ROTHAMSTED RESEARCH

The Soil at Rothamsted

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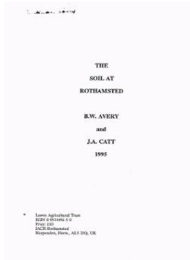
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THE SOIL AT ROTHAMSTED

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Geology and Soil Parent Materials

The Rothamsted Estate (Fig. 1) overlies Chalk on the dipslope of the Chiltern Hills, about seven miles south-east of the steep scarp slope at Dunstable and eight to nine miles north-west of the Tertiary outcrop (Reading Beds and London Clay) on the north-western margin of the London Basin. Over most of the gently inclined dipslope plateau, the Chalk is covered by at least 2 m of Clay-with-flints, but it directly underlies the soil in places on the steeper north-eastern sides of major valleys dissecting the dipslope, including the Ver valley on the western margin of the farm. Elsewhere in valleys and minor depressions, the Clay-with-flints is replaced or overlain by less clayey, loamy, gravelly or chalky superficial deposits, also containing flint in widely varying proportions.

The Clay-with-flints was originally regarded as the insoluble residue of the underlying Upper Chalk produced by prolonged weathering in mid- and late Tertiary times, but Jukes-Browne (1906) showed that it contains too much clay and insufficient flint to be simply chalk residue. Mineralogical analyses of the material at Rothamsted (Weir *et al.* 1969; Avery *et al.* 1972) and elsewhere in south-east England (Avery *et al.* 1959; Hodgson *et al.* 1967) support his conclusion that the additional clay, together with included sand and flint pebbles, are mainly derived from Reading Beds. During the later Tertiary and Quaternary periods it seems that the essentially impermeable London and Reading Beds Clays were progressively removed from the Chiltern dipslope by subaerial denudation. Once the Reading Beds had been reduced to a certain critical thickness, the remaining veneer of residual or redistributed materials became sufficiently permeable for water to pass through it and so to initiate weathering of both the veneer and the Chalk beneath. Whenever and wherever these conditions obtained, dissolution of the Chalk led to release of the contained flints and formation of voids which were filled with illuvial clay from above, giving rise to a distinctive basal layer of unworn flints in a reddish clay matrix which Loveday (1962) termed Clay-with-flints *sensu stricto*. During Quaternary cold stages when areas to the north and east were periodically glaciated, the more or less weathered remains of Reading Beds and previously formed Clay-with-flints *sensu stricto*, along with some chalk and fresh flint, would have undergone deep-reaching mixing and re-arrangement by cryoturbation and gelifluction, and it is in this way that the bulk of the Clay-with-flints, which Loveday grouped with other Chalk dipslope deposits as Plateau Drift, is believed to have originated.

Besides Reading Beds, the Plateau Drift at Rothamsted incorporates remnants of marine sediments laid down when the sea temporarily invaded much of what is now south-east England in late Tertiary or early Quaternary times. In 1926, when trenches were dug across many of the fields and the Geological Survey inspected the exposures, two angular blocks of fossiliferous ferruginous sandstone were found in West Barnfield (Fig. 1). Judging from the fossils they contained, which are exhibited in the Geological Museum, Kensington, the sandstone can be correlated with the Plio-Pleistocene Red Crag formation of East Anglia and similar deposits over Chalk at Netley Heath, Surrey. As much of the drift underlying the northern part of the farm contains appreciably more sand than elsewhere, it seems reasonable to suppose that the additional sand may have

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Area : 330ha (811acres)

Elevation : 95–134m (310–440ft) above sea level

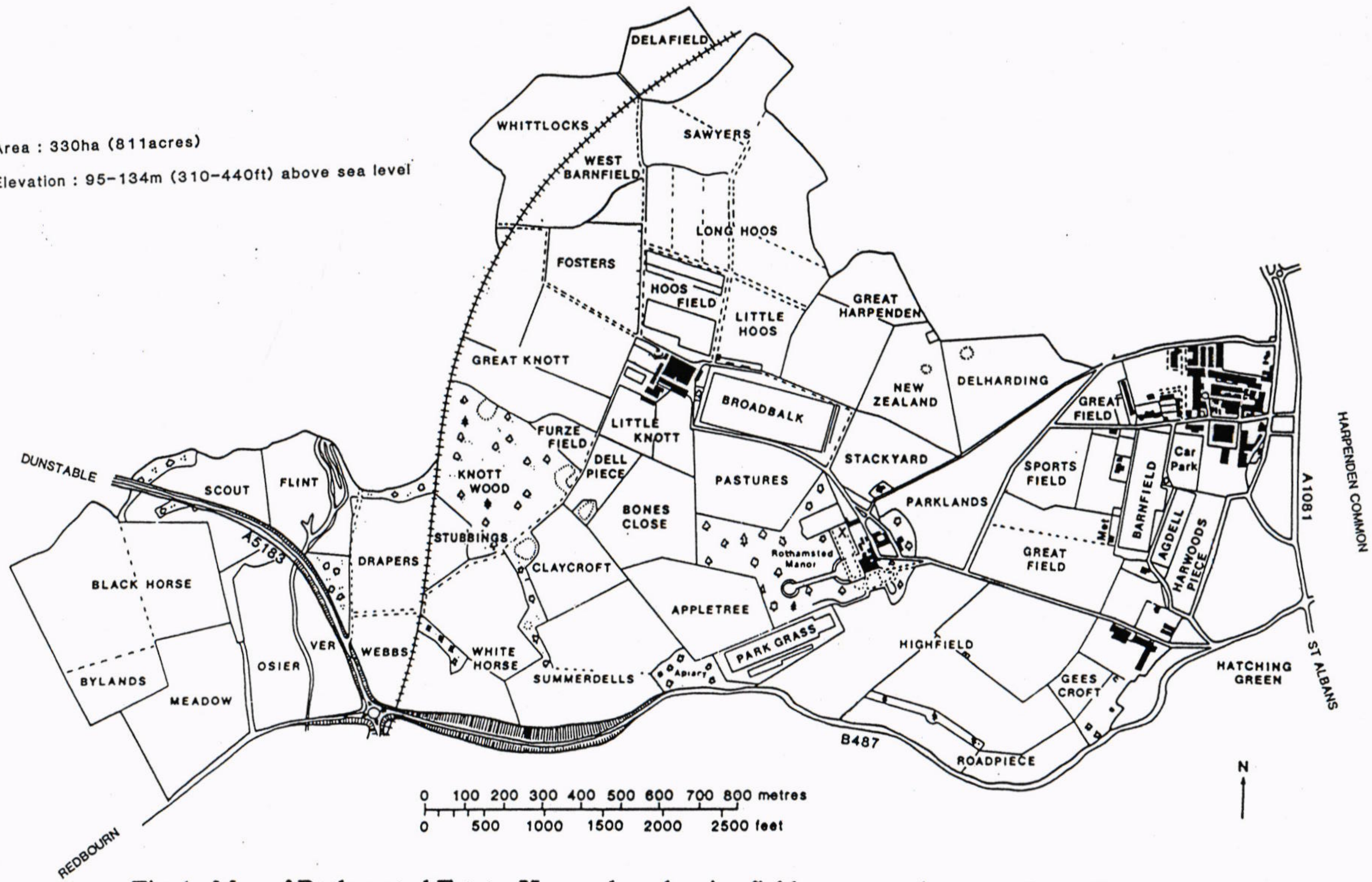

Fig. 1. Map of Rothamsted Estate, Harpenden, showing field names, main areas of woodland and the principal field experiments.

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been derived from the same deposit, though mineralogical analyses (Moffat 1980) have failed to confirm this and suggest that the sand could equally well have come from a former cover of sandy Reading Beds.

Everywhere on the dipslope plateau, the topsoils and often the immediate subsurface horizons contain more silt (2-60 μm) than the deeper subsoil. Mineralogical analyses (Avery *et al.* 1959; Catt 1969; Avery *et al.* 1972) support the conclusion that the upper silty horizons are composed of Late Devensian loess (windblown dust deposited about 14,000-18,000 years B.P.) intimately mixed by cryoturbation with clay and frost-shattered flints from the Plateau Drift. On parts of Whittlocks, Park Grass (Fig. 1) and other fields, the layer rich in Devensian loess exceeds 80 cm in thickness and contains few stones below the topsoil.

In many localities on the Chiltern Plateau, thicker and often almost stone-free silty deposits known as brickearths occur as inclusions within or below the more stony Plateau Drift and have been exploited at various times for brickmaking. They occupy funnel- or basin-shaped depressions in the underlying Chalk surface, which appear to have originated as solution hollows or dolines when the Reading Beds cover had only been partly removed. Investigations during the 1970s revealed the existence of such a doline beneath Little Knott Field (Fig. 1) (Avery *et al.* 1982) and there may well be others elsewhere on the farm, as they are normally completely infilled and hence have little or no surface expression. Mineralogical analyses of silt fractions from within the infill at Little Knott, where the Chalk surface locally descends to a depth of at least 11 m, suggest that the uppermost layer of Devensian loess is underlain by inwashed deposits consisting partly of older (Wolstonian and Anglian) loesses. No artefacts have been found there, but similar infilled dolines elsewhere on the Chilterns (Caddington, Gaddesden Row) have yielded rich assemblages of Paleolithic flint implements, and at Round Green (Luton) there is an intriguing record of a human skeleton found about a century ago. It is likely that the dolines were often water-filled and attracted human interest at various times in the later Quaternary.

The various deposits underlying sideslopes of the Ver valley and in minor valleys heading on the plateau also consist partly of loess, which was mixed with locally derived materials under periglacial conditions and moved downslope by gelifluction or by more recent rainwash since the land was first cultivated. In Flint, Scout and Osier Fields (Fig. 1) the drift includes more or less re-arranged flint gravel originally laid down by precursors of the Ver in Devensian or earlier cold periods. Flint gravel with a sparse loamy matrix also underlies the floor of the valley and is covered in the lowest places by thin spreads of silty alluvium. On construction of the A5183 Redbourn bypass, however, the stream course in Ver field was diverted and the naturally occurring superficial deposits and soils there were incorporated in loamy and gravelly 'made ground'.

