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SOIL SURVEY OF ENGLAND AND WALES

D. A. OSMOND

E. M. Bridges and D. V. Jones resigned, and were succeeded by D. J. R. Manley and E. M. Thomson, respectively. A. V. Vann was appointed to take charge of the Proline mechanical soil corer, which has proved satisfactory and has aroused great interest. C. C. Rutherford returned from Pakistan and started work at Aberystwyth, where a new centre was established.

D. A. Osmond visited Rome, Ghent and Athens in connection with the production of the Soil Map of Europe being prepared by a Working Party of F.A.O. Surveyors from the North of England visited southern Scotland to correlate the soils on Carboniferous drift on each side of the border, but the heavy contamination, for example, by igneous rocks, of the Scottish drift makes correlation difficult. J. Muir (Soil Survey of Scotland) and B. W. Avery were requested to study the classification of British soils in the light of European and American classifications published recently.

Several surveyors gave lectures, arranged courses and field demonstrations, provided material for exhibitions and surveyed areas at the request of official bodies. Six visitors worked in the field for various periods with surveyors. The Cartographic Section produced maps and many diagrams, as well as continuing the preparation of maps for publication.

Eighty sq. miles were surveyed at 1 : 63,360 and 1,430 sq. miles at 1 : 25,000 on a reconnaissance basis; special surveys at various scales necessitated the mapping of more than 50 sq. miles.

NORTHUMBERLAND

Sheet 77, 7th Series (Hexham)

Surveying was concentrated in the south-west and the east central parts of the sheet. Over much of the south-west the mapping units previously established proved adequate, but in the valley of the East Allen a dark-grey, compact, tenacious drift deposit outcrops in many streams, particularly in their upper reaches. It varies from a laminated, silty clay to a very compact, stony clay, does not weather readily and shows little or no evidence of oxidation; any visible soil formation is confined to the upper 6–9 inches. Roots rarely penetrate below about 9 inches and only a poor vegetation is carried. When closely examined it gives the impression of water deposition, and in some places there are sand and silt partings suggesting deltaic conditions. Near Knock Shield, where the sands are best developed, a very strongly cemented iron pan ($\frac{1}{4}$ inch thick) occurs at the base of the sand parting and directly above a clay band.

Much of the lower (700–800 feet) east-facing slope of Allendale is covered by the drift overlain by glacial and post-glacial deposits of

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Carboniferous origin. Its presence significantly affects the overlying soil, as it impedes drainage and limits profile and root development. Occasionally similar deposits occur in the West Allen valley as far eastwards as the Font valley at Mitford, where they are buried beneath the reddish-brown coastal drift.

The east central area, characterised by its gently rolling relief, merges into the Northumbrian plain at 400–500 feet. It is covered by a clay drift with few stones, usually giving clay loam and silty clay loam soils with impeded drainage. The soils appear to be derived mainly from Carboniferous material and to have a fairly high inherent fertility; calcium carbonate frequently appears below 27 inches. Some larger depressions still carry basin peat, which formerly may have been more widespread.

Occasional hills of Carboniferous formations, usually capped by a sandstone, protrude through the drift and often support birch scrub. The soils, particularly on crest and edge sites, are podzolised, with gley soils surrounding them, but where cultivated the podzols have lost most of their characteristics. (Ashley and Suggett.)

YORKSHIRE

Sheet 71 (Selby)

The remaining areas of this sheet proved no less complicated than the rest. Everywhere several thin superficial deposits occur sporadically and contribute to a pattern so intricate that only the very great importance of cash crops, which are strongly influenced by soil differences, justifies the separation of soil series.

Allerthorpe Common and its surroundings may be taken as typical. Fluvio-glacial sands, giving soils of the Stockbridge and related series, are overlaid by low mounds, which were probably dunes, of finer sands giving soils of the Holme Moor Group, whereas some of the deeper channels have flinty sands over flint gravels. Marling has been very important, and local opinion ascribes great and continuing benefit to it. Before reclamation the commons are very acid, and doubtless the primary crop response is to the lime in the marl. To what extent its clay content controls blowing and confers physical and chemical benefits to the soil is less clear and is being investigated. The black sands, i.e., podzols, are said to be more responsive than the brown sands or humus-deficient brown earths, which need careful treatment in the early years after marling if the marl is not to move down the profile too quickly. This suggests that a clay-humus complex has to be formed before the clay acquires stability. There is evidence that marled sands are more prone to develop a plough pan than unmarled sands; this may be associated with the high silt content of the marl.

