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## SOIL SURVEY OF ENGLAND AND WALES\*

By A. MUIR

The Soil Survey, which from 1939 had been directed by Professor G. W. Robinson, F.R.S. was transferred to Rothamsted on 1st October, 1946 and placed under the administration of the Lawes Agricultural Trust. The work is supervised by the Soil Survey Research Board appointed by the Agricultural Research Council.

This report deals with the progress made in mapping the soils of various districts from the time of the transfer until December 1948. Since the transfer, systematic survey has been continued in the areas where surveyors were previously stationed with the object of completing and checking certain areas for publication on the 1" (Third Edition) Ordnance Survey sheets.

The new laboratories have been completed and analytical results are now coming forward.

### *Durham County*

A soil map of the county on a scale of 1" to 1 mile had been prepared before 1946 and areas around Lanchester and Seaham Harbour were chosen for more detailed survey. Around Lanchester some 15,000 acres were completed and the boundaries of 10 soil series delimited, while around Seaham Harbour some 26 series have been identified.

The Lanchester area may be regarded as a system of ridges and valleys falling from over 800 feet O.D. in the west to about 300 feet O.D. in the east. The area is drained by the Browney, but natural and artificial drainage are more disturbed, by subsidence due to colliery workings, than in many other districts, since the mines are shallow. The solid geological deposits are of the Coal Measures consisting of alternating bands of sandstone, shale and coal, but, except on the highest areas, these are almost completely obscured by glacial drifts. The drifts are derived either from the Carboniferous or, in places, more specifically, from the Coal Measures formations. The series mapped around Lanchester can be classed as being of the Brown Earth and Gley soil groups with some small areas of peaty clay soils.

Soils included in the Brown Earth Group are derived from fine-grained (Newburn and Lanchester series) or coarse-grained Coal Measures sandstone (Esh), from grey shales (Greencroft) and from boulder clay mainly of Coal Measures origin (Kirk Merrington, Improved Croxdale). These soils are brown light to medium loams, freely drained, and usually provide good agricultural land, though liming and the addition of phosphatic manures are necessary on the Kirk Merrington series.

Poorly drained soils included in the Gley Group are found on grey shale (Ebchester), Coal Measures boulder clay (Croxdale, Burnhope) and on Carboniferous boulder clay (Egglestone) in all

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\*A more detailed report of the Soil Survey work in England and Wales and in Scotland is published on behalf of the Soil Survey Board by the Agricultural Research Council in a Soil Survey Report series.



of which rusty mottling extends into the grey-brown surface soils. The Burnhope series has a peaty surface soil. With adequate drainage, the Croxdale series provides reasonably good agricultural land and there is a continuous gradation from the Croxdale series to the Kirk Merrington series with improving drainage conditions.

#### *Yorkshire*

The soils over approximately 4,000 acres of the Yorkshire Moors, north of Ryedale, have been mapped on the 6" to 1 mile scale. The hills are composed of the upper beds of the Middle Oolite, the rocks including limestones and calcareous grits, and only small areas are covered by boulder clay. Where *Calluna* is dominant, podsol and podsollic gley soils appear, the former being confined to sandstone on the steeper slopes. The upper Calcareous Grit and some limestones give rise to Brown Earths and on the younger limestones, Red and Brown Calcareous Soils occur similar to those found on the Cotswold Hills and in Dorset, and soil development is markedly controlled by the calcium carbonate content of the rock.

A reconnaissance survey of parts of the Yorkshire Wolds showed that since the parent material is the Chalk, soils of the Rendzina group appear on the steeper slopes but elsewhere Red and Brown Calcareous Soils predominate with some light coloured rendzinas.

Some 15,000 acres have been systematically surveyed south-west of York (O.S. Sheet 71). Lacustrine, glacial and alluvial deposits of very mixed composition and irregular distribution occur together with outcrops of Keuper Marl, Lias Clay and Chalk. Some forty series have been established and delimited, and fall into the Brown Earth, Podsollic Gley and Rendzina Groups, with gleyed soils predominating.