Soil Classification and Mapping

Soil surveys based on field examination of topsoil and subsoil horizons, together constituting the soil profile, were initiated in Britain during the 1920s. Following contemporary American usage, soil series were adopted as the basic units of classification and mapping and named according to the localities where they were first identified or were most extensive. By 1939, when the Soil Survey of England and Wales received formal recognition, soil-series maps had been made in a number of widely scattered localities, each series being conceived as a set of soils with similar profiles developed

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under similar conditions from the same type of parent material. To systematize their differentiation and show their relationships, they were grouped into broader classes termed genetic or major soil groups (brown earths, podzols, calcareous soils, gley soils and organic soils) and subgroups, and characterized by field-determined properties supplemented by particle-size and chemical analyses of horizon-samples from representative profiles (e.g. Kay 1939).

A soil-series map of the Rothamsted Farm was first compiled by Professor Linwood L. Lee of Rutgers University, New Jersey, in 1931 (Rothamsted Report for 1931, p. 40). He identified and mapped 14 series, four of which were further divided into soil types on a textural basis, but a later (1945) survey by B.W. Avery failed to substantiate his findings. They were therefore disregarded in subsequent surveys of similar terrain by the Soil Survey of England and Wales, including those of the neighbouring Aylesbury and Hemel Hempstead district (Avery 1964), the West Sussex Coastal Plain (Hodgson 1967) and the Reading district (Jarvis 1968). In these the classification adopted featured a number of series, including Batcombe, Charity, Hamble, Hook, Icknield, Wallop and Winchester, originally named and mapped in earlier surveys in Berkshire, now Oxfordshire (Kay 1934), Hampshire (Kay 1939; Green 1940) and Dorset (Robinson 1948).

This classification, summarized in Table 1, was used in accounts of the soil published in successive issues of the Station Guide from the mid-1950s onwards, together with a soil map based on closely spaced screw-auger borings along traverses 50-100 m apart. In accordance with contemporary Soil Survey practice, soil textures were described using U.S.D.A. classes (Fig. 2a) as determined in the field by comparison with analysed samples. In 1966, following the purchase of the greater part of Scout Farm, Redbourn, including Black Horse, Bylands, Meadow, Scout, Flint, Osier, Ver, Drapers, Webbs, Stubbings, White Horse and Summerdells fields (Fig. 1), the newly acquired land was surveyed in the same fashion and the soil map extended accordingly. By this time particle-size and chemical data had been obtained on samples from 18 representative profiles described in detail, but most of these were in Knott Wood and on Scout Farm, and only three in classical experimental sites (Park Grass and Broadbalk Wilderness). In 1968 and 1971 respectively, the soils of Broadbalk and Barnfield were examined more intensively (Avery and Bullock 1969; Weir *et al.* 1969; Catt 1969; Avery *et al.* 1972); six profiles in Broadbalk and 13 in Barnfield were sampled for analysis, which included mineralogical and micromorphological studies as well as particle-size and chemical measurements.

The decade beginning in 1973 saw the adoption by the Soil Survey of a revised hierarchical soil classification scheme (Avery 1973, 1980; Clayden and Hollis 1984) in which major soil groups, soil groups, soil subgroups and soil series are defined by progressive division, using selected observable or measurable profile characteristics as differentiating criteria. In particular, soil series were redefined as divisions of subgroups with limited ranges in lithology, including texture, stoniness, depth to specified substrata and mineralogical or mineralogically related characteristics. At the same time the U.S.D.A. textural classes (Fig. 2a) previously used were replaced by a smaller number of newly defined particle-size classes (Fig. 2b) based on the particle-size grades of the British Standards Institution (1975). For differentiating soil series, the classes were grouped as in Fig. 2c. These classes accord closely with those used to differentiate family groupings in the US Soil Taxonomy (Soil Survey Staff, 1975). The system was first fully utilized in compiling the national 1:250,000 soil-association maps (Mackney *et al.* 1983;

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Jarvis *et al.* 1984) in which associations are identified by the names of the dominant or most distinctive soil series each contains. As a consequence of the newly systematized soil-series definitions, the total number of series recognized nationally was considerably reduced, although the number represented within a limited area such as the Rothamsted estate is generally larger, particularly in situations where differentiating criteria not previously used have been introduced. Thus the Winchester, Charity, Coombe and Icknield series as previously conceived (Table 1) have each been divided into two or more series.

Table 1. Soil series on Chalk, Clay-with-flints and associated deposits (after Avery, 1964 and Hodgson, 1967)

Major soil group	Subgroup	Parent material or substratum	Soil series
Calcareous soils	Rendzinas	Chalk	Icknield
	Brown calcareous soils	Silty chalky drift (Head) Thin Clay-with-flints over Chalk	Coombe Wallop
Brown earths	Brown soils (*sols lessivés*)[1] (leached brown soils)	Silty drift (brickearth) Flinty silty drift (Head) Clay-with-flints	Hamble Charity[2] Winchester
	Brown earths (*sols lessivés*)[1] with gleying	Silty drift (brickearth) Clay-with-flints (Plateau Drift)	Hook Batcombe

[1] With clay-enriched (argillic) subsurface B horizons.
[2] Mapped with associated soils as Charity complex at Rothamsted.

Twenty soil series as currently defined have been positively identified at Rothamsted, including three that have yet to be named by the Soil Survey. They are listed in Table 2, along with their differentiating characteristics. Batcombe and Carstens soils on Clay-with-flints are together estimated to cover nearly three-quarters of the area, and several of the others are only sporadically represented. The table also relates each series to classes in the internationally utilized U.S.D.A. (Soil Survey Staff 1990) and F.A.O. (1990) systems, and lists recorded profiles with morphological and analytical data conforming or nearly conforming to the prescribed definitions. As classes of the England and Wales Soil Classification do not correspond precisely with those of the other systems, in which different differentiating criteria are used (cf. Avery 1980), the correlations are inexact and in some cases tentative. Abridged descriptions of the 42 profiles listed and related analytical data (Avery and Bascomb, 1982) are given as Appendices A and B, respectively. The colour, texture and stoniness of the horizons distinguished are described in accordance with the Soil Survey Field Handbook (Hodgson 1974). For profiles 1-33 described and sampled before 1974, this entailed modifying the original descriptions. Similarly, the particle-size data were recalculated where necessary to accord with the currently used size grades (Fig. 2b) in order to attain uniformity.

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Table 2. Classification of Rothamsted soils according to the Soil Survey of England and Wales (Avery 1980; Clayden & Hollis, 1984), the U.S.D.A. Soil Taxonomy (Soil Survey Staff 1975, 1992) and F.A.O. (1990)

Soil Subgroup (Avery 1980)	Soil Series (Clayden & Hollis 1984)	Soil Subgroup (Soil Survey Staff 1992)	Soil Unit F.A.O. (1990)	Recorded Profile(s)
3.42 Grey rendzinas	UPTON loamy, lithoskeletal chalk	Typic Udorthent	Eutric (or Rendzic) Leptosol	
3.43 Brown rendzinas	WALLOP clayey, lithoskeletal chalk	Typic Udorthent or Rendollic Eutrochrept	Eutric Leptosol or Calcaric Cambisol	6
5.11 Typical brown calcareous earths	PANHOLES fine silty over lithoskeletal chalk	Rendollic Eutrochrept	Calcaric Cambisol	8
	COOMBE fine silty, chalky drift	Rendollic Eutrochrept	Calcaric Cambisol	18
5.47 Colluvial brown earths	NOTLEY fine silty, non-calcareous colluvium	(no definite correlative)	(no definite correlative)	4, 23*, 27
5.71 Typical argillic brown earths	CHARITY fine silty drift with siliceous stones	Typic Hapludalf	Haplic (or Chromic) Luvisol or Alisol	12*, 28*, 36
	HAMBLE silty, stoneless drift	Typic Hapludalf	Haplic Luvisol or Alisol	15*, 31
	ROWTON silty over non-calcareous gravel	Typic (or Glossic) Hapludalf	Haplic (or Chromic) Luvisol or Alisol	14*
	WOLD fine silty over clayey, over lithoskeletal chalk	Typic Hapludalf	Haplic (or Chromic) Luvisol	9
	________ fine silty over clayey, chalky drift	Typic Hapludalf	Haplic (or Chromic) Luvisol	7, 29

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Soil Subgroup (Avery 1980)	Soil Series (Clayden & Hollis 1984)	Soil Subgroup (Soil Survey Staff 1992)	Soil Unit F.A.O. (1990)	Recorded profile(s)
5.71 Typical argillic brown earths	MAPLESTEAD coarse loamy, drift with siliceous stones	Typic Paleudalf (or Glossudalf)?	Chromic Luvisol (or Eutric Podzoluvisol)	16
5.72 Gleyic argillic brown earths	HOOK silty, stoneless drift	Typic (or Aquic) Hapludalf or Paleudalf	Haplic (or Chromic) Luvisol	32, 33*, 41*
	TIDMARSH loamy-gravelly with very hard siliceous stones	Mollic Hapludalf (or Glossudalf)	Chromic Luvisol?	38
5.81 Typical paleo-argillic brown earths	CARSTENS fine silty over clayey, drift with siliceous stones	Typic Paleudalf (or Hapludalf)	Chromic Luvisol (or Alisol)	25*, 35*, 40
	PORTON fine silty over clayey, over lithoskeletal chalk	Typic Hapludalf	Chromic Luvisol (or Alisol)	
	WINCHESTER clayey over lithoskeletal chalk	Typic (or Vertic) Hapludalf	Chromic (or Vertic) Luvisol	5, 30
5.82 Stagnogleyic paleo-argillic brown earths	BATCOMBE fine silty over clayey, drift with siliceous stones	Aquic (or Typic) Paleudalf	Chromic Luvisol (or Alisol)	1*, 2, 10, 11, 13, 19, 20, 21, 22*, 24, 26*, 34, 42
	HORNBEAM fine loamy over clayey, drift with siliceous stones	Aquic (or Typic) Paleudalf	Chromic Luvisol (or Alisol)	3
8.41 Typical argillic gley soils	BINSTEAD loamy-gravelly with very hard siliceous stones	Typic (or Aeric) Endoaqualf	Gleyic Luvisol?	39
8.73 Argillic humic gley soils	________ fine silty over non-calcareous gravel	Typic Argiaquoll or Mollic Endoaqualf	Gleyic Phaeozem?	17, 37

* Marginal in respect of one or more differentiating characteristics at series level.

