturally acidic and the subsoil has a strong tendency to fix phosphates, so regular dressings of lime and phosphorus are necessary. Steep slopes can restrict access, and their lack of management may lead to invasion of pasture by bracken and gorse.

Early potatoes are grown in Manod soils in south west Wales where the winters and the early springs are mild. These coastal areas are also windy and so the snils dry rapidly and can be cultivated in short rain-free periods in February, although care must be taken to avoid damaging soil structure.

Elsewhere spring cultivation is very much the exception, and it is only regularly successful where average annual rainfall values are less than 1000 mm

#### Forestry

Oakwoods have survived on many steep slopes with Manod soils. Most of the woods are secondary, and affected by grazing livestock, but several are of considerable interest for nature conservation, The valley-side woodlands of the Rheidol Valley in Dyfed for example are listed as a grade I conservation site by **Ratcliffe** (1977). As well as their value

for wildlife many include land that has nwer been disturbed by any form of cultivation. Such sites are rare and give researchers an uninterrupted record of soil development. The woods are also of immense landscape value, and wherever they occur these soils offer wide scope for amenity planting. Commercial foresters value Manod soils as among the best available to them. Larch grows well, as do most softwoods. Windthrow is not usually a problem. The soil is too infertile for commercial crops of the more demanding hardwoods howwer, and oak seems the best choice. Plantations of red oak do particularly well. Beech can be grown in sheltered sites, but will not vield as well as in the more fertile soils of the lowlands. Slope is a swere limitation, special machinery being required for planting and harvesting.

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- Sails and their use in Northern England. Bull. Soil Surv. Gt. Br. (1984).
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- Soil Survey publications are obtainable from: Soil survey of England and Wales, Rothamsted Experimental Station, Harpenden, Herts, AL5 2JQ.



The sloping land on *this* firm in east Powys *has Manod soils* with bracken *infested grassland*, *a small larch plantation* and a strip of oak wood. The *cultivated land* in the *foreground* has *Denbigh* series.

# **Research at the NIAE**

The National Institute of Agricultural Engineering's Annual Report is thicker this year and contains **more** details of research programmes.

Although in his introduction the Director mentions cuts in research and development funding, he points to a bright future for the NIAE. This is based on continued development of industry links. The high spot of the year was when the Institute gained the **MacRobert** Award from the Fellowship of Engineering. It was presented by HRH The Duke of Edinburgh in November.

Selecting just two of the many projects covered in the report we quote as follows on the Institute's work on design of a self propelled gantry and on investigation of wear resistant materials for soil engaging components.

#### Ceramics for wear resistance;

The development of alumina protection for soil engaging components (Foley, 1985) has continued with particular emphasis on subsoiling equipment. An experimental ceramic protected subsoiler has been compared with a conventional steel subsoiler to assess the relative lives of the various components and thereby the cost effectiveness of the alumina protection. The ceramic protected shin (single-ended)consists of 'V' shaped pieces of alumina bonded onto the leading edge of a conventional steel shin. The sides of the experimental leg are protected by alumina tiles, again attached using adhesives. The 2-part experimental foot consists of a cutting edge in hardened spring steel (BS 970:250 A53, 500H<sub>o</sub>) and an upper surface of dumina tiles. After 440ha (about 1600km of travel through the soil per leg), the ceramic shin had outlasted three double-ended steel shins and although badly worn, was still usable The leg protection had also shown significant savings in wear (measured by the change in leg width) by an average factor of about 4.5. The performance of the new design of subsoiler foot was encouraging in that the amount of metal scrapped when the cutting edge was worn out was significantly reduced.

Work currently in hand on protecting the cutting edge of plough shares should enhance the design.

Heavy duty cutting edges such as plough shares and subsoiler points cannot be protected with dumina because of its limited impact resistance. With such applications in mind, a range of tougher wear resistant materials have been considered, including sialons, toughened alumina and sintered tungsten carbide/cobalt composites. At present only the latter are readily available and their use as a wear resistant tip on plough shares is currently being studied. A number of designs, grades of material and methods of attachment are being field tested. Adhesive bonding is being investigated as an alternative to brazing, since it is likely both to he cheaper and to reduce thermally induced stresses in the carbide tip. Early indications suggest that carbide tipping significantly reduces wear rates hut, in addition to optimising the design, the cost effectiveness must be examined in longer term trials.

A feasibility study of the use of **ceramic** materials in agricultural plain bearings **reveal**ed that only alumina was likely to be cost effective. A survey of the extent of abrasive wear induced failure of plain bearings in soil contacting environments will be carried out before field trials can be justified.

#### **Gantry design**

Work on the development of a wide-span vehicle ') continued – and additic support was provided by the European Economic Commission in the form of a 4-year joint research contract with the Netherlands and West Germany. Progress on the gantry included provision of a complete hydraulic spray system on the experimental 12m span machine and replacement of the driver's existing two double-axis controllers by a joy-stick and steering wheel. Provision was also made for a 12m wide cultivator mounting beneath the frame, and the design of a three-point linkage on a cross-slide is now in progress.

Plans were formulated for the Autumn of 1986 for a **replicated** field **experiment**, and a larger scale field trial with the gantry. These provide a comparison between a conventional method of crop establishment and one using the gantry. In the latter system, no machine other than a combine-harvester on rice tracks will wheel the cropped area of soil, following thorough loosening of the site prior to the experiments.

For a copy of the N.I.A.E. Report, or more details on research programmes please contact: Dr. G. F. Forster, Head Information Services Dept., N.I.A.E., Wrest Park, Silsoe, Bedford. MK45 4HS. Tel: (0525) 60000.

#### Losses in grassland wheelings

A preliminary account is presented in the June issue of BSRAE Association News of **NIAE** investigations into grassland wheelings.

The grassland wheelings trials are being carried out at the North Wyke site of the Animal and Grassland Research Institute in Devon.