#### *Lancashire*

About 22,000 acres around Preston (O.S. Sheet 75) have been mapped on the 6" to 1 mile scale. The undulating Triassic plain in the north-west is covered by glacial drift which has been reworked by post-glacial streams and the soil-pattern is complex. In the south and east, the Coal Measures formation forms higher ground and frequently outcrops through the extensive cover of glacial drift. Post-glacial sand and peat occur in the west and hill-peat is found above 1,000 ft. O.D. in the south-east.

Twenty-three series have been identified, including three on alluvium of different origins and two on peaty areas. Of the remaining eighteen, three had already been named (Wem, Newport, Salop) and there is a possibility that three more (Sea, Oaklands, Gratrix) may be correlated. The boulder clay in the north-west provides light and heavy textured parent materials and on the former, three series (Wheyrigg, Salwick, Clifton) have been differentiated according to drainage characters. As the drainage deteriorates so the degree and kind of mottling visible in the profiles of these series alters from a small amount of rusty mottling to an intermingling of rusty and pale grey colours, and finally to a heavily mottled horizon overlaying one of dull grey colour.

On the heavier textured boulder clay the Salop and Cotham series are impeded and imperfectly drained respectively.



In the east the Anderton, Rivington and Blindhurst series with progressively deteriorating drainage are developed on Coal Measures sandstone. The boulder clay is mainly of Coal Measures origin and the Charnock, Brickfield, and Rothwell, Hallsworth series are developed on sandy and silty clays respectively, under imperfect or impeded drainage conditions.

It is of interest to note that conditions of very severe impedance produce very similar profiles whatever the parent material and there is a possibility of correlating several series in different parts of the country on this basis, e.g. Sea, Oaklands, Gratrix, Godney.

#### *Devon*

A survey of N. Devon was started at the instigation of Mr. J. B. E. Patterson (Provincial Chemist, S.W. Province) to see if any relation exists between soil series and the incidence of pining in sheep, but the work has not progressed sufficiently for such a correlation to be definitely established.

The area comprises the Hangman Grits, Ilfracombe Beds and Morte Slates of the Old Red Sandstone and contains many steep-sided, narrow valleys often more than 300 feet deep. Approximately 16,000 acres have been mapped on the 6" to 1 mile scale and are covered by five main series which appear to fall into the Brown Earth and Podsollic Groups.

The shales and fine-grained sandstones of the Ilfracombe Beds give rise to the Kentisbury series whose profile consists of a thin, black, silty loam resting on a pale grey horizon overlying a mottled, bright orange silty subsoil. Frequently an appreciable iron-pan is developed between these last horizons. The Blackmoor Gate series occurs on shaly material and is found on the tops of the lower hills and the sides of the valleys. The profile consists of a brown, friable, silty medium loam merging to an orange brown silty B horizon.

The Hangman Grits give soils of the Bodley series having a brown surface soil passing to a very stony reddish orange subsoil.

The topography of this region lends itself more than many to the use of the soil catena in describing the distribution of the soil series. Owing to the surveyor being seconded to a post in the Middle East, the work has had to be abandoned temporarily.

#### *Cardigan*

Work has been carried out in the semi-upland area of Mynydd Bach. The soils are peaty and usually strongly podsolized. Eight series have been delimited, three being new.

The shales and fine grits of Palæozoic age are included in five series of which the Hiræthog is podsolized with a well-developed, bleached horizon and iron-accumulation horizons found under heather and bilberry. Under cultivation the Ithel series is found having a black well-humified peaty loam passing sharply to a bright orange brown light loam. Under less severe conditions the Powys series occurs which can be considered as a Brown Earth. The typical profile is shallow, freely drained, acid in reaction and consists of a brown shaly loam passing to a yellowish brown shaly brash. The Penrhyn series occurs on drifts mainly of shales and, apart from being deeper and greyer in the surface soil differs little from the Powys series. Where the drainage of the drift is impeded,



soils of the Cegin series are formed which are deep, neutral silty loam soils, rust mottled to the surface, beneath which is a light brownish grey silt clay with much grey mottling.

#### *Merioneth*

Mapping was continued on the coastal belt between Harlech and the river Mawddach. In the north, the soils fall into the Powys suite, the dominant series being the Cymnar. As far south as Talsarnan the area is free of drift but north of this the soils are of the Bangor suite.