A somewhat similar pattern occurs at Heslington, where the parent materials appear to rest on a gently undulating surface of boulder clay, all but the higher points of which are covered by fluvio-glacial sands and lighter morainic drifts. Slight rises therefore may have soils that are heavy, poorly drained and less easily cultivated than those surrounding them, or may be mounds of blown sand. The accompanying changes of height are usually scarcely perceptible to the unpractised eye.

Reconnaissance survey was continued on Sheet 90, 7th Series (Wensleydale), where 50 sq. miles were mapped between Settle, Arncliffe and Grassington. The most widespread soils are those over Carboniferous limestone, and include shallow rendzinas, brown earths of high base status, acid brown earths and podzols with thin iron pan. Preliminary studies suggest that only the rendzinas have developed from the limestone, the other soils having received extraneous material of both glacial and aeolian origin. Above 1,500 feet are the Yoredale sandstones, shales and limestone, which are mainly covered by a variable thickness of peat, except on the steeper slopes, where erosion prevents its formation. Above these rocks, at about 1,800 feet, the soils are mainly brown earths and podzols developed over Millstone Grit. (Crompton and Bullock.)

LANCASHIRE

Mapping on a reconnaissance basis was continued on Sheet 94, 7th Series (Blackpool), east of a line Garstang-Lancaster, and about 175 sq. miles were covered in which no new association was recognised.

The survey of the Lowland mosses at 1 : 63,360 is complete, and land-utilisation maps have been prepared by the Agricultural Land Service. The total area of 51,000 acres has been divided into arable and grass (42,000 acres), scrub land (3,900 acres), woodland (1,450 acres), peat cutting (1,400 acres), under reclamation (250 acres) and other uses, e.g., tipping sites, golf course, etc. (2,000 acres).

Soil maps were prepared of the Halsall Estates (5,230 acres) for the Church Commissioners and of the holdings of the Lilford Estates around Tarleton and Much Hoole (5,105 acres). (Hall and Folland.)

DERBYSHIRE

Sheet 125 (Derby)

The survey of the sheet was completed when 20 sq. miles were mapped in the parishes of Annesley, Felley and Silston in Nottinghamshire and Riddings in Derbyshire. All the soil series encountered have been described in earlier Soil Survey Reports. The field maps were prepared for the Cartographic Section, and an extended legend was prepared showing the relationship of the soils within major soil groups. Detailed descriptions were made, and samples were taken from representative profiles for use in the memoir; altogether seventy-seven profiles were sampled. (Bridges.)

SHROPSHIRE

The description and sampling of soils required for the memoir on Sheet 166 (Church Stretton) was completed.

The Forestry Commission's request for soil information to aid the preparation of working plans necessitated visiting many woodlands in Shropshire, Herefordshire, Staffordshire and Worcestershire; the information will also be of use as the reconnaissance survey in the West Midlands is extended. Some 80 sq. miles were

mapped, mainly in Clun Forest, where the soils are predominantly developed on Head or other drift of very local origin. Soils derived from the underlying Ludlovian and Downtonian rocks are of subordinate importance and differ from soils on rocks of the same age east of the Church Stretton fault. Above 1,300 feet soils somewhat similar to the Manod series are formed on Ludlovian rocks and derived Head. At similar elevations peaty gley podzols and peaty gley soils sometimes occur on finer-textured redistributed material, but at lower altitudes sols bruns acides are dominant.

A reconnaissance survey was made of 25 sq. miles near Orleton, Herefordshire, for the Agricultural Land Service, in connection with a proposed site for a new town. (Mackney and Burnham.)