It has been found that "in Spring during the application of fertiliser, 12% of the field may be covered by tractor wheelings, which in wet conditions can cause considerable damage to both soil and grass':

"Experiments carried out over three years have shown that high contact pressures have consistently reduced yield in the wheelings at the first cut; in the worst case a reduction of 50% was recorded. The work is continuing to investigate the effect oi sward type, long term effects of wheelings and the balance between timeliness of fertiliser application and damage due to wheelings':

#### Fast Ion Analysis in Water

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# The ssessmer of Windthrow Hazard for Commercial Forestry

E. M. Lee Geomorphological Services Ltd

The widespread expansion of commercial forestry has largely been controlled by financial interests. Most investments proceed on the basis of careful investment appraisal, balancing the costs of development with the expected timber yields. In view of the long time scales associated with forestry and the high opportunity costs, real **rates** of return may he low. On the other hand, the tax incentives are valuable and the risks involved in the investment are usually slight. However, local environmental conditions can **influence** forest growth in such a way that the value of the mature stand is affected. Indeed, the interrelation of wind and soil can be critical in forestry development.

**Wind is one** of the **main hazards** to the commercial viability of a plantation, **affec**-ting forest growth in two main ways:

- the restriction of tree growth rates. At critical levels of exposure tree growth is reduced to such a level that forestry becomes uneconomical. In very extreme conditions young trees may die as a result of severe tissue and mechanical abrasion;
- plantations, particularly on exposed sites where wet or compacted soils restrict root development are susceptible to premature windthrow.

#### Damage from windthmw

Windthrow in conifer stands has become an increasingly serious problem in many parts of the United Kingdom. Often windthrow begins well before plantations have reached the economically desirable rotation age, and the yield of valuable large diameter timber may be considerably reduced. It is possible to identify two main types of windthrow damage:

- **catastrophic windthmw** is caused by severe storms with long recurrence periods. The levels of damage are influenced by wind speed rather than site conditions or management practice;
- endemic windthrow is of greater significance to the forester than the largely unpredictable catastrophic windthrow. It arises as a result of normal winter gales with wind speeds of around 45 mph, gusting to 67 mph. The damage to a plantation is often sporadic, hut is strongly influenced by site conditions and management. The typical form of damage is the uprooting of stands of trees on wetter, poorly drained sites. In some cases plantations can be devastated by windthrow.

#### Prediction of windthrow susceptibility

The relationship between damage and site conditions is very important as it offers a means of predicting the occurrence of endemic windthrow. Such predictions are extremely valuable for investment appraisals where it is necessary to estimate the rates of tree growth, the length of rotation and the probable yield class. The prediction of the windthrow susceptibility enables more accurate production forecasting as the degree of risk will affect the management practices such as thinning type and hence the yield, size class distribution and quality. The considerable losses due to windthrow make it important that forest managers can predict where and when it is likely to occur, in order to select the most appropriate treatments for each stand.

The main method of assessment used in commercial forestry is the Windthrow Hazard Classification system developed by the Forestry Commission (Miller, 1985). This classification involves the evaluation and scoring of four important site factors:

1. Wind. Using a combination of exposure flag data and published meteorological data the Forestry Commission has produced a wind zone map of the country, according to the incidence and severity of strong wind conditions. In general wind speeds are greater in the north an west, and in coastal areas.

2. **Elevation.** Both the mean wind speed and gale frequency increase with elevation. As a result forests at higher elevations tend to be more at risk than lowland sites in the same area. These effects are not linear, and for a





#### Soil Map 1:10 000

- I Brown earths
- Upland brown earths
- 4 Ironpan Soils
- 4b Intergrade Ironpan-brown earth
- 6 Peaty gley
- 6i Imperfectly aerated peaty gley
- 86 Juncus bog
- 10b Contained or basin bog
- 138 Scree 13r Rack
- stony Phase
- flushed phase
- p peaty phase

similar increase in height there is a greater increase in risk at higher than lower elevations. **3. Topography. The relationship between** topography and exposure is very complicated. Often the surrounding topography can produce locally important lee slope turbulence, funnelling and along slope wind acceleration. A simple objective estimation of the topographic shelter of a site can be made by **topex** assessment. This involves the measurement of the angle of inclination of the horizon at the eight major compass points. The cumulative total gives a **topex** value for the site and by surveying over the whole aquisition a **topex** map can be **produc**-

#### **Corporate Members**

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#### ed (Figure 1).

4. Soil conditions. The most important soil characteristics are those that influence the development of the tree root system and the soil shear strength. Both these factors determine the degree to which a tree can resist the leverage and overturning forces of the tree stem under wind loading. The scoring for soil conditions is based on the Forestry Commission soil classification system (Pyatt, 1982) with each individual soil type having its own score The more detailed the soil mapping the better the Windthrow Hazard assessment. Widespread experience in the UK has shown that mapping scales of 1:10,000 are the most useful in assessing the extent and distribution of upland soils (Figure 2).

Windthrow Hazard Classification The combined scores for these four factors is



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Windthrow Hazard Map 1:10 000

used to assign the land units into one of six Windthrow Hazard Classes (Figure 3). Each Windthrow Hazard Class is associated with a critical height, which is the stand height (i.e. age) at which windthrow is likely to start. The terminal height is the stand top height when windthrow has spread progressively to reach 40% damage level and clear felling would be necessary. These heights are influenced by the thinning practices (Table I).

#### Effect of thinning

Thinning is normally carried out to provide more growing space for the remaining trees, to increase' the total yield of usable timber over the life of the stand and to produce an intermediate yield. In general, thinning leads to windthrow, starting at lower top heights (and earlier age) than in unthinned stands. Systematic thinning, on susceptible sites, in line or chevron patterns can result in windthrow at lower heights than *selective* thinning, producing lower timber yields.