#### *Shropshire*

Checking of the earlier survey of the Wem sheet (O.S. Sheet 138) has been completed. An explanatory memoir to accompany the map is in hand and Mr. Morley Davies (Provincial Chemist, E. Midlands) is assisting in its writing. The standard of mapping of the earlier surveyors was found to be high and very little modification has been needed.

#### *Somerset*

About 28,000 acres have been surveyed on the 6" to 1 mile scale, the object being to complete the Glastonbury Sheet (O.S. Sheet 196). Work has been concentrated in two areas, one around Glastonbury, the other centred on Sparkford. The solid geology comprises the various divisions of the Lias and Rhætic formations which here include calcareous clays and shales with associated limestones, silt clays, fine sands and ferruginous oolitic limestones. Relatively narrow outcrops of Keuper Marl are found near Glastonbury and the Inferior Oolite caps the Lias, east of Sparkford. Thick deposits of estuarine clays and silts with bands of fen peat occur near Glastonbury.

Twenty-eight soil series have been distinguished and mapped and they can be grouped as Brown Earths, Gleyed Soils, Calcareous Soils and Organic Soils. The soils considered as Brown Earth are derived from the sandier beds of the Upper and Middle Lias (South Petherton, Atrim) from Keuper Marl (Worcester) and from various fluvial drifts commonly occupying terrace-like features related to the present or previous drainage systems (Badsey, Isle Abbotts, Polsham, Langford).

Poorly drained non-calcareous soils showing gley effects at 18" or less are associated with silt-clays and non-calcareous clays of the Lias (Martock, Long Load, Charlton Bank) and with fluvial drifts of Liassic origin (Honeybourne). Series derived from recent alluvium are also included and the Highbridge, West Lydford, Fladbury, Wyre, Compton and Midelney series are distinguished by differences in texture, origin and depth of water-table below the surface.

The calcareous clays and shales of the Lower Lias and Rhætic with subordinate limestone bands (Evesham, Haselor) and the tea-green marls (Charlton Mackrell) give rise to dark coloured clay soils which are calcareous throughout and have a stable granular structure. Drainage is slow, gley effects are not as marked as in non-calcareous clays and the soils are described as calcareous gley soils. Only one series (Godney) is regarded as a peaty gley soil, the profile consisting of 12"-18" of fen peat or peaty silt overlying blue-grey silt-clay.



Red and Brown Calcareous Soils are represented on the Lower Lias and Rhætic formations by the Somerton and Butleigh series, on the Inferior Oolite by the Sherborne series and on Upper Lias limestone by the Pennard Hill series. Drainage is variable and may be excessive or free depending on the depth of soil and the presence or absence of clay or shale bands.

The peat areas provide two series (Sedgemoor and Westhay), the former being developed on fen peat while the latter represents relic raised moss.

#### *Special Investigations*

The survey of orchards in connection with Red Spider field trials in Essex has been continued and soil maps were made of plots in several orchards. In some respects the soils and problems are similar to those in the Vale of Evesham, the soils being of a coarse sandy nature frequently mixed with or overlying clay at various depths. Local "hot-spots" appear where the soils are deep, coarse sands and gravel on which tree-growth is unsatisfactory.

In connection with the extension of the work of the National Agricultural Advisory Service soil maps have been prepared of a number of farms in Yorkshire, Staffordshire, Kent, Worcestershire and Somerset.

The Glan-y-llyn Estate, Llanuwchllyn, Merioneth was surveyed for the Rural Land Utilization Officer. It comprises about 35,000 acres of which one-sixth is farm land, the remainder being enclosed upland grazing or unenclosed mountain land.

Soil maps have been prepared for Rural Land Utilization Officers, Planning Authorities, Associations and private individuals.

A number of farms in Yorkshire and a few elsewhere have been examined in connection with the survey of the incidence of Johnes disease of cattle, but no definite correlation has yet been established between soil and incidence of disease.

A variety of soil clays from the south of England have been examined by X-ray diffraction in conjunction with the Pedology Department. The commonest clay mineral appears to be a dioctahedral mica, in some cases hydrated, which may constitute up to 80 per cent. of the clay. Kaolinite is usually present in moderate amounts and in only one case was much quartz found. The main constituent of the clay from a soil from the Upper Chalk and from the insoluble residue of the rock appeared to be a mixed mica-montmorillonite crystallization, a little kaolinite was present.