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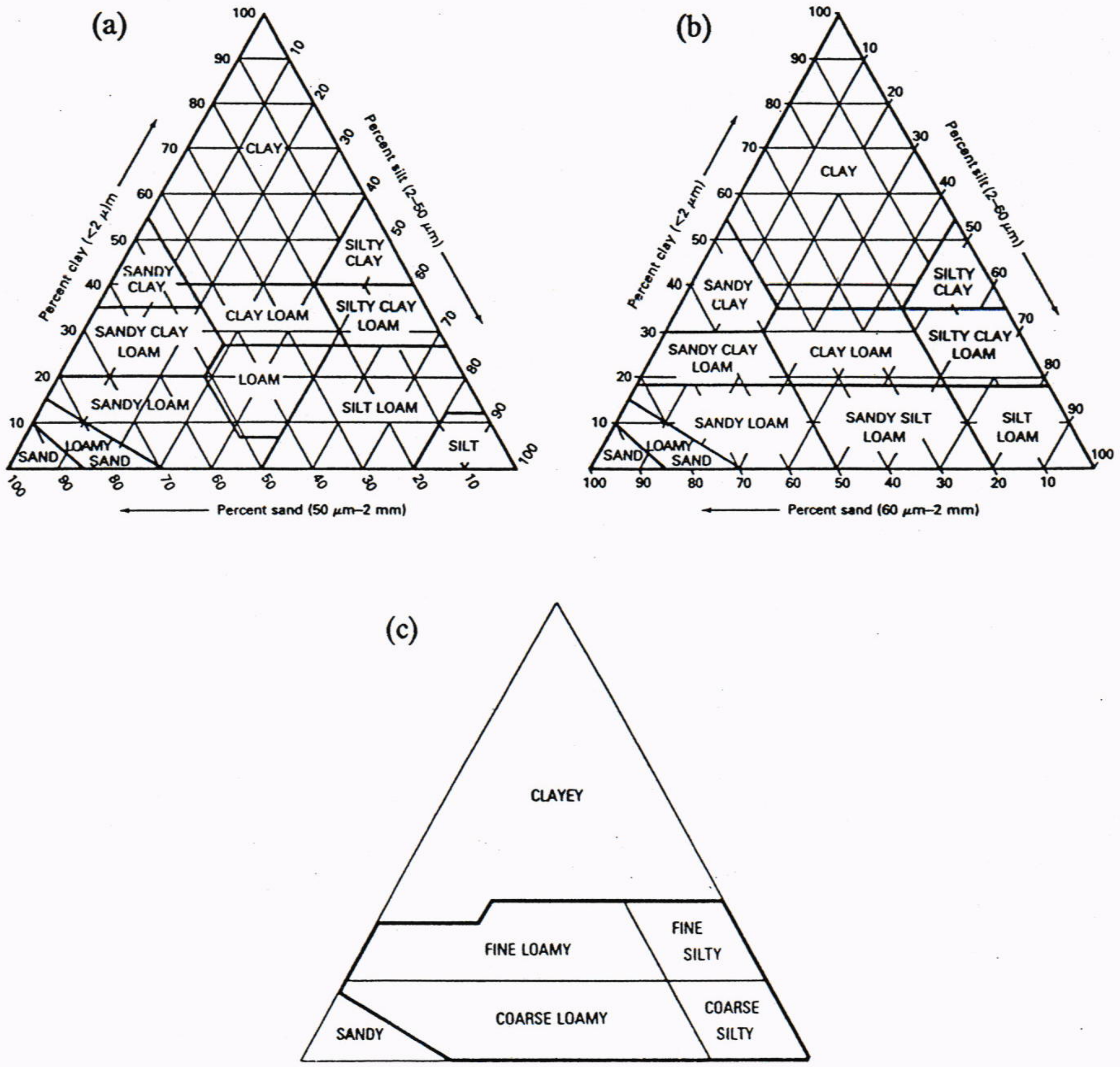

Fig. 2. Textural (particle size) classes according to (a) United States Department of Agriculture; (b) Soil Survey of England and Wales (now Soil Survey and Land Research Centre); and (c) groupings from (b) used to differentiate soil series in England and Wales.

Locations of the numbered profiles are shown on the accompanying 1:10,000 soil map (Fig. 3). This was derived from an improved auger survey made in 1977 by C.G.G. Van Beek and L.G. De Klerk of the University of Utrecht, with due reference to earlier work. Borings were made at 1,225 pre-determined points 50 m apart (grid survey), using a 6 cm diameter Edelman auger which permits examination of soil colour, texture, structure and consistence to a depth of one metre except where stopped by very stony material. Details of each boring were recorded on cards designed for the purpose: 16 topsoil samples were submitted to particle-size analysis to aid field determinations of texture, and three further profiles (nos. 40-42) fully described and sampled.

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The map legend (Table 3) includes 13 units identified in all but one case by names of the dominant soil series as now defined. 'Typical' and 'heavy' phases of the Batcombe series are set apart on a textural basis and the locally variable soils on the Ver valley floor are grouped as the Ver complex. A further unit comprises unsurveyed and/or disturbed (made) ground, including pits and 'dell-holes'.

It is now generally recognized that soil-series mapping based on field examination of the soil profile at sampling sites is subject to errors arising firstly from short-range lateral variability and secondly from the limited precision of field estimates of differentiating properties defined in quantitative terms. Thus the bodies of soil represented by mapping delineations normally include profiles conforming to more than one soil series. A map unit is conventionally identified by a single series name when it is predicted that most of the soil in every delineation conforms to it and that unconforming inclusions are similar for practical purposes or occupy negligible proportionate areas. Undifferentiated units, estimated to include substantial but variable proportions of two or more closely related series, are identified by the names of the two most extensive (e.g. Batcombe-Carstens); units comprising significant proportions of contrasting series in each delineation are distinguished as complexes.

Salient Soil Properties

General profile characteristics

As indicated in earlier accounts, the undisturbed soils are readily divisible into three broad classes as follows:

1. Well drained calcareous soils (rendzinas and brown calcareous earths) on Chalk or chalky drift.
2. Well drained to moderately well drained, originally acid soils (nearly all paleo-argillic or argillic brown earths) on Clay-with-flints and in other non-calcareous or superficially decalcified drift over Chalk.
3. Low lying soils (groundwater gley soils, including argillic, humic and humic-alluvial gley soils) over river gravel, that show signs of periodic saturation by groundwater in the recent past.

Soils of the first class, confined to sloping land on the eastern side of the Ver valley, have relatively simple profiles in which the topsoil rests more or less directly on fragmented chalk (rendzinas) or overlies a brown subsurface (B) horizon of similar texture (brown calcareous earths).

Soils of the second class, which are by far the most extensive, nearly all have brown to yellowish-red subsoil horizons of noticeably finer texture (argillic Bt horizons), either directly below the topsoil or at greater depths beneath a less strongly coloured and more friable subsurface (Eb) horizon. In both cases the increase in clay content with depth is at least partly attributable to downward translocation of clay-size particles, though on the Clay-with-flints, as mentioned above, it is accentuated by the presence of a more silty superficial layer rich in loess-derived material. Soils in the thicker loess-containing deposits of Devensian age (argillic brown earths) have B horizons that are less brightly coloured than the Clay-with-flint subsoils, which are normally strong brown

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(7.5YR5/6) to yellowish red (5YR5/6-8) and show additional micromorphological features (Avery & Bullock 1969; Avery *et al.* 1972) attributed to soil development in one or more earlier interglacial stages of the Quaternary. Soils with B horizons of this kind have been grouped as paleo-argillic brown earths in England and Wales, and are typically more strongly leached and weathered than younger soils in parent materials of originally similar composition. Those on Clay-with-flints include typical paleo-argillic brown earths (Carstens and Winchester series) with uniformly coloured B horizons, and stagnogleyic paleo-argillic brown earths (Batcombe and Hornbeam series) in which the B horizons show varicoloured mottling within 60 cm depth, indicative of reduction/mobilization and redeposition of iron (gleying) under periodically water-saturated conditions.

Following construction of the Redbourn by-pass, soils of the third class are of very limited extent, occurring only in Flint Field and the adjoining Ver Spinney (Fig. 1). They have very dark coloured topsoils rich in organic matter and greyish gleyed subsurface horizons with ochreous mottles and streaks.

Texture and stoniness

As the topsoils generally contain substantial proportions of loess-derived material, they are predominantly silty in texture. Over at least 75 per cent of the area mapped, the estimated particle-size (textural) class is silty clay loam (Fig. 2b), or silt loam according to the U.S.D.A. system (Fig. 2a), with between 18 and 27 per cent clay and less than 20 per cent sand (60 μm - 2 mm). Topsoils of finer texture, mainly heavy silty clay loams with 27-35 per cent clay, occur chiefly on upper slopes susceptible to erosion, as in Barnfield (Avery *et al.* 1972) and Claycroft, and only sporadically on the plateau. Lighter soils, mainly silt loam or sandy silt loam containing less than 18 per cent clay, have been recorded only in parts of Flint, Scout, Ver and Osier fields (Fig. 1).