The value of Windthrow Hazard Classification to forest managers lies both as an essential aid to investment appraisal and in improved production planning, by assisting isic is it  $l_{i}$  and extent of future thinning d i \_ operations. Even a small increase in the length of rotation on susceptible areas can improve the value of a stand due to the increase in average tree size.

#### References

MILLER K. F. 1985 Windthmw Hazard *Classification*. Forestry Commission Leaflet 85. HMSO

PYATT D. G. 1982 Soil *Classification*. Forestry Commission Research Information Note 68/82/SSN

Windthrow hazard	Critical heights (m) (onset of windthrow)			Estimated <b>terminal</b> heights( <b>m</b> ) (40% stand area <b>blown</b> )		
	Non-thin	Selective thin	Systematic thin	Non-thin	Selective thin	Systematic thin
1		Ŭ	Inconstrained	by Windthro	w	
2	25.0	22.0	21.0	31.0	28.0	28.0
3	22.0	Í9.0	17.0	27.0	25.0	23.5
4	19.0	16.0	14.0	24.0	21.5	18.5
5	16.0	13.0	12.0	19.5	17.5	15.5
6	13.0	10.0	9.0	15.5	13.5	11.5

Table I Critical and terminal heights associated with windthrow hazard classes

#### BOOKS

## Acid sulphate Soils: a baseline for research and development

by D. Dent, University of East Anglia, *England*.

#### ILRI, Wageningen, the Netherlands 1985, 150 pages, Df195.00 US\$38.00

Acid sulphate soils develop in some marshes and swamps when drained. The conditions suitable for their formation occur in relatively small but widely distributed areas. Aeration of soils with high sulphide and low calcium carbonate content leads to extreme soil acidity with resultant toxicity and nutrient deficiency symptoms in most crops. Accompanying problems arise from poor soil structure, iron ochre f ti nd the production of highly corrosive and ecologically damaging groundwater and drainflow.

Research has yielded an extensive body of knowledge regarding the causes and possible solutions to these problems. The purpose of this book is to present this knowledge, together with a common terminology and strategy guidance, for ready use by those involved in the management of acid sulphate soils. This will include farmers, agricultural advisers, soil surveyors, soil scientists and land development planners at all levels.

Introductory recommendations underline the need to consider alternatives to reclamation of potential problem soils, and warn of the difficulties which will be experienced and the dangers of inadequate evaluations or over-rapid development. The surveys and **ap** plied research necessary to assess a given situation are outlined.

The main body of the text, whilst making a complete and coherent whole, is divided into sections aimed primarily at different sectors of the intended readership.

The origins of these soils, the changes which take place in them and the **agronomic**, engineering, social and environmental problems of their reclamation are described.

A section on Management details alternative approaches to utilising the land, from policies of minimum intervention and minimised problems to full reclamation with intensive control measures, where these are justified.

In other sections the chemical and physical processes in the soils and the effects of ameliorative techniques are covered.

Soil profile development and description are considered and alternative classification schemes compared.

Relationships between the highly variable soils properties and recognisable surface features are explained. Practical guidance is offered on surveying and analysing these soils in the field for land **evaluation**, land use planning and project design.

#### Wealth of practical information

The book is well organised and written in a clear, concise, readable style. As expected in a handbook for professional use, some familiarity with the relevant subjects is **need**-

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ed to fully appreciate each section. A wealth of vital practical information is presented and a reference list of **150** or so journal papers and conference proceedings indicate the extent of the material drawn upon in addition to theauthor's twenty years of **experience**. **Illustration** is provided by monochrome photographs of generally good quality together with line diagrams and useful graphs and tables. A set of colour plates show soil profile details.

Many of the examples described are from tropical areas but locations in New Zealand, the Netherlands and the UK are also represented.

Existing and potential acid sulphate soils in the UK are of limited extent and, whilst troublesome locally, do not pose a serious agricultural problem nationally. Awareness of their presence and difficulties will often be of importance in economic and environmental appraisal, however.

The specialised nature of the subject and a price in excess of  $\pm 20$  will limit the casual readership. This book should, howwer, be of particular interest and value to all those who have an advisory role concerned with acid sulphate soils, perhaps especially in **develop**ing countries via consultancy work or international development agencies. It would be an ideal **vade-mecum** for the field and would also provide a very thorough introduction to the subject for any interested student of agriculture or soils.

A. THORBURN

#### Trickle Irrigation for Crop Production: Design, Operation and Management

Edited by **E** S. Nakayama & D. **A.** Bucks. **Elsevier, Amsterdam,** 1986. 384 Pps. DFI 160.00

Although interest in trickle irrigation in the UK has grown steadily over the past decade to over 3000 ha, in recent years there have been concerns brought about mainly through system operation and management problems. Not least of these is emitter blockage and how to overcome it. This hook looks as though it could provide some of the answers.

It is written by 23 US trickle irrigation specialists from a wide range of disciplines and brings together a wealth of experience from **both** research and field practice. The reader should note at this point that like many US irrigation textbooks, US practice is the main topic and so some measure of interpretation will he needed for European conditions.

#### History and design

The book has four chapters. The first is a general introduction to trickle irrigation with an interesting historical survey in which the UK gets some credit for having introduced plastic pipes for trickle irrigation in the **1940s**. The second chapter deals with design principles and covers topics such as emitter construction, system design, soil water distribution and salt distrubution. Very detailed studies are presented of plastic materials for

emitter and pipe manufacture, the hydraulic design of pipe systems and the mathematical treatment of the physics of soil water movement. These will be of particular interest to the system designer and the researcher.

#### **Operation and management**

The most interesting chapters are the third and fourth dealing with operation and management respectively and more than 60% of the book is dwoted to these subjects. Information is given on emitter clogging and its avoidance, water treatment, automation, field performance and waluation, irrigation scheduling, use of fertilizers in trickle systems and handling salinity problems. Very little information has been published to date in an easily accessible form. This book fills the gap and provides an invaluable rwiew and source hook of the latest experience and solutions to problems which face practicing trickle irrigators throughout the world.