CAMBRIDGESHIRE

Sheets 173 (Ely), 174 (Thetford) and Sheet 135, 7th Series (Cambridge)

With the surveying of 45 sq. miles the reconnaissance survey of Sheet 173 (Ely) is almost finished. Most of the work was done south and east of March, but areas were also surveyed at Beck Bow, Soham Fen, Welney and the Bedford Level Washes, near Feltwell Anchor, and smaller areas elsewhere. Near March, on raised ground, Strettham, Wicken, Aldreth and Milton soils were mapped, but most of the work was in the adjacent fenland, where fen "clay" and rodden "silt" complexes predominated, although Middelney soils occur around Christchurch, east of March. Near Stonea is a complex sequence of peaty and humose gley soils of medium texture, developed on boulder clay, which has not been previously seen.

Detailed mapping continued on Sheet 174 (Thetford) in the outlying parts of the Forest, where plantations at Mildenhall, East Harling, Croxton and Wretham were surveyed. In addition, Swaffham Forest and King's Forest, Bury St. Edmunds, both outside Sheet 174, were also surveyed. In all 45 sq. miles have been covered, and the survey of the State woodland of about 80 sq. miles in the Brecklands, mainly of Corsican and Scots Pine, is now complete.

The soil pattern is generally similar to that observed previously, most soils being formed on the Chalk and sand mixture forming the Gipping Till. Humus podzols (Santon series) and brown earths (sols lessivés) of the Worlington series occur on raised flat ground; complexes of shallower soils, such as rendzinas (Newmarket series), brown calcareous soils (Methwold series) and brown earths (Worlington series), occur on slopes and valley sides. In King's Forest rolling ground predominates, mainly with soils of the latter group and no Santon soils.

Mildenhall Forest is a small block adjacent to the River Lark and the Fens; in addition to the slope soils, humus podzols (Santon series) and brown earths (Feckenham series) occur on gravels and associated blown sands, and gley soils and organic soils in the lowest parts. A somewhat similar sequence occurs between Croxton and Great Hockham, north-east of Thetford, where an extensive, discontinuous gravel strip, 4 miles wide and 1 mile long, runs in a north-easterly direction. The Santon series and brown earths (Redlodge and Feckenham series) are plentiful, but on the lower ground, with

an irregular, hummocky relief, gley soils and organic soils may appear in the hollows. (Hodge, Seale and Corbett.)

CARDIGANSHIRE

Sheet 127, 7th Series (Aberystwyth)

Part of the lower land near Aberystwyth had been mapped some years ago, and with the establishment of a new centre the soil series then used were appraised together with those used in North Wales on similar parent materials derived from Silurian and Ordovician rocks. An additional 53 sq. miles was surveyed at 1 : 25,000, a soil map was made of the College Farm, Aberystwyth, at 1 : 63,360, and the map of the Welsh Plant Breeding Station was revised. From the information thus obtained the applicability of the previous soil series was assessed.

The division of parent materials into those derived from hard and soft shales is not considered satisfactory, although hard and soft bands alternate in the solid shale, and are thought to result largely from texture variations in the original sediments. The areas of soils described as having hard and soft shales respectively as parent materials do not consistently correspond with recognisable hard and soft shale deposits. The explanation for the slight texture and colour differences that occur is probably to be found in a study of the site characteristics which reflect geomorphological history and drainage conditions. Work has started on the micromorphology of these soils. (Rudeforth.)

BEDFORDSHIRE AND HERTFORDSHIRE

Sheet 147, 7th Series (Luton and Bedford)

The reconnaissance survey was continued, and a further 150 sq. miles were completed mainly north of a line joining Shefford and Royston. In the Biggleswade market-garden district the soils are mainly coarse textured, and are often stony where overlying the gravels of the Ivel and the glacial sands and gravels of the Southill-Broom district; the last are somewhat thin, and clay usually occurs within 3 feet of the surface. Small areas of very acid, sandy soils formed on the Lower Greensand occur around Rowney, Warden and Sandy Warren.

To the north-west, where these drifts overlie Oxford Clay, heavier and more poorly drained soils occur in Northill and Moggerhanger, but the higher ground is occupied by rather better-drained calcareous clay loams and clays of the Hanslope series associated with Chalky Boulder Clay. This series, one of the most widespread, also covers all the higher ground between Dunton and Wimpole. To the south-east the ground falls sharply to the Cam valley, which is cut in the Gault and is fairly free from drift; imperfectly and poorly drained, olive-brown clays and clay loams of the Wicken series are dominant.