The topsoils nearly everywhere contain angular, or angular and rounded, flint stones in proportions which locally exceed 15 per cent by volume. Under old grass, as in Highfield (profile 13), they are concentrated in a layer some 10-20 cm below the surface as a result of earthworm activity. Of the predominant 'Clay-with-flint soils' (Batcombe, Carstens and Winchester Series), those on the nearly level plateau are generally less stony than on bordering slopes, and the subsoils contain fewer but larger flints. Average weights per acre of stones (> 6 mm) in successive 23 cm layers, quoted for the chief experimental fields by Hall (1917), exemplify these trends. Thus the surface layer of Barnfield is significantly more stony than those of Broadbalk and Hoosfield but not quite as stony as Agdell, and the topsoils of both Barnfield and Broadbalk are on average two to three times more stony than the subsoils at 46-69 cm. In the generally loamy soils at lower levels, however, the subsoils are in places much more stony than the topsoils, particularly alongside and west of the R. Ver in Flint, Osier and Scout fields (Fig. 1).

Mineralogy

The mineralogy of the fine earth < 2 mm has been studied only in Batcombe and associated soils in Broadbalk (Weir *et al.* 1969) and Barnfield (Avery *et al.* 1972). The results indicate that the Batcombe soils in both fields are developed in a relatively silty (loess-containing) superficial deposit overlying and mixed with the Clay-with-flints. The fine sand and more particularly the coarse silt fractions of the latter contain around 95

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per cent quartz, small amounts of flint and feldspar, and heavy fractions dominated by iron oxides, zircon, tourmaline, rutile, staurolite and kyanite. In samples from the superficial layer, however, the coarse silts contain up to 17 per cent feldspar and heavy fractions yielding chlorite, epidote, garnet and amphiboles in addition to the more resistant mineral assemblage typical of the lower deposit. As well as flint, the fine sand fractions contain small amounts of chalcedony derived ultimately from shells of partially silicified fossil lamellibranchs, brachiopods and echinoids in the Chalk (Brown *et al.* 1969). The data also support the conclusion that upper horizons of the soils in the lowest parts of both fields (profiles 23 and 27) are developed in recent colluvium (Notley series).

The clay (< 2 μm) fractions of the soils examined are composed mainly of interstratified expanding-layer silicates containing smectite and other layers, with subsidiary mica and kaolinite and small amounts of feldspar (in coarser clay fractions), chlorite and crystalline (goethite) or amorphous ferric oxides. In general, the clay fractions of loess-rich horizons differ from those consisting mainly or entirely of Clay-with-flints in containing vermiculite, chlorite and feldspar; they also contain more mica, kaolinite and quartz, but less smectite. Data on soils elsewhere in the Chilterns (Avery *et al.* 1959; Loveday 1962; Avery 1964) show that clay fractions of the Clay-with-flints *sensu stricto* immediately overlying the Chalk in Winchester and Carstens soils are normally richer in smectite than those of overlying horizons. As this layer also contains more clay, amounting in places to more than 80 per cent of the fine earth (e.g. in profile 5), it has a correspondingly larger shrink-swell capacity.

Organic matter content and pH

Under semi-natural conditions, as in woodland or old grassland, the calcareous soils on Chalk or chalky drift contain significantly more organic matter, and hence more nitrogen, than the moderately to strongly acid soils on Clay-with-flints and associated deposits. This trend is well exemplified in profiles 6-9 in Knott Wood (Fig. 3). Still larger amounts, ranging up to 7-8 per cent organic carbon in the upper 20 cm, occur under old grass in the Ver valley (profiles 17, 37-39), where humus accumulation has been favoured by the former prevalence of high water table levels as well as by high base status.

Broadbalk and Geescroft Wildernesses (Fig. 1), uncultivated since 1882 and 1885 respectively and both on Batcombe soils, provide further evidence of the effect of calcium carbonate in promoting accumulation of organic matter under semi-natural conditions. In Broadbalk Wilderness (profiles 10 and 11), the topsoil of which still contains $CaCO_3$ remaining from heavy applications of chalk before the 1880s, there was a rapid increase in organic matter content such that by 1964 it was greater than in the nearby arable plot that had received 35 t/ha of farmyard manure annually since 1843 (Jenkinson 1971). On Geescroft Wilderness, now bearing deciduous woodland dominated by oak, previous chalking had been less generous; the topsoil pH (in water) declined from 7.1 in 1883 to 4.2 in 1990 (Johnston *et al.* 1986), and the accumulation rates of organic carbon and nitrogen were slower, less than one half that for carbon and less than one third that for nitrogen in Broadbalk Wilderness.

On the farmed land, both pH and organic matter content are primarily dependent on management history, including experimental treatments. As already indicated, Broadbalk, Hoosfield and other land regularly cropped during and before the 19th century traditionally received heavy dressings of chalk, each amounting to as much as

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150-250 t/ha, which was dug from infield 'bell-pits' or from 'dell-holes' on bordering slopes and spread by hand to improve the fertility and workability of the originally acid Batcombe and related soils; this eventually rendered them base-saturated and near-neutral in reaction to depths of 1.5 m or more. Grassland used for pasture or hay, as in Highfield and Park Grass (Fig. 1), was seldom chalked and hence remained at least moderately acid. By the 1950s, reserves of $CaCO_3$ remaining from earlier dressings had in places become exhausted by leaching and the soil had become acid, particularly in plots on Broadbalk and elsewhere receiving annual applications of ammonium sulphate. Except for areas deliberately kept acid, pH (H_2O) values on the cultivated land have since been maintained at around 7.0 by regular liming.

On Broadbalk, continuously cultivated since 1843 or earlier, organic carbon contents in the upper 23 cm of soil vary from around 0.8 per cent in the unmanured plot to around 2.2 per cent in the plot that has received farmyard manure annually. Profiles 19-27 in Broadbalk and Barnfield were located in inter-plot pathways and hence contain less topsoil organic C than adjacent plots. Corresponding values in profiles 18, 28-35, 41 and 42, all in fields not used for long-term experiments but cropped for varying periods before sampling, range from 1.4 to 2.8 per cent. Organic-carbon and pH data on a field-to-field basis, derived from a systematic survey in 1978-79, are given by Johnston *et al.* (1981).

Soil structure

Under woodland or old grassland, the structure of the topsoils is clearly influenced by organic matter content and base status. Thus the very dark coloured surface horizons of the soils that remain calcareous, either naturally or through the retention of added chalk as in Broadbalk Wilderness, are characterized by strongly developed granular or fine subangular blocky peds. In contrast those that are acid are more weakly structured and in extreme cases, typified by the unlimed Park Grass plots that have received regular applications of ammonium sulphate, organic matter has accumulated at the surface to form a discrete *mor* layer and the immediately underlying mineral soil is massive and structureless.

Despite the presence of $CaCO_3$ in varying amounts, structure is markedly weaker in the arable land than in the uncultivated calcareous soils. As a consequence the relatively impermanent aggregates produced by cultivation are apt to slake under the impact of rain, so reducing permeability and promoting the formation of a cap which can set hard and so delay the emergence of seedlings if dry weather follows. These effects are most evident in lighter soils, however, and are mitigated in the silty clay loam topsoils which predominate at Rothamsted by subsequent cultivation under favourable conditions, aided by the restorative action of periodic wetting, drying and freezing. There is accordingly no clear evidence that structural deterioration under continuous arable cultivation has influenced crop yields significantly (Boyd *et al.* 1962), though spring-sown crops may be adversely affected in unfavourable seasons as a result of failure to obtain a satisfactory seedbed.

Soil water regime

The Clay-with-flint subsoils of the Batcombe and Hornbeam series which underlie some 60 per cent of the estate are slowly permeable and hence are periodically saturated with

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water in most years, but are distinctly more permeable than the unaltered Reading Beds clays from which they are largely derived. This can be attributed, at least in part, to long-continued, oxidative weathering as evidenced by the relatively large amounts of 'free iron oxide' in relation to clay that they contain. Thus excess winter rain is eventually disposed of by slow downward movement to the unsaturated Chalk and any water moving laterally over the clay enters the Chalk at the margins of the drift cover or in other places where it is relatively thin.

Water levels in 10 cm diameter dip-wells in a typical Batcombe soil near the southern boundary of Park Grass were recorded at fortnightly intervals over the winters of 1965-6 and 1966-7, both of which were wetter than average. The results (Robson and Thomasson 1977) showed that the subsoil was waterlogged at 70 cm depth for 64 and 80 days *in toto* respectively, and at 40 cm depth for 24 and 30 days, so placing the soil in Wetness Class II (moderately well drained) as defined by Hodgson (1974). Permeability tests using civil engineering procedures at other sites at Rothamsted and Kinsbourne Green (north of Harpenden) have given conformable results that show a clear correlation between the location and intensity of greyish subsoil mottling and the rate of removal of added water from standard-sized holes. Thus it is very much slower in typical Batcombe soils than in unmottled Carstens and Winchester soils (Table 2) that have well fissured clayey subsoils overlying Chalk within 1-1.50 m depth. Except where a plough pan has developed or severe surface compaction occurred, however, they are seldom waterlogged within 40 cm depth for more than a few days at a time and it is only locally, as in Broadbalk and other intensively used land, that pipe drainage has been installed.

Apart from the Ver valley-floor soils and the Hook series in 'plateau brickearth', the other soil series represented are normally well drained (Wetness Class I), implying that the rooting zone is seldom, if ever, waterlogged. In the groundwater gley soils occupying the lowest parts of Flint and Ver (now made ground) fields and the intervening copse, the water regime was profoundly affected by the installation of the Friars Wash pumping station, some 3 km up-valley, in the early 1950s. Before then the water table is these soils regularly rose into the upper horizons in winter and spring, but by spring 1966, when profile 17 was sampled, it was deeper than 80 cm and the river bed nearby was dry. Following cessation of pumping in 1992, however, the river is now flowing again and the water table correspondingly high.