Two notable examples are the reviews of micro-biological and chemical accretion problems which reduce water flow through trickle emitters. A further example is the detailed review of fertilizers and their application through the trickle system including the injection equipment which is available. This is perhaps the most important advantage that trickle irrigation has over other methods and is one that the book fully exoloits.

The book has many worked examples to hclp the reader in absorbing the concepts and these will no doubt he helpful to teachers as *continued on nage 18* 



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Further information and application forms may be obtained from:

Dr. R. G. Burns, Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ,

or Miss J. Ingram, Wye College. University of London, Wye, Ashford, Kent TN25 5AH

# A Mechanistic approach to predicting nitrate leaching

by D. Barraclough, Imperial Chemical Industries plc, Jealotts Hill Research Station

Predicting the vertical movement of chemicals through soils is of interest in a wide range of activities. From theleaching of fertilizers and pesticides through agricultural soils to the disposal of radio-active waste, there is a need to predict the rate of displacement through the soil profile.

Even a casual survey of the scientific literature, however, will indicate that there are almost as many models designed to perform such predictions as problems to solve. This in itself is a clue to an important feature of this area of work. Because soils and climates vary widely and because chemicals differin their behaviour in soils (adsorbed or not, for example), it is impractical to construct completely accurate, comprehensive models in which every physical, chemical and biological process is explicity described. Such 'mechanistic' models, whilst in theory the ideal, would be largely unworkable, requiring quantities of generally unavailable data.

The starting point for conventional descriptions of solute leaching is the convective-dispersion transport equation:

$$\frac{\delta \mathbf{C}}{\delta \mathbf{t}} = \frac{\mathbf{E} \delta^2 \mathbf{C}}{6x^2} - \frac{\mathbf{v} \delta \mathbf{C}}{\delta \mathbf{x}}$$

where C is the solute concentration, E is the coefficient of hydrodynamic dispersion, v the average pore-water velocity, and x is distance.

In the past, solving this equation for initial and boundary conditions relevant to practical problems was a major obstacle. The advent of numerical solution techniques on digital computers has largely eliminated this problem but significant difficulties remain. These concern the correct characterisation of v, the average pore-water velocity.

Establishing pore-water velocity

In a soil with one pore size, the average value of v is unambiguous. In a 'real' soil, if the range of pore sizes is small and normally distributed, an average v appears to work quite well; the spread of solute resulting from the range of pore velocities being catered for by the coefficient of hydrodynamic dispersion.

Many soils, however, have a wide range of pore sizes, from those associated with clay domains, to 'biopores' such as worm holes. Under these circumstances, the conventional convective-dispersion equation, when used with an average pore-water velocity appears to break down. The movement of solute is often underpredicted, and the physical significance of the very large coefficients of hydrodynamic dispersion required to account for the marked solute spreading, becomes unclear.

## Simplifications necessary ton data available and information i

Further progress is **usually** only possible if some *simplifications* are made, and the degree and nature of the simplification is largely dictated by the likely availability of data, and the type of information required from the model.

If, for example, only the cumulative leaching over a relatively long period were required, it may be legitimate to use a 'bulked parameter' approach in which time does not appear explicitly.

Similarly, to d u c e the apparent **range** of pore-water velocities, the pore-water can be divided into that which carries the major part of the dispersive flow, the so-called mobile pore-water, and that in which flow is relatively slow, the immobile pore-water (see Figure I).

This means that thepore-water velocity is averaged over only the mobile pore fraction, thus reducing its range and raising the mean velocity.

#### 'Time' as a variable

The model of Drs Addiscott and Whitmore, described in a previous asue, uses both these simplifications very successfully.

For a variety of reasons we have decided to retain time as a variable in our approach,

while adopting the mobile-immobile water simplification. This results in amodel with a series of rate expressions; the rate at which water moves through the soil v, and the rate at which solute exchanges between the mobile and immobile pore-water.

It of necessity, the model is more imechanistid than the onedeveloped by Drs Addiscott and Whitmore. An immediate drawback of this is that it needs more information to run. Whether this additional complication is justified is too early to judge

#### The ICI Model

The model uses lcm soil layers. Each layer is characterized by an initial nitrate content and an initial water content. Solute movement resultine from convection. disoersion, and exchange with the immobile pore **space** is described by a series of simultaneous **finite**difference equations. **Simulations** are run on a daily basis.

For a given rainfall event, the partition of pore-water into **mobile/immobile** is determined by the rainfall intensity, and the relation between hydraulic conductivity and pore size class. Thus at low intensities, say 0.2mm/hr, all the pores in a given soil may be able to transmit water sufficiently rapidly and no immobile water is present.

In contrast, if the rainfall intensity were **5mm/hr**, the pore-size distribution in many soils is such that only the larger pores could transmit water at the required rate; these would then be the mobile pore fraction.



Fig I. Immobile wafer concept.

**OBSERVED NO<sub>3</sub>-N LEACHING vs MODEL PREDICTIONS 1982/3** 60 Model output  $a = 0.0005 d^{-1}$ 50  $\beta = 0.2$ NO<sub>3</sub>-N (mgl<sup>-1</sup> 40 30 20 10 °ò 20 40 80 60 100 120 140 160 180 200 220 240 260 Cumulative drainage (mm)

**Fig 2.** Histogram *d* observed concentrations. The remaining data required to run the model, the coefficient of hydrodynamic dispersion and the rate of solute exchange, are obtained from analysing solute breakthrough curves in laboratory column  $\alpha$  and  $\beta$  are model parameters. studies.

Initial results with this model suggest that it can reproduce nitrate leaching profiles obtained by monitoring the drainage water from experimental fields (see Figure 2). The real test, however, will be to see if the parameters obtained for a wide range of soil types in the laboratory column studies can reliably predict nitrate leaching under varying climatic regimes. That work is now in hand.