As the land rises to the main mass of the Chalk, very calcareous grey clay loams and silty clay loams with imperfect drainage occur on the Chalk Marl between Guilden Morden and Whaddon. Farther

south, between Steeple Morden and Royston, the flatter areas on the Chalk are covered with freely draining, brown, calcareous soils formed on loamy drifts; the more rolling country around Limlow Hill and Morden Grange Plantation is characterised by soils of the Icknield series. (King.)

HERTFORDSHIRE AND ESSEX

Sheet 148, 7th Series (Saffron Walden)

Reconnaissance surveying was continued in north-west Essex between Braintree, Haverhill and Saffron Walden, where about 200 sq. miles were completed. Most of the soils were satisfactorily grouped in the associations previously described, but additional associations needed will be described later.

Over much of the area, the Chalky Boulder Clay is more than 100 feet thick, and the derived soils (Hanslope association) cover both plateaux and valley sides, with only minor differences in profile characteristics. Along the deeper valleys river down-cutting has breached the Chalky Boulder Clay to expose Glacial Gravels and, occasionally, London Clay. The aspect of the valley sides is particularly important in soil-mapping. On east-facing slopes the gravel outcrop is usually masked by finer-textured Head mainly derived by periglacial mixing of boulder clay and gravel, whereas many west-facing slopes have coarse-textured soils developed directly on Glacial Sand and Gravel.

River alluvium is fine-textured, calcareous, high in organic matter and more or less gleyed. Where these soils are taken into arable cultivation dressings of manganese salts were beneficial, and soils of coarser texture at the base of the gravels, where springs are thrown out, appear to respond similarly. These soils are also calcareous and have a very dark-coloured A horizon which is conspicuous on ploughland; under semi-natural conditions they are recognisable by the dense cover of rushes and marsh marigold (*Caltha palustris*). (Thomasson.)

GLAMORGAN

With the surveying of 350 sq. miles, between the Swansea Valley in the west and the Rhymney Valley in the east, the reconnaissance survey of the county is complete. The Coalfield may be described as a series of concentric radial ridges and valleys rising towards the highest point, Cefn Fford (1,969 feet), near Hirwaun on the north crop. The soil-distribution pattern is governed mainly by topography, elevation and lithology (interbedded sandstone and shale) in an area of high rainfall.

Shallow peaty gley soils under *Molinia* occur along the crests; the upper slopes carry podzols under *Nardus* or *Vaccinium*, and shallow podzolised soils carrying bracken occur on the lower steeper slopes. The pattern is frequently interrupted by deep peaty gley soils, covered by *Molinia*, sedges and mosses, where the shale outcrop is extensive. Forestry Commission land (e.g., Rheola Forest) is concentrated in such areas. Where the relief and lithology permit, peaty gley soils are continuous along the valleys. Some drift is

always present, and where it is abundant, non-peaty, bouldery gley soils occur in the valleys. Similar soils are formed after restoring opencast mining sites, and where they replace deep peaty gley soils the land is upgraded for agricultural purposes.

The main effect of the increasing elevation is the formation of concentric zones of soils centred on Cefn Fford, the zones being characterised by overlapping but different combinations of soils. Thus, freely drained sedentary soils and deeper drift soils occurring on ridges and in valleys chiefly south of the Coalfield are the best local agricultural soils. The next inner zone tends to contain more podzolised soils in addition to these brown earths; in the next, podzols and shallow peaty gley soils are more extensive, and around Cefn Fford are extensive deep peaty gley soils and small areas of acid peat. The north and south margins of the Coalfield are delimited by an E.-W. depression containing peaty gley soils on shale, extensive areas of former mine workings, particularly around Merthyr Tydfil, and of opencast mining or restored land. (Crampton.)

BERKSHIRE

Sheet 268 (Reading)

Mapping was continued at the scale of 6 inches to 1 mile, during which 36 sq. miles were surveyed in a rectangle with Sonning, Reading, Bradfield and Goring at the corners.