Except in these few small areas where the summer water table may remain within root range, plant growth over the April-September period, during which monthly transpiration normally exceeds rainfall, is dependent on water stored in the soil. The extent to which crops and grass are affected by drought in an average year depends primarily on the difference between potential transpiration as determined by meteorological factors and the effective available-water capacity of the soil, but is also influenced by rooting habit and growing period. Grass needs most water because of its long growing period with full ground cover, so that the mean maximum potential soil-moisture deficit (PSMD) for grass, estimated as 153 mm at Rothamsted (Hodge *et al.* 1984), is larger than for other crops which do not cover the ground completely in the earlier part of the growing season or, like cereals, ripen before the maximum PSMD is reached. The corresponding effective available-water capacity (AP) of the dominant Batcombe and Carstens soils, derived from water-release measurements, is approximately 135 mm; on this basis PSMD exceeds AP by 18 mm, implying that growth of grass is significantly limited by lack of water in most summers. For winter wheat PSMD is

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estimated as 91 mm, some 44 mm less than AP, so that the crop is unlikely to suffer from drought and Yates (1969) concluded from a review of earlier investigations that wheat yields on Broadbalk were generally larger in dry years.

The deep, nearly stone-free silty soils of the Hook and Hamble series have larger available-water capacities than the Batcombe and Carstens soils and are predictably less droughty on this basis, though an experiment in 1976 on the Hook soil of Little Knott field (Fig. 1) showed that excluding rain from a spring barley crop for 4, 6 or 8 weeks in the main part of its growing season (April 28 onwards) using a mobile shelter decreased grain yield by 17, 29 and 41 per cent, respectively (Woodhead 1977). It is possible, however, that subsurface compaction at this site may have reduced the effective AP by limiting root development.

Of the remaining soils, the most droughty are those in Flint, Scout and Osier Fields that have loose gravelly subsurface horizons of varying thickness, as in profiles 16, 38 and 39. Grass in these areas was severely 'burnt' during the dry summers of 1989 and 1990, even in places where the winter water table is now high. The effective available-water capacity of the shallow chalky soils of the Upton series occurring in parts of White Horse and Drapers Fields is difficult to assess because the shattered Chalk substrate is penetrable by roots to varying depths, but is evidently larger than might be expected because the Chalk itself, unlike other consolidated rocks, is porous and holds considerable amounts of water extractable by plants (Burnham and Mutter 1993).

The Soil-Map Units

Typical Batcombe (139 ha)

This unit, occupying 46 per cent of the mapped area, consists mostly of Batcombe series with a flinty silty clay loam (U.S. silt loam) topsoil containing 18-27 per cent clay and strong brown to yellowish red clay with varicoloured mottling at less than 80 cm depth. The main variations, which can recur laterally within a few metres, are in depth to clay, degree of subsoil gleying and stoniness. In much of the old arable land, including Broadbalk (profiles 20 and 21), the clay is encountered immediately below the topsoil, the clay content of which may locally exceed the 27 per cent limit; elsewhere, as in most of High Field (profiles 2 and 13), a brown friable subsurface horizon similar in texture to the topsoil overlies clay at greater depths, and in variants marginal to the Hook series (profiles 1 and 22) passes downwards into mottled silty clay with few stones. The most gleyed profiles have red, brown and grey mottles within 60 cm depth, the greyest colours occurring on structural (ped) faces and around stones; in the least gleyed, which grade into Carstens soils in places where the underlying Chalk is relatively close to the surface, red mottles and paler brown ped faces are still evident within the same depth, but grey inclusions are rare or absent.

On the sloping land in Black Horse and Bylands fields (profile 34), both surface and subsurface horizons are generally more stony than elsewhere; the boundary between the superficial loamy layer and the clay subsoil tongues downwards to more than 80 cm in places, and the topsoil locally contains enough sand (clay loam rather than silty clay loam) for the soil as a whole to qualify as Hornbeam series (Table 2) rather than Batcombe.

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Heavy Batcombe (20 ha)

These soils also conform nearly everywhere to the Batcombe series but the topsoils are heavier, generally containing between 27 and 35 per cent clay, and the characteristically mottled Clay-with-flints subsoil starts at or a little below plough depth. In the main areas of occurrence on more or less eroded upper valley-side slopes in Barnfield (profiles 24 and 26), Agdell, Delharding and Claycroft, they grade into Carstens or Winchester soils as the Chalk approaches the surface. Smaller and less well defined patches, each with some topsoil containing 30 per cent or more clay, occupy nearly level plateau sites in Broadbalk (profile 19), Hoos, Little Hoos, Long Hoos and Great Harpenden fields. The patch in the south-west corner of Broadbalk is clearly revealed on a map of isodynes (lines of equal resistance as measured by drawbar pull) constructed by Haines and Keen (1925) from dynamometer readings, which they correlated with clay content (Avery and Bullock 1969).

Batcombe-Carstens (47 ha)

In the nearly level northern part of the farm mapped as Batcombe-Carstens, Batcombe soils with 18-27 per cent clay in the surface horizon are estimated to underlie at least 60 per cent of the area, but the subsoils are more variable than in the Typical Batcombe unit to the south. Thus around 27 per cent of the borings showed few or no mottles within 60 cm, so qualifying as Carstens or related well drained series, and 38 per cent revealed layers or patches of brightly coloured, more or less mottled sandy clay or sandy clay loam at varying depths below 30 cm. In a few places, too, particularly in Sawyers Field (profile 3), the loamy topsoil contains more than 20 per cent sand and so qualifies as clay loam rather than silty clay loam. These somewhat sandier soils, estimated to comprise no more than 20 per cent of the unit, may meet the requirements of the Sheldwich (well drained fine loamy), Marlow (well drained fine loamy over clayey) or Hornbeam (moderately well drained fine loamy over clayey) series, depending on subsoil texture and degree of gleying. Very small areas of Hook or Hamble soil (Table 2) with nearly stone-free silty subsurface horizons are also included.

Typical Carstens (7.5 ha)

The dominant component of this unit, the largest delineation of which extends from the western side of Great Knott into Knott Wood (profile 40), is well drained Carstens soil with a flinty silty clay loam (U.S. silt loam) topsoil containing 18-27 per cent clay and a yellowish red flinty clay subsoil overlying Chalk at depths greater than 80 cm. Similar soils of the Porton series (Table 2) with Chalk at less than 80 cm occur as sporadic inclusions, notably in Furze Field. Small areas of heavier Carstens or Batcombe soil are also included, the latter in places where the Clay-with-flints is thicker than about 1.5 m.

Carstens-Winchester (6.7 ha)

In a discontinuous belt of sloping land extending southwards from Great Knott (Fig. 1), and in a small part of White Horse Field, similar but generally heavier Carstens soils with Chalk at moderate depths occur in association with still heavier Winchester soils (profiles 5 and 30). As now defined, these have strong brown to yellowish red, unmottled flinty clay subsoils (Clay-with-flints *sensu stricto*) overlying more or less

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fragmented Chalk within 80 cm depth and no loamy surface horizon more than 15 cm thick. Small inclusions of heavy Batcombe with a mottled clay subsoil also occur where the undulating boundary between Clay-with-flints and Chalk descends locally to greater depths.

Hook (11 ha)

The soils of this unit, occurring in association with Batcombe in level or slightly depressed plateau sites, are developed in relatively stone-free silty drift (brickearth) which is composed largely of loess and overlies Clay-with-flints at depths greater than 80 cm. The dominant component, represented by profiles 32, 33 and 41 in Little Knott Field, has a brown silty clay loam to silty clay subsoil with paler coloured mottling at 40-80 cm depth. It is classed as a variant of the fine silty Hook series, intergrading to Batcombe, which is slightly more stony and contains rather more clay than typical Hook soils in Devensian (last glaciation) brickearth (e.g. Hodgson 1967). The largest delineation, in Whittlocks Field, also includes a small area of well drained (unmottled) but otherwise similar Hamble soil (profile 31).

Charity-Notley (18 ha)

Soils of the Charity series in flinty silty drift have flinty silt loam to silty clay loam topsoils, normally containing less than 27 per cent clay, and brown slightly to very flinty subsoils that become finer in texture with depth (profiles 12, 28 and 36). In the Charity-Notley unit, located in minor dry valleys heading on the plateau, they grade into superficially similar Notley soils (profile 4), the upper horizons of which are evidently in recent colluvium (Avery 1980). Charity soils and associated fine silty over clayey variants (profile 7) predominate in the valley extending through Knott Wood down into Stubbings and Drapers fields (Fig. 1). Here the non-calcareous subsoil horizons overlie chalky drift at varying depths. At higher levels they are generally underlain by Clay-with-flints and are in places less well drained, with varicoloured mottling below 40 cm depth, as in profiles 23 and 27 sampled in the lowest parts of Broadbalk and Barnfield respectively. These soils are identified as moderately well drained variants of the Notley series. The base of the colluvium is marked in both profiles by a layer that is more stony than the overlying horizons and rests in turn on a sequence of mottled silty horizons with few stones resembling those in Hook soils at comparable depths.

Charity-Hamble (20 ha)

In the Charity-Hamble unit mapped on footslopes in Meadow and parts of Black Horse, Scout and Osier fields, the dominant Charity soils grade locally into Hamble soil (profile 15) in which the upper horizons are only very slightly stony (< 5 per cent by volume) and more than half the upper 80 cm is stoneless (< 1 per cent). Both the stoniness and thickness of the brown silty subsurface horizons can vary considerably within a few metres, however, and reddish flinty clay is encountered within 80 cm in a few places, giving profiles that conform to the Carstens (profile 35) or Batcombe series.