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The Impact Mole is designed to punch horizontal, inclined or vertical bores (dead-end or through) in compactable, non-rocky soils. Because of its trenchless operation, it allows telephone and power cables, pipelines, etc., to be laid under existing surfacestructures and installations (such as roads, railways, airport runways, banks, dams and industrial or residential buildings).



# TILLAGE

# **Compaction Studies in the USA**

# The new concept of Soil Compaction Management

Jim Taylor<sup>1</sup> talks to Geoff Baldwin about the work of the National Soil Dynamics Laboratory at Auburn, Alabama, USA.



The core of the **research** facilities **at the National Soil** Dynamics **Laboratory** are these hune dc and two indoor soil bins containing a variety of soils representative of **types** found throughout the United States. The bins are provided with unique equipment for soil preparation giving fine control in each trial over the degree of compaction, the moisture content and the degree of pulverisation.

Problems of soil compaction and how to tackle them continue to be the subject of detailed study in many countries worldwide. In the United States, in particular, compaction research has been carried out for many years at what was formerly the National Tillage Machinery Laboratory; now re-named the National Soil Dynamics Laboratory (NSDL).

Responsible for much of this work at the NSDL is Dr. Jim Taylor and, having lately read his paper, 'Controlled Traffic: A Soil Compaction Management Concept:' I was

keen to meet him and hear more about his research and his conclusions. The opportunity for this presented itself recently when Dr. Taylor visited the NIAE.

#### The work of the Tillage Laboratory

During our meeting I asked Dr. Taylor first for a broad view of the work at the NSDL – at the "Tillage Lab". He explained that, after 50 years service as the National Tillage Laboratory there has been a in their approach to the subject and the new name is more closely descriptive of the work now being undertaken.

Dr. Taylor describes the work of the

Laboratory as the study of soil-forcesystems; the investigation of what happens to soil when forces are applied to it. In agriculture, such forces have been considered as those applied by tillage tools or by traction devices. Research staff was accordingly divided into two groups – one for traction research and one for tillage research.

#### The new approach

Two new ideas have now been introduced – on the one side, the plant itself is now added to the soil-machine studies and on the other side there is now to be considerable field

#### Notes.

2. SAE Technical Paper Series No. 860731, April, 1986.

I. Dr. Taylor is National Technical Adviserfor Traction and Controlled Traffic Research and also Research Leader for Cropping Concepts at the National Soil Dynamics Laboratory, US Dept. of Agriculture, Auburn, Alabama, USA.

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# TILLAGE

work, besides the soil bin research, in order to pursue ideas and findings to their logical practical outcome.

To meet their new approach to tillage studies there are now three research groups. These are concerned specifically; with soilplant interactions; with soil-machine relations and with Cropping Systems. It is this new group, Cropping Systems Concepts, that Jim Taylor now heads up. His aim now is to take the principles derived from the more basic soil bin research and apply them in the development of cropping systems. In this, he and his team will be focussing particularly on the soil compaction question and doing controlled traffic work in the field. Dr. Taylor stressed that he will continue to work closely with the two other research groups but he has needed to add some specialist-qualified staff - such as a plant physiologist to strengthen his own team.

The Compaction Problem in the USA Returning to the specific question of soil compaction, Dr. **Taylor explained** that this became a problem in South Eastern United States as early as the **1950's starting** in the **sandy loams of the Peidmont and Coastal** Plains, spreading into the Mississippi Delta and the Southern Plains. California's San Joaquin Valley was also an early victim. The **Corn** Belt of the midwest was the last major crop area to be affected but general complaints of soil compaction have come from Corn Belt farmers in the 1980's.

Indeed, compaction has always been present in agricultural soils but so long as it existed only in the upper levels it did not persist and did not develop into a major problem. The "Compaction problem" has developed as compaction forces have reached deeper into the soil, especially below normal ploughing depth.

Even then, the effects of compaction can be quite variable. A compacted soil can sometimes still give a good yield if nature has helped by, perhaps, extra rainfall at critical growth periods. Conversely, though, soil loosened by subsoiling will not necessarily ensure a good yield if plant growing conditions are otherwise unfavourable.

For example, a good organic matter content in the soil appears to have a favourable influence in reducing the effects of compaction, but a new soil, cleared and prepared for cultivation with heavy equipment could still have severe compaction problems. The age of the soil or the years in cultivation have not been found to be correlating factors. Similarly, freezing and thawing, although probably effective against shallow compaction, cannot be regarded as curative agents for deeper level compaction.

The general answer to relieve or cure **compaction** has been the use of the subsoiler. In the South East United States, subsoiling became common practice 30 years ago with the advent of deep compaction and the practice has spread elsewhere since then in the wake of the spreading compaction problem.

#### The Plant Physiologist approach

However, results of **subsoiling** tests have been mixed and difficult to interpret because the phenomenon of compaction was poorly understood. This is where Dr. Taylor sees the benefit of the plant physiologist approach – the engineers and soil scientists by themselves without the knowledge of plant physiology have been unable to interpret the interactions of plants with compacted soils. As to the causes of compaction, Dr. Taylor considers that, although irrigation, tillage tools and cultural practices can sometimes be blamed, the main culprit has been recognised by most researchers for the past fifteen years as being essentially wheel traffic, deriving particularly from the frantic pace of agricultural mechanisation after the second world war.

#### Ideas to reduce compaction

Having recognised the culprit, many ideas have been tried to reduce the effect of random wheel traffic; fewer passes over the field. dual tyres, flotation tyres, low pressure tyres and direct drilling systems. The results have been less effective than hoped for.

Commenting on these, Dr. Taylor pointed out that, normally, reducing the number of passes a tyre makes over the field is not very beneficial – the first pass of the tyre in a tilled soil will usually cause 75 per cent of the bulk density change and 90 per cent of the sinkage that would result from half a dozen passes.