The district is crossed by the Thames, Kennet and Pang, and contains the dry valley formerly occupied by the Kennet. The two main land forms of plateau surfaces and valley floors are separated by moderately steep slopes with outcrops of bedrock that influence soil development. The commonest outcrops are of Upper Chalk, with Middle Chalk in the north and Reading Beds and London Clay in the south. Away from the slopes superficial deposits predominate.

Except for small outliers of Reading Beds, the plateau surfaces above 300 feet are covered by a diverse formation commonly containing many flints and far-travelled stones with a red-mottled clay matrix. This suggests that it may be the remnants of a soil, developed in a warm climate with distinct wet and dry periods, which was greatly disturbed during Pleistocene glacial periods; the main type of soil formed now is brown earth with gleying. On plateau sites below 300 feet are well-sorted fluvial gravels with smaller, more rounded stones. Freely drained brown earths showing well-defined clay migration dominate, but where the gravels overlie Tertiary rocks there are brown earths with gleying. Surface soils of silt loam, suggesting aeolian deposits, rarely occur below 300 feet, but do occur in the highest parts of the area.

Soils on the valley floors are developed on either alluvium or river terraces. On alluvium the wide range of drainage conditions and calcium-carbonate content give five mapping units, including peaty soils, calcareous and non-calcareous gley soils and rendzina-like warp soils. On adjacent low terraces the thickness and texture of the material overlying the gravel are the most variable characteristics, but most soils are freely drained brown earths (*sols lessivés*).

The intervening steep slopes, where Chalk is the bedrock, have a

sequence of soils similar to that on the Chilterns, except that the Charity series is missing. (Jarvis.)

GLOUCESTERSHIRE AND WILTSHIRE

Sheet 156, 7th Series (Bristol and Stroud)

About 240 sq. miles have now been surveyed, mainly on the Cotswolds except for a short stretch of the Avon valley between Chippenham and Melksham. The strongly dissected part of the Cotswolds around Stroud and Bath presents a regular association of soils. Very steep slopes on Fuller's Earth, frequently slumped and thickly wooded, give way to gentler slopes with brashy limestone soils carrying arable crops. A spring-line often marks the junction of the limestone or limestone Head and the underlying sandy or clay strata which give rise to a complicated pattern of light-textured soils of differing drainage supporting permanent grass and orchards.

In contrast with the scarp slopes, the higher dip-slope provides extensive stretches of gently sloping land with few shallow dry valleys. These are mainly covered by a thin, brashy clay loam, except in valley floors or where Fuller's Earth clay outcrops in thin bands on some valley sides.

East of a line Avening-Badminton-Corsham the pattern is complex, as the country is more undulating, more thickly wooded and has more extensive stretches of soils derived from Forest Marble clay. Although the surface soils may be sandy, because of variations in the parent rock or the presence of a coarse-textured drift, drainage is impeded by the underlying clay. Around Chavenage, Westonbirt and Gastard are small patches of well-drained, stoneless loamy soils. The area underlain by Cornbrash also provides a characteristic association of soils with extensive, nearly flat tracts of brashy soils of variable texture above which rise low, rounded clay hills. Although similar to those on the Great Oolite Limestone, the Cornbrash soils need artificial drainage.

Where the Oxford Clay outcrop is continuous, soils are not unlike those on Forest Marble clay, with loamy surface soils and impeded drainage. North of Chippenham, the Kellaways sands are thick, and deep light-textured soils predominate, though drainage is not everywhere free.

Wide gravelly terraces with well-drained loams occur on the west bank of the Avon, but on the east the gravels are thinner and the soils are poorly drained on the flat surface of the Oxford Clay. (Findlay.)

DEVON

Work on the Nuffield Farm Project area in the Teign Valley was completed and an account prepared for local distribution with the map at 1 : 25,000 which is now ready for printing.