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Maplestead (5.5 ha)

This unit, embracing parts of Flint, Scout and Osier fields, is distinguished by the common occurrence of very flinty (gravelly) subsurface horizons that resist penetration with an auger, so preventing examination of the profile to below 80 cm as required for positive identification of soil series. The upper horizons are generally also coarser in texture, mainly sandy silt loam, than in the adjacent Charity-Hamble unit. Coarse loamy Maplestead soils (profile 16) in which a subsurface gravelly layer overlies a brighter coloured, less stony and finer textured horizon within 80 cm are probably dominant, but flinty silty clay loams of the Charity series also occur, and variants in which gravelly material extends below 80 cm may conform to the fine silty over gravelly Rowton (profile 14) or the loamy-gravelly Bockmer series (Clayden & Hollis 1984), depending on the thickness and texture of overlying horizons.

Panholes (10 ha)

Soils with more or less flinty silty clay loam to clay topsoils and Chalk or chalky drift at moderate depths underlie the greater part of Knott Wood and much of Stubbings, Drapers, Webbs and White Horse fields, covering in all some six per cent of the estate, rather more than half of which is mapped as Panholes. The Panholes soils (profile 8) have brown, very slightly to moderately calcareous silty clay loam subsurface horizons overlying fragmented Chalk within 80 cm, and generally give place on lower slopes to essentially similar Coombe soils (profile 18) in which the substratum is compact chalky drift rather than Chalk *in situ*. The unit also includes small areas of Upton soils, where Chalk is closer to the surface and the brown subsoil is missing, and pockets of deeper, more or less completely decalcified soil of the Wold or related series (profiles 9 and 29), in which a clay-enriched Bt horizon has developed.

Upton (4.5 ha)

As shown on the map, shallow chalky soils of the Upton series predominate in parts of White Horse and Drapers fields. In earlier surveys (e.g. Avery 1964) they were included in the Icknield series, now restricted to very dark coloured (humic) rendzinas on Chalk as originally described by Kay (1934). The topsoils, normally of silty clay loam (U.S. silt loam to silty clay loam) texture, contain much finely divided chalk and are greyish brown to brown when moist but become paler in colour when dry. Fragmented chalk or extremely chalky unconsolidated material is encountered directly below the ploughed layer or within 30 cm depth.

Wallop Complex (3.5 ha)

In this unit, mapped in the southern part of Knott Wood and White Horse Field, more or less disturbed Chalk occurs nearly everywhere within 60 cm of the surface, but the thickness and morphology of the overlying horizons vary over short distances. As they incorporated vestigial or disturbed remains of Clay-with-flints, they are generally more flinty and finer in texture than in the Panholes-Coombe and Upton units. Although no single soil series is clearly dominant, Wallop soils (profile 6) with flinty clay topsoils and thin brown or reddish subsurface horizons of similar texture are extensive, grading on the one hand into shallower, less clayey and more calcareous Upton soils and on the other

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into Winchester soils, in which the clayey subsurface horizon extends to depths greater than 30 cm and contains little or no calcium carbonate.

Ver Complex (5.5 ha)

This unit, which was formerly well represented in Ver Field (profiles 37, 38 and 39), is now confined to the lower part of Flint Field, through which the stream runs, and the adjoining partly wooded area (Ver Spinney). As far as can be ascertained, the ground has never been cultivated and the surface is uneven, with former stream channels or closed depressions alternating with slightly higher terrace remnants. Although the soils vary morphologically in broad accordance with the micro-topography, they all have very dark coloured, very friable surface horizons with well developed granular (crumb) structure and a substratum of flint gravel with a sparse loamy matrix which becomes finer in texture at varying depths.

Three distinct variants were identified and mapped in the detailed survey of Scout Farm, as follows:

Soil G, represented by profile 38 (Tidmarsh series) is associated with the higher ground and shows little or no evidence of gleying in the upper 40 cm. The brown gravelly subsurface horizon becomes paler in colour with depth and tongues downwards into a more compact, clay-enriched Bt horizon with ochreous and greyish mottling related to former watertable levels.

Soil C is confined to low lying, seasonally wet, areas and is characterized by a surface layer of calcareous silty alluvium attributable to recent (Holocene) sedimentation. In profile 39, classed as a variant of the Binstead series (Hodgson 1967), the calcareous silty layer overlies non-calcareous loamy gravel at 25 cm depth and all the subsurface horizons are gleyed. In part of Ver Spinney the calcareous silty layer is 35 cm or more thick and the dark topsoil is also thicker and richer in organic matter, so that the profile as a whole qualifies as a calcareous humic-alluvial gley soil (Avery 1980).

Soil H, represented by profiles 17 and 37, also occupies low ground and has greyish silty upper horizons overlying gravel but is non-calcareous throughout. In profile 17 the 25-41 cm horizon is interpreted as a buried topsoil, presumably dating from a period before deforestation and cultivation of the adjoining upland slopes led to increased run-off and erosion, with consequent renewal of sedimentation in the river valley.

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Appendix A: Descriptions of Sampled Profiles

Profile 1 (B.W. Avery, 1945)

Location:	Park Grass (TL 122130)
Land use:	old grass
Soil series:	Batcombe (intergrading to Hook)
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth. U.S.D.A. (1992): Aquic Paleudalf F.A.O. (1990): Chromic Luvisol (or Alisol)
Horizons (cm):	
0 - 20 Ah	Thin turf mat over dark greyish brown, very slightly flinty silty clay loam. (U.S. silt loam)
20 - 45 Eb	Brown to yellowish brown, very slightly flinty silty clay loam (U.S. silt loam)
45 - 69 2Bt(g)1	Strong brown, slightly or very slightly flinty silty clay loam (U.S. silty clay loam) with common paler mottles
69 - 90 2Bt(g)2	Strong brown, slightly flinty silty clay (U.S. silty clay loam) with common reddish, greyish and paler brown mottles.

Profile 2 (B.W. Avery, 1945)

Location:	High Field (TL129131)
Land use:	old grass
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic Paleudalf or Paleudult F.A.O. (1990): Chromic Luvisol (or Alisol)
Horizons (cm):	
0 - 18 Ah	Dark greyish brown flinty silty clay loam (U.S. silt loam)
18 - 30 Eb	Brown flinty silty clay loam (U.S. silty clay loam)
30 - 60+ 2Bt(g)	Strong brown slightly flinty clay (U.S. clay) with paler and redder mottles becoming more prominent with depth

Profile 3 (B.W. Avery, 1945)

Location:	Sawyers III (TL122142)
Land use:	arable
Soil series:	Hornbeam
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Typic Paleudalf F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 20 Ap	Dark greyish brown, very slightly flinty clay loam (U.S. loam)
20 - 38 Eb	Brown, slightly flinty clay loam (U.S. loam)
38 - 90 2Bt(g)	Strong brown to yellowish red, slightly flinty clay (U.S. clay) with paler and redder mottles

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Profile 4 (B.W. Avery, 1945)

Location:	Harwood's Piece (TL134132)
Land use:	arable
Soil series:	Notley
Classification:	England and Wales (1980): colluvial brown earth U.S.D.A. (1992): Typic Hapludalf or Paleudalf? F.A.O. (1990): Chromic Luvisol?
Horizons (cm):	
0 - 20 Ap	Dark greyish brown, flinty, slightly calcareous clay loam to silty clay loam (U.S. clay loam)
20 - 51+ Bw	Brown, flinty silty clay loam (U.S. silt loam); few chalk fragments (augering proved brighter brown silty clay or clay at 80 cm)

Profile 5 (B.W. Avery, 1951)

Location:	Knott Wood (TL117133)
Land use:	woodland (hazel with ash and brambles)
Soil series:	Winchester
Classification:	England and Wales (1980): typical paleo-argillic brown earth U.S.D.A. (1992): Typic (or Vertic) Hapludalf F.A.O. (1990): Chromic (or Vertic) Luvisol
Horizons (cm):	
0 - 10 Ah	Very dark greyish brown (10YR3/2) flinty silty clay loam (U.S. silty clay loam)
10 - 23 Eb	Brown flinty clay (U.S. clay)
23 - 38 2Bt	Strong brown (7.5 YR5/6-8) flinty clay (U.S. clay) with paler brown ped faces
38 - 66 2Bt	Yellowish red (5 YR5/8) flinty clay (U.S. clay) with brown ped faces
66 - 76 3Bt	Yellowish red (5YR5/6) clay (U.S. clay) with large unbroken flints and black manganiferous segregations
76+ 4Cu	Fragmentary Chalk with clayey inclusions

Profile 6 (B.W. Avery, 1951)

Location:	Knott Wood (TL116133)
Land use:	woodland; clearing in hazel coppice with field layer of grass and herbs
Soil series:	Wallop
Classification:	England and Wales (1980): brown rendzina U.S.D.A. (1992): Typic Udorthent F.A.O. (1990): Eutric Leptosol
Horizons (cm):	
0 - 10 Ah	Very dark greyish brown (7.5-10YR3/2) calcareous silty clay (U.S. silty clay); few chalk fragments
10 - 23 Bw	Brown to strong brown (7.5YR4/4-5/6) flinty, slightly calcareous clay (U.S. silty clay to clay); few chalk fragments

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23 - 46 BC	Reddish yellow, flinty, very calcareous clay containing many soft chalk fragments
46 - 60+ Cu	Columns of hard white blocky chalk alternating with more friable chalk brash and brown clay

Profile 7 (B.W. Avery, 1951)

Location:	Knott Wood (TL116133)
Land use:	woodland; hazel coppice with field layer of grass and herbs.
Soil series:	unnamed, fine silty over clayey, over chalky drift
Classification:	England and Wales (1980): Typical argillic brown earth U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Haplic Alisol
Horizons (cm):	
0 - 13 Ah	2 cm turfy (not sampled) over dark brown (7.5YR4/3) flinty silty clay loam (U.S. silt loam)
13 - 30 Eb	Brown (7.5YR4/4) flinty silty clay loam (U.S. silty clay loam)
30 - 56 Bt1	Brown, flinty silty clay loam (U.S. silty clay loam)
56 - 86 Bt2	Reddish brown, flinty silty clay (U.S. silty clay loam) resting with an irregular boundary on chalky material with clayey inclusions