Lower ground pressures beneficial but subsoil compaction still a problem Another feature explored in earlier soil bin trials by Dr. Taylor has been the **compaction** effect of total **axle** load.

Taking two different axle loads, one roughlydoubletheother and fitting suitably larger tyres for the heavier load did result in roughly equal soil pressures in the surface area down to about normal ploughing depth. Below that depth however, the heavier axle load even on the larger tyres did show a substantially greater soil compaction pressure.

Total axle load appears therefore to **be** the dominant factor in causing deeper subsoil



The 8-metre wide gantry now in process of construction for controlled traffic research. compaction and an outcome of this effect must be that as subsoiling is practiced to eliminate compaction the use of increasingly heavier equipment, even though on proportionately larger tyres, may itself be causing compaction to still greater depths.

If tillage is stopped altogether, as in the direct drill system there is still a risk of **compaction** problems wherever traffichas to run over soil in a wet, structurally weakened condition.

## Wheel traffic incompatible with growing crops

Summing up the position today Dr. Taylor points out "we have tried reducing the number of trips over the field and we have tried spreading the weight over larger tyres; we are still getting **compaction**. So when both these efforts have failed, it is logical to assume that wheel traffic and growing crops are incompatible. The only solution is divorce':

#### The management of compaction

The answer is to control trafficover the field. The controlled traffic system is a crop production system in which the traffic lanes and the cropping area are distinctly and permanently separated.

Research into this system has been going on now for several years. To begin with, modified conventional machinery was used but in recent years **several** wide-frame vehicles (gantries, spanners) have been built.

One such machine is under construction at the Soil Dynamics Laboratory. When this is completed Dr. Taylor plans a considerable programme of field work to explore and develop his new concept of managed compaction. By this he means that compaction in certain areas, the traffic lanes, will not just be tolerated it will be encouraged, but elsewhere there will he no wheeled traffic and no compaction other than that arising from natural causes of weathering and plant growth. In other words, the compaction will be managed to suit the diverse requirements of traction

#### continued from page 13

well. The index however, leaves much to he desired and could be extended so that the book can be used much more for reference work. The editors describe the book as being multi-purpose and this is reflected in the way authors jump rapidly from the very practical to the highly theoretical. This approach may well be to attract a wide range of buyers from farmers through to research workers but the danger is that it may leave both rather dissatisfied.

The book clearly makes an important contribution to the art of trickle irrigation and those involved in irrigation will find it a valuable and useful reference work. However, it is for the serious reader, not least because of its price (approximately £42.00)!

M.G. KAY

Note: In US/Canada also available from Elsevier Science Publishing Co Inc. PO. Box 1663, Grand Central Station, New York. NY 10163.

#### and cropping.

Crop production costs reduced

One of the most important results that Dr. Taylor sees arising from this work is that there will be reduced costs of production. Initially, investigators were looking for increased yields from incompacted soil – and in most cases some yield increases have resulted. However, the most significant result appears to be reduced cost of production. Annual deep tillage is no longer necessary and the firm traffic lanes improve tractive efficiency and mobility.

Further benefits in costs, as well as in yields, may be expected also from the greater timeliness of operations; of spraying; of harvesting from firm traffic lanes. These are aspects to be explored by Dr. **Taylor's** team.

Another subject of their investigation will also be the nature of the traffic lane itself – should it stand proud, or below the level of the growing area. Will water run-off be a problem and, if so, how should it be tackled? Dr. Taylor is not in favour at this stage of soil additives to set the surface in permanent **road**ways, but obviously that is one possible solution.

#### Cooperative working worldwide

Finally, as an indication of the world-wide nature of the compaction problems, Dr. Taylor outlined the international contacts which are maintained by himself and his colleagues. In this visit to the **NIAE** they are meetine fellow researchers from the **Netherlands with whom they already have a** cooperative project. The Netherlands in turn has cooperative work with England, Scotland and West Germany. The Soil Dynamics Laboratory also has a cooperative project with Israel; a project under discussion with Japan and is maintaining close contact with researchers in Sweden, South Africa, Australia and others around the world doing controlled traffic work.

"Eliminate the **boll** weevil but manage compaction!"

With a statement which he said would be clearly understood in American cotton producing areas, Dr. **Taylor** stated, 'We want to eliminate the **boll** weevil but we want to manage soil compaction': ''Soil compaction is as desirable in a traffic lane as it is undesirable in the crop zone':

#### concluded from page 19

also pointed out that it is vital to maintain a steady 7pH-plenty of lime is needed – otherwise there might be problems with heavy metal elements.

We heard that although Cr can be quite prominent in the top layers there is little penetration and only a very small percentage, 0.3 per cent of the chromium taken up by cattle is actually retained. Lead seems not to persist and routine monitoring shows a very low Pb content in the silage crop. Nitrogen is obviously high and does seem to penetrate more deeply but this still does not represent an acute problem and there has been little or no leaching into adjacent waterways. Nitrogen level must be considered though in cropping; it would not be liked by spring barleys, for example. Grain production from the Estate has, by law, to go for stock feed in order to comply with EEC regulations.

We covered many more aspects of the injection process and the associated management practices.

#### SaWMA thanks to STWA

The visit was well worthwhile and we are indebted to the Severn Ti Water Authority and, in particular, to Chris Holt and to Howard Rundle for their kind attention and hospitality.



For further information contact:

Alison Saxby SOIL SURVEY OF ENGLAND AND WALES Rothamsted Experimental Station Harpenden, Herts AL5 2JO OR PHONE Harpenden 63133 ext 2492

## Stoke Bardolph Sewage Farm, Nottingham

# Continuous soil injection of sewage sludge allows greater volume of application with less odour nuisance.

#### The Field Meeting at the Stoke Bardolph Sewage Farm was organised for SaWMA members by Mr. Chris Holt, Farms Controller, Severn Trent Water Authority.