Reconnaissance survey was started on Sheet 176, 7th Series (Exeter), which includes the Project area, and a further 20 sq. miles were covered on the Haldon Hills and in the Bovey Basin. Great and Little Haldon form a narrow, flat-topped plateau at 700-800

feet extending in a N.-S. direction parallel with and midway between the Exe estuary and the middle reaches of the Teign. Coarse flint gravels with seams of granitic sand and whitish clay cover most of the plateau and overlie Greensand, the narrow outcrop of which around the edge of the plateau is frequently mantled by flinty Head. The soils on the gravels and the marginal Greensand are included in the Haldon association. They are mainly iron-humus podzols, but vary considerably owing to local differences in parent material. Most of Haldon is now planted by the Forestry Commission, but large areas remain of the former cover of semi-natural wet heath.

The Bovey Basin occupies a rectangle of low-lying, gently undulating ground, between Bovey Tracey and Newton Abbott, crossed by the lower course of the Teign. Oligocene clay, sand and lignite derived from Dartmoor underlie the Basin, but are mainly covered by Head of varied composition. Clay- and sand-pits are extensive, and extraction of "ball-clay", begun about 1740, still continues. Surface-water gley soils and peaty gley soils are extensive where dense whitish clay occurs close to the surface; podzols and sandy brown earths occur on marginal sands and gravels, with acid brown earths on more loamy Head. Ground-water gley soils of fine sandy loam texture were mapped on the flood plains of the Teign and Bovey. (Clayden and Manley.)

SUSSEX

Sheets 332 (Bognor) and 317 (Chichester)

About 25 sq. miles were mapped, extending the survey west towards the Hampshire border and about 1 mile up the slope of the South Downs. Several soils already mapped on the Chalk (Sheet 238, Aylesbury) were recognised, including Charity, Icknield, Coombe, Winchester and Wallop series. Three new mapping units were needed, one of which can probably be correlated with the Andover series, the shallow brown calcareous soil on the Hampshire Chalk. The Icknield (shallow phase) is mainly confined to the steeper slopes and crests of narrow ridges; elsewhere the Andover series predominates, except where Wallop and Winchester soils are formed on the Clay-with-flints capping broader ridge-tops above 400 feet. In the Chalk, Charity soils are confined to the lower slopes of valleys, often on terrace-like features, but southwards they expand to a broad belt where the Downs meet the coastal plain. As well as the normal Charity soils, very stony and shallow phases were mapped. (Hodgson.)

KENT

Reconnaissance mapping was started, and soils developed on or associated with the Chalk, Gault, Lower Greensand and Weald Clay were examined. In connection with a course on soils held at Juniper Hall, similar examinations were made around Dorking, Surrey, and about 20 sq. miles were mapped at 1 : 25,000.

The preparation of maps and the memoir dealing with Romney Marsh is proceeding. (Green.)

OTHER WORK

1. Several surveyors took part in describing soils at the sites of field trials of different kinds.
2. A report was made for the Agricultural Land Service on the possibility of reclaiming Pilling-Cookerham Marsh. (Hall and Folland.)
3. The Hertfordshire Agricultural Institute Farm at St. Albans was surveyed. (Thomasson.)
4. At the request of the Department of Scientific and Industrial Research Hydraulics Research Station the 8 sq. miles of the Grendon Underwood Experimental Catchment were surveyed. Rainfall and stream-flow are being measured there, and seasonal changes in soil-moisture status are being measured by direct sampling, tensiometer and resistance-block methods at sites chosen on the basis of the soil survey. (Avery.)
5. The degree and rate of podzolisation under conifers of three soils in close proximity is being studied. (Ashley.)
6. A study of the colonisation by vegetation of bare sand and gravel surfaces suggests that colonisation is speeded by nitrogenous manures. (Crompton and Bullock.)
7. The morphology of soils developed on silty parent materials is often similar to that of podzols on sandy materials. Micromorphological studies, however, show that the B horizon has small well-flocculated aggregates of weakly birefringent clay more resembling those in the braunerde (Kubiěna) than those in the spodic horizon of American authors. (Mackney, Burnham and Waine.)
8. A small area considered suitable for a Nature Reserve in the Isle of Wight was surveyed. (Hodgson.)
9. At the request of the Forestry Commission a reconnaissance survey was made of part of Halwill Forest, Holsworthy, where problems occur on surface-water gley soils. (Clayden and Manley.)
10. The environs of a proposed reservoir near Pontypool were surveyed to advise on their suitability for wildfowl and conservation. (Crampton.)