Profile 8 (B.W. Avery, 1951)

Location:	Knott Wood (TL115135)
Land use:	woodland; hazel coppice with field layer of dogs mercury and bluebells
Soil series:	Panholes
Classification:	England and Wales (1980): typical brown calcareous earth U.S.D.A. (1992): Rendollic Eutrochrept F.A.O. (1990): Calcaric Cambisol
Horizons (cm):	
1 - 0	Litter layer (not sampled)
0 - 10 Ah	Dark brown (7.5YR3/2), very slightly flinty, calcareous, humose silty clay loam (U.S. silt loam)
10 - 36 Bw	Brown (7.5YR4/4), slightly flinty, calcareous silty clay loam (U.S. silty clay loam)
36 - 61 BC	Brown flinty, very calcareous, silty clay loam to silty clay (U.S. silty clay loam) containing abundant chalk fragments
61 + Cu	Hard blocky Chalk with inclusions of brown loamy material and fresh white-coated flints

Profile 9 (B.W. Avery, 1951)

Location:	Knott Wood (TL115134)
Land use:	woodland (cut-over); hawthorn scrub with elder and brambles; field layer of grass and herbs
Soil series:	Wold
Classification:	England and Wales (1980): typical argillic brown earth

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	U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Haplic Luvisol
Horizons (cm):	
0 - 10 Ah	2 cm turfy over very dark greyish brown (7.5-10YR3/1) flinty silty clay loam (U.S. silt loam)
10 - 25 Eb	Brown (7.5YR4/3) flinty silty clay loam (U.S. silty clay loam)
25 - 51 Bt	Brown to strong brown (7.5YR4/4-5/6) flinty silty clay (U.S. silty clay)
51 - 55/76 BC	Brown to pale reddish yellow, flinty, very calcareous silty clay loam to silty clay containing abundant chalk fragments
55/76 + Cu	Hard white blocky Chalk with loamy inclusions

Profile 10 (D.W. King, 1953)

Location:	Broadbalk Wilderness (TL121136)
Land use:	woodland; self-sown sycamore, hazel and hawthorn; field layer predominately ivy.
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic (or Typic) Paleudalf F.A.O. (1990): Chromic Luvisol.
Horizons (cm):	
0 - 15 Ah	Very dark greyish brown (10YR3/2), flinty, slightly calcareous clay loam (U.S. loam)
15 - 30 Eb/Bw	Brown (10YR4/3), flinty, calcareous silty clay loam (U.S. clay loam to silty clay loam); few small chalk fragments
30 - 41 Eb	Brown (7.5YR4/4), flinty, very slightly calcareous silty clay loam (U.S. silt loam)
41 - 91 2Bt(g)	Reddish brown to yellowish red (5YR4/4-5/6) flinty clay (U.S. clay) with greyish and reddish mottles becoming more prominent with depth

Profile 11 (D.W. King, 1953)

Location:	Broadbalk Wilderness (TL121136)
Land use:	grassland regularly mown, with hogweed and nettles.
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic Paleudalf F.A.O. (1990): Chromic Luvisol
Horizons:	
0 - 15 Ah	Dark greyish brown (10YR4/2), slightly flinty, slightly calcareous silty clay loam (U.S. silt loam to silty clay loam); few chalk fragments
15 - 25 Eb	Brown (9YR4/4) slightly flinty, slightly calcareous silty clay loam (U.S. silt loam to silty clay loam); chalk fragments more common
25 - 51 2Bt(g)	Brown to strong brown (7.5YR4/4-5/6), very slightly flinty, very

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	slightly calcareous silty clay (U.S. silty clay) with redder mottles and paler ped faces
51 - 76 + 2Bt(g)2	Strong brown (7.5YR5/6), very slightly flinty clay (U.S. clay) with common redder and greyer mottles

Profile 12 (B.W. Avery & A.J. Thomasson, 1956)

Location:	Meadow Field, Scout Farm (TL109130)
Land use:	old grass
Soil series:	Charity (intergrading to Hamble)
Classification:	England and Wales (1980): typical argillic brown earth (possibly disturbed) U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Haplic (or Chromic) Luvisol.
Horizons (cm):	
0 - 13 Ah	Thin turfy mat over dark greyish brown (10YR4/2) slightly flinty silt loam (U.S. silt loam)
13 - 76 Eb/Bw	Brown (7.5YR4-5/4) very slightly flinty silt loam
76 - 117 Bt1	Brown very slightly flinty silty clay loam (U.S. silt loam) with faint paler and redder mottles and clay skins on ped surfaces
117 - 160 Bt2	Strong brown (7.5YR5/6) very slightly flinty silty clay loam (U.S. silty clay loam) with faint paler and redder mottles and clay skins on ped surfaces
160 +	Becoming gravelly

Profile 13 (B.W. Avery and D. Mackney, 1963)

Location:	High Field (TL124129)
Land use:	old grass
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic Paleudalf F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 6 Ah	Dark greyish brown (10YR4/2) stoneless silty clay loam (U.S. silt loam); added chalk
6 - 20 Ah/Eb	Dark greyish brown and dark yellowish brown (10YR4/4) very slightly flinty silty clay loam (U.S. silt loam)
20 - 35 Eb	Yellowish brown (10YR5/4) slightly to moderately flinty silty clay loam (U.S. silt loam) with paler ped faces
35 - 65 2Bt(g)1	Brown (10YR5/4) to strong brown (7.5YR5/6-8) slightly flinty silty clay (U.S. silty clay) with paler and redder mottles
65 - 125 2Bt(g)2	Strong brown (7.5YR5/6) to yellowish red (5YR5/6-8) very slightly flinty clay (U.S. clay) with pale brown and greyish mottles becoming more prominent with depth

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Profile 14 (R.G. Sturdy, 1966)

Location:	Meadow Field, Scout Farm (TL107128)
Land use:	old grass
Soil series:	Rowton? (needs deeper sampling for positive identification)
Classification:	England and Wales (1980): typical argillic brown earth or typical brown earth? U.S.D.A. (1992): Typic Hapludalf or Glossudalf? F.A.O. (1990): Haplic (or Chromic) Luvisol?
Horizons (cm):	
0 - 11 Ah	Dark greyish brown (10YR4/2), very slightly flinty silty clay loam (U.S. silt loam)
11 - 43 Bw/Eb	Brown (7.5YR4/4) slightly flinty silt loam to silty clay loam (U.S. silt loam)
43 - 56 Bw/Eb	Brown (7.5-10YR4/4) moderately flinty silt loam (U.S. silt loam)
56 - 81 2Bw/Eb	Brown (7.5YR5/4), very gravelly sandy silt loam (U.S. silt loam); stones mainly rounded flint pebbles with some larger angular flints

Profile 15 (B.W. Avery, 1966)

Location:	Scout Field, Scout Farm (TL108134)
Land use:	old grass
Soil series:	Hamble intergrading to Charity
Classification:	England and Wales (1980): typical argillic brown earth U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Haplic Luvisol
Horizons (cm):	
0 - 18 Ah	Dark greyish brown (10YR4/2-3) very slightly flinty silty clay loam (U.S. silt loam)
18 - 38 Eb	Brown (10-7.5YR4/3) silty clay loam (U.S. silt loam) with occasional flints < 5 cm
38 - 61 Bt1	Brown (7.5YR4-5/4) silty clay loam (U.S. silt loam to silty clay loam) with occasional small flints as above
61 - 89 Bt2(g)	Brown (7.5YR5/4-6) silty clay loam to silty clay (U.S. silty clay loam) with faint mottling in shades of brown; occasional flints as above

Profile 16 (B.W. Avery and R.G. Sturdy, 1966)

Location:	Osier Field, Scout Farm (TL109132)
Land use:	old grass
Soil series:	Maplestead
Classification:	England and Wales (1980): typical argillic brown earth U.S.D.A. (1992): Typic Paleudalf (or Glossudalf) F.A.O. (1990): Chromic Luvisol (or Eutric Podzoluvisol).
Horizons:	
0 - 10 Ah	Very dark greyish brown (10YR3/2) slightly flinty sandy silt loam to clay loam (U.S. silt loam)

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10 - 25 Ah/Eb	Dark greyish brown to brown (10YR4/2-3) moderately flinty (c.20%) sandy silt loam (U.S. silt loam); added chalk
25 - 48 2Eb	Brown (7.5YR4-5/4) very gravelly (mainly small angular flints) sandy silt loam (U.S. loam); wavy lower boundary
48 - 58/66 2 Eb and Bt	Strong brown to yellowish brown (7.5-10YR5/4-6) very flinty (as above) sandy silt loam (U.S. silt loam) with light yellowish brown (10YR6/4) patches; irregular lower boundary with more clayey inclusions
58/66 - 91 3Bt	Reddish yellow to strong brown (7.5YR6/8-5/6), moderately to slightly flinty silty clay loam to silty clay (U.S. silty clay loam) with redder (5YR5/6) patches and thick clay skins

Profile 17 (B.W. Avery and R.G. Sturdy, 1966)