During our visit we firstly had opportunity to hear from Mr. Holt details of the main purpose of the Stoke Bardolph Estate—the disposal of sewage sludge—and then to learn about the injection technique now employed and the extent to which this has demanded special attention in overall management of the estate.

Mr. Howard Rundle, Senior Soil Scientist with the STWA kindly joined Mr. Holt to deal with the morespecific soil and chemical matters.

## Permanent piping solved transport problem

From this initial meeting, we learnt how the Stoke Bardolph Estate has been used since the early **1900's** as the disposal site for all the sewage sludge produced by the city of Nottingham. Formerly, the estate was divided into a number of lagoons to which the sludge was pumped for settling and absorption. Now, the practice is to inject the sludge straight into the soil and special equipment has been devised to allow the existing permanent piping installation to be used so there is no logistical problem of continual traffic with tankers carrying the sludge to the fields.

# System wins Pollution Abatement Award

The development of the special piping and connections between injector and field stand

pipes had been achieved jointly by the Severn Trent Authority working with the BKW company of Ribchester near Preston. Mr. John Conroy, Sales Director with BKW kindly attended our meeting and provided specialist information on the machinery aspects.

As reported in our last issue, the process was selected as one of the five winners to receive the coveted 1985 Pollution Abatement Awards.

#### Greater volume; less odour

From the point of view of the Severn Trent Water Authority the injection technique is paying off handsomely in allowing greater volumes of sludge to he disposed of and, for the general public, there is the advantage in improved environment through minimising odour nuisance and eliminating the unsightly settling beds.

The background to the operations at Stoke Bardolph is that the Authority has to dispose daily of 300,000 gallons of sludge. It is not economic to orovide much storaee capacity so disposal must be regularly six days a week throughout the year. The soil – ranging from light sandy through medium loam to some heavier loam and generally overlying gravel—is well suited for injection through most of the year, the only difficulties being when it is frozen or becomes very dry. Under those conditions injection is not possibleand Chris Holt reverts to surface spraying.

Working at an injection rate of 25,000 gallons an acre, the special constraint on Chris **Holt's** management of the estate is to have available throughout the year a daily 12 acres suitable for injection. This requirement



The soil injection machine and supply pipe at work in grassland.



SaWMA members Roger Unwin, MAFF; Bill Whitfield, Soil Survey; were able also to offer some professional advice on an impervious layer in a former sewage lagoon.

may change in the future-thegrowth of the City has meant a trend to increased volume of sewage-but Severn Trent engineers are looking at ways of increasing the concentration of the sludge; doubling the dry matter content to around 5 per cent and also of increasing the volume that can be applied by the injector.

Close co-operation on these developments, as with theearlier work, is also maintained with research scientists at the UK Water Research Centre.

## Cropping to match disposal requirements

Chris **Holt's** answer to the Authority's basic requirement is to work on essentially a four shift rotation with two winter cereals on about 850 acres, fodder maize 350 acres and 400 acres grassland suitable for injection. Other grassland-new seeds and riverside areas open to thepublic cannot be used for sludge disposal.

The winter cereals allow only one injection operation between harvest and drilling, the maize acreage may take five or six but in the summer only the grassland is available and this can then come under considerable pressure to provide enough acreage without risk of excessivecutting up of the sward. Increasing the grass acreage could inrease the acreage for sludge disposal but this would introduce more oroblems of increasing stock levels and then acquiring higher quotas.

#### Timely cultivations and liming essential

To get maximum benefit from the sludge injection and to maintain good soil surface conditions Chris Holt stressed the imporlance of spring harrowing, of rolling at exactly the right time (a difficult one this) and of strictly observing the minimum three week period between injections. Howard Rundle concluded on preceding page DRAINAGE

# Drainage

# — the all important factor in successful farming

Efficiency and cost reduction highlighted at the Farmers Weekly International Drainage Event, 1986

**Report by Geoff Baldwin** 

Despite the interference of some very unfriendly weather, the Farmers Weekly 1986 choice of a two-day event, coupled with a central location succeeded in doubling the attendance **achieved** the previous year.

The Event-the biggest in Europe again provided an unequalled opportunity for farmers, contractors, manufacturers and dealers to come together to see the latest equipment and techniques in a working environment.

Demand for drainage must continue. Ministry estimates suggest an annual 'pool' of 100,000 acres needing to be drained just to correct the deterioration of old systems Increasing evidence in crop and stock response proves that drainage is indispensible. Drainage work should be reearded not as an expense but as a highly profitable medium/long term investment. Soil types identified by SSEW

This year's demonstration site at Marston Trussell, Leicestershire had been carefully studied and the soil types mapped out by the Soil Survey of England and Wales.

Mr. Tony Hodge of the Soil Survey showed that the site was predominantly Wickham clay loam but bordered by substantial areas of Denchworth clay and oxpasture clayloam. All parts of the site could be expected to lie waterlogged in winter if not provided with adequate drainage.

Drainage requirements for the three soils are similar. The ADAS/SSEW recommendation is for pipes/tiles at 750 to 900mm depth and at intervals of 20 to 40m (closer spacing being for the Wickham and Oxpasture soils which do not hold a mole channel as well as in the Denchworth). Permeable backfill is considered essential for all three soils.

#### ADAS Drainage plan

The ADAS drainage plan was for 20m intervals with gravel permeable backfill followed by cross moling. Lateral drains were to be 60-80mm plastic or 76mm tiles with the cross moling 550mm deep at 2.3m intervals. It is considered that the moles should last reasonably well in the Denchworth soils but may need re-drawing more regularly in the other soils.

The overall site offered scope for practical demonstration of a wide range of machines and skills-not least sometimesskill in making progress under the extremely wet surface conditions on the second day.