Location:	Flint Field, Scout Farm (TL112132)
Land use:	old grass with rushes, buttercups and tufted hair grass
Soil series:	unnamed; fine silty over non-calcareous gravel
Classification:	England and Wales (1980): argillic humic gley soil U.S.D.A. (1992): Typic Argiaquoll F.A.O. (1990): Luvic (or Gleyic) Phaeozem
Horizons (cm):	
0 - 9 Ah1	Very dark brown (10YR2/2) very slightly flinty (mainly < 1 cm) humose silty clay loam (U.S. silt loam)
9 - 25 Ah2	Very dark grey (10YR3/1) slightly to moderately flinty (gravelly) humose silty clay loam (U.S. silt loam) with fine reddish brown (rusty) mottles, ochreous stains on flints, and paler grey lenses at base
25 - 41 bAh1	Very dark greyish brown (10YR3/2) slightly to moderately flinty (gravelly) silty clay loam (U.S. silt loam) with common fine rusty mottles
41 - 46 2bAh2	Loose flint gravel with dark grey loamy matrix and common ochreous stains on flints
46 - 71 2Eg	Loose flint gravel with yellowish red mottles and ochreous deposits on flints, concentrated at 61-66 cm
71 - 90 3Btg	Light grey to light greyish brown (10YR-2.5Y6/1) flinty sandy clay loam, sticky and plastic

Profile 18 (R.G. Sturdy, 1966)

Location:	Webb's Field, Scout Farm (TL113128)
Land use:	arable
Soil series:	Coombe
Classification:	England and Wales (1980): typical brown calcareous earth U.S.D.A. (1992): Rendollic Eutrochrept F.A.O. (1990): Eutric Cambisol
Horizons (cm):	
0 - 25 Ap	Dark greyish brown (10YR4/2) slightly flinty, slightly calcareous silty clay loam (U.S. silty clay loam)

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25 - 53/58 B	Brown to dark brown (7.5YR4/4) slightly flinty, very slightly calcareous silty clay loam (U.S. silty clay loam) becoming slightly more clayey towards base; wavy lower boundary
53/58 - 86 Cu	Light yellowish brown (10YR6/4) and very pale brown (10YR8/3), compact, extremely calcareous silty clay loam (U.S. silty clay loam) containing common sub-rounded chalk fragments and brown to strong brown loamy inclusions

Profile 19 (B.W. Avery, 1968; Profile 1 in Avery & Bullock, 1969)

Location:	Broadbalk: intersection of Sections IB/2, plots 17/18 (TL122135)
Land use:	arable
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic Paleudalf F.A.O. (1990): Chromic (or Vertic) Luvisol
Horizons (cm):	
0 - 20 Ap	Dark brown (10YR4/3-2) slightly flinty, slightly calcareous silty clay loam (U.S. silty clay loam); added chalk
20 - 51 2Bt(g)1	Yellowish red (5YR5/6-8) and strong brown moderately flinty clay (U.S. clay) with common red and lighter brown to greyish brown mottles
51 - 94 2Bt(g)2	Yellowish red, strong brown and red slightly flinty clay (U.S. clay) with common brown to light brownish grey (10YR6/2) mottles, mainly as vertical streaks

Profile 20 (B.W. Avery, 1968; Profile 2 in Avery & Bullock, 1969)

Location:	Broadbalk: intersection of Sections 3/4, plots 3/5 (TL123136)
Land use:	arable
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic Paleudalf F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 20 Ap	Dark brown (10YR4/3) slightly flinty, slightly calcareous silty clay loam (U.S. silt loam); added chalk
20 - 51 2Bt(g)1	Yellowish red to strong brown (5 - 7.5YR5/6-8) very slightly flinty clay (U.S. clay) with few to common red mottles and paler brown ped faces
51 - 96 2Bt(g)2	Yellowish red and strong brown slightly flinty clay (U.S. clay) with red and brown (10YR5/3) to light grey (10YR6/1) mottles
96 - 142 2BC(g)	Similar mottled clay containing common large, little broken nodular flints and fewer mottles

Profile 21 (B.W. Avery, 1968; Profile 3 in Avery & Bullock, 1969)

Location:	Broadbalk: intersection of Sections 3/4 and plots 8/9 (TL123136)

Land Use:	arable
Soil Series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth. U.S.D.A. (1992): Aquic Paleudalf (or Hapludalf) F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 18 Ap	Dark greyish brown to brown (10YR4/2-3) slightly flinty, very slightly calcareous silty clay loam (U.S. silt loam)
18 - 48 Bt	Brown (7.5YR4/4) slightly flinty silty clay (U.S. silty clay)
48 - 71 2Bt(g)1	Strong brown to reddish yellow (7.5YR5/6-8) very slightly flinty clay (U.S. clay) with more sand than above, many red and few to common light grey (10Y7/1) mottles
71 - 102 2Bt(g)2	Strong brown to yellowish red (7.5-5YR5/8) very slightly flinty clay (U.S. clay) with appreciable sand and common red and light grey mottles
102 - 152 2BCt(g)	Yellowish red to strong brown stoneless clay loam to clay (U.S. clay loam) with fewer red and grey mottles, platy structure

Profile 22 (B.W. Avery, 1968; Profile 4 in Avery & Bullock, 1969)

Location:	Broadbalk: intersection of Sections 2/3 & plots 7/8 (TL122136)
Land use:	arable
Soil series:	Batcombe, intergrading to Hook
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic Paleudalf (or Hapludalf) F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 23 Ap	Dark greyish brown to brown (10YR4/2-3) slightly flinty, very slightly calcareous silty clay loam (U.S. silt loam)
23 - 41 Eb/Bt(g)	Brown (7.5-10YR) very slightly flinty, very slightly calcareous silty clay loam (U.S. silt loam) with faint greyer and brighter brown mottles
41 - 66 Bt(g)1	Brown to strong brown (7.5YR4/4-5/6) very slightly flinty silty clay (U.S. silty clay loam) with paler brown to light brownish grey (10YR6/2) mottles
66 - 94 Bt(g)2	Strong brown (7.5YR5/6) very slightly flinty silty clay (U.S. silty clay) with mottles as above more common
94 - 117 2Bt(g)3	Yellowish red (5YR5/8) and strong brown moderately flinty silty clay with common light brownish grey to light grey (10YR6/1) mottles

Profile 23 (B.W. Avery, 1968; Profile 5 in Avery & Bullock, 1969)

Location:	Broadbalk: south corner, headland beside plot 19 (TL124135)
Land use:	arable
Soil series:	Notley
Classification:	England and Wales (1980): colluvial brown earth intergrading to gleyic argillic brown earth.

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	U.S.D.A. (1992): Aquic Paleudalf
	F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 25 Ap	Dark greyish brown (10YR3/2) slightly flinty silty clay loam (U.S. silt loam)
25 - 41 Bw/Eb1	Brown (7.5YR4/4) slightly flinty silty clay loam (U.S. silt loam)
41 - 53 2Bw/Eb(g)	Brown (7.5YR4-5/4) moderately flinty silty clay loam (U.S. silt loam) with common, faint, paler brown (6/3) mottles
53 - 71 3Bt(g)1	Brown (7.5YR5/4) very slightly flinty (< 2%) silty clay loam (U.S. silty clay loam) with many paler brown to light grey (10YR6-7/1) mottles and black manganiferous segregations
71 - 91 3Bt(g)2	Strong brown (7.5YR5/6-8), brown, and light brownish grey (10YR6/2) prominently mottled, very slightly flinty silty clay (U.S. silty clay loam) with manganiferous segregations as above

Profile 24 (B.W. Avery, 1971; Profile 5 in Avery *et al*., 1972)

Location:	Barnfield: section 6, between plots 4 and 5 (TL132132)
Land use:	arable
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth
	U.S.D.A. (1992): Aquic Paleudalf
	F.A.O. (1990): Chromic (or Vertic) Luvisol
Horizons (cm):	
0 - 18 Ap	Dark brown (10YR4/3) very slightly flinty, very slightly calcareous silty clay loam (U.S. silty clay loam)
18 - 35 2Bt(g)1	Strong brown (7.5YR5/6) to yellowish red, stoneless clay (U.S. clay) with fine redder mottles and paler brown ped faces
35 - 55 2Bt(g)2	Strong brown very slightly flinty clay (U.S. clay) with red and paler brown mottles and paler brown ped faces
55 - 90 2Bt(g)3	Strong brown to reddish yellow (7.5YR5/8) very slightly flinty clay (U.S. clay) with many red and common light brownish grey (10YR6/2) to grey (6/1) mottles, particularly around stones and on structural faces

Profile 25 (B.W. Avery, 1971; Profile 7 in Avery *et al*., 1972)

Location:	Barnfield: section 3, between plots 4 and 5 (TL132134)
Land use:	arable
Soil series:	Carstens (intergrading to Notley)
Classification:	England and Wales (1980): typical paleo-argillic brown earth
	U.S.D.A. (1992): Typic Paleudalf
	F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 15 Ap1	Dark brown (10YR4/3) slightly flinty, slightly calcareous silty clay loam (U.S. silt loam)
15 - 30 Ap2	Dark brown (10YR4/3) slightly flinty (more than above), very slightly calcareous silty clay loam (U.S. silt loam)
30 - 41 Bt	Brown (10-7.5YR4/3-4) moderately flinty silty clay loam (U.S. silty

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	clay loam)
41 - 70 2Bt1	Brown to yellowish red (7.5-5YR4/4-5/6) slightly flinty clay (U.S. clay)
70 - 90 2Bt2	Yellowish red (5YR5/6-8) slightly flinty clay (U.S. clay) with few paler brown mottles

Profile 26 (B.W. Avery, 1971; Profile 8 in Avery *et al.*, 1972)

Location:	Barnfield, section 1, between plots 4 & 5 (TL132135)
Land Use:	arable
Soil series:	Batcombe (intergrading to Givendale)
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth U.S.D.A. (1992): Aquic (or Vertic) Paleudalf F.A.O. (1990): Chromic (or Vertic) Luvisol
Horizons (cm):	
0 - 19/21 Ap	Dark brown (10YR4/3) slightly flinty, very slightly calcareous, silty clay loam to silty clay (U.S. silty clay loam)
19/21 - 35 2Bt1	Strong brown to yellowish red (7.5-5YR4-5/6) very slightly flinty clay