#### Overseas visitors welcome

Amongst the trenchers being demonstrated, **Bruff** were offerineuo-rated versions of their BT4 and BT6 machines; Interdrain had several machines at work and were also **show**-



The avenue in front of Miles stand truly reflects the wetness of the occasion.



The Bruff BT6 trencher now with larger engine.

ing the only new drainage machine at the event, the new Interdrain 2028T. The Mastenbroek range was there in force and clearly the company has an eye, not only on the British contractor, but also on the many overseas drainage specialists who visit the event.



The action of the Birtill Gravel saver.

Quoted in the **Farmers** Weekly **Drainage** supplement, Mr. Mastenbroek has expressed confidence that land drainage will rally in the UK if the Dutch experience is anything to go by. At the present time, Mastenbroek finds 80 per cent of its orders from overseas, with Holland and Belgium particularly prominent purchasers.



Birtill Gravel saver behind a Barth K140 trenching machine.



## New machines-emphasis on cost savings

V14-3

Amongst new machines, we saw the Silsoe College floating-beam mole plough. Incorporating a hake hitch and a hydraulic hitch control the Silsoe design and will hold depth and direction of the mole, whilst at the same time, catering for simple grading without the need of expensive laser control. The design has attracted commercial manufacturing interest and we are pleased to report that Mastenbroek plans to show a production model at the Royal Show. We understand Mastenbroek see this mole as complementing their existing range of drainage equipment and expect a good market overseas as well as in the UK.

Another machine being shown for the first time after several years of trials and development is the Birtill gravel saver. Although in concept a simple idea, the Birtill unit offers startling savings in gravel usage and with less gravel required there are further substantial savings in transport costs, fewer journeys and fewer wheelings. The Birtill gravel saver, by restricting gravel fill to only part of the trench width and hack filling soil into the other part reportedly save 30 per cent

# DRAINAGE

of the gravel that would normally be neededfor a 5 inch trench. At a base price of £3,500, the Birtill gravel saver could pay for itself in a month's typical work. A vibrator is available as an optional extra for the gravel hopper.

# Increasing demand expected for mole ploughs

A number of manufacturers expect there to be increasing demand for moling to prolong the life of basic drainage systems. Michael Moore Moles are catering for this by offering their new MINIMOLE. This tractormounted machine is designed for the smaller horse-power tractor and aims to incorporate



The Silsoe College floating beam mole plough-now to be built by Mastenbroek.

With a bulk density of only  $800 \text{kg/m}^3$  (50 lb per cu. ft) Lytag is less than half the weight of gravel and this means lighter truck loads for wet difficult conditions or greater volume and fewer loads from the depots.

This year's Farmers Weekly demonstration has shown that there is still great interest in drainage in this country. However, the em-



The Mastenbroek 25/20V plough-difficult to tell where it's been were it not for the track marks.

the best features of the beam plough whilst significally reducing draft.

Yet another cost-saving, and time-saving, proposition is that offered by Lytag with their unique light weight aggregate for back filling.





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leading high speed narrow trenching machines. Case trenchers are available Nationwide for hire.

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Picture shows model TF700 digging 10" wide  $\times$  48" deep through heavy ground at 60 linear yards per hour. The spoil comes out in a fine friable tilth making for easy backfill with the integral hydraulic angle dozer.

The Michael Moore MINIMOLE for medium power wheel tractors.

phasis may be changing towards display of cost saving methods rather than the full scale demonstration of working drainage machines. Farmers Weekly will be exploring attitudes amongst both exhibitors and visitors and are keen to ensure that future events reflect and fulfill all participant's aims.

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# DIARY

#### SEPTEMBER 1986

1-4	Conference–Institute of Agricultural
	Engrg., Wageningen, the Netherlands.
	features: Agricultural Waste Management
3	Tractors at Work–"reducing the Autumn workload" Deeping St. Nicholas. Lincs.
17	Working <b>Demonstration</b> —"Tilth without

fire<sup>3</sup>-East of England Agricultural Society at Abbey Farm, Old Warden, Beds.

NOVEMBER 1986

19\* SaWMA Field Meeting, 1.30-4.30

 Silsoe College, Beds - review of the College's latest research and field work in soil management, tillage, drainage.

- 30 Royal Smithfield Show– Earl's Court,
- to4 Dec London

#### JANUARY **1987**

- 5-8\* Soil Management Short Course, Silsoe College
  5-8 Field Management for Effective
- 5-8 Field Management for Effective Drainage—Short Course, Silsoe College

\*denotes events at which SaWMA is participating.



# **Principal Research Officer** (Soils and Plant Nutrition) Solomon **Islands**

The Solomon Islands became independent in 1918 and Honiara, the capital, is on the island of Guadalcanal.

A Senior/Principal Research Officer is required to take responsibility for planning and implementing the Solomon Islands Government's Agricultural Research Programme related to soils and plant nutrition This will include surveying specified land for agricultural development, administering a chemical laboratory and liaising with internal and external organisations, and a variety of other duties, including training.

Applicants should be British Citizens holding a first degree in an appropriate science subject with suitable post-graduate qualifications and/or at least five years experience of working in tropical agriculture.

The appointment is on contract to the Government of the Solomon Islands for a period of two years. Local salary is in the range SI\$8,316 to SI\$11,772 pa, plus a tax free supplement. payable by ODA, in the range of £10,908 to £13,908 pa A terminal gratuity of 25% of local salary is also payable.

Exchange rate as at 8 April 1986 -£1.03stg=23825 Solomon Island dollars.

For further details and application form. F 35 J J y, quoting ref AH369/JC/SW stating post concerned and giving details of age, qualifications and experience to: Appointments Officer, Overseas Development Administration, Room 351, Abercrombie House, Eaglesham Road, EAST KILBRIDE, Glasgow G758EA.

Closing date for completed applications is one month from date of publication



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## TILLAGE-WHAT NOW AND WHAT NEXT?

5th February 1987: Full details in our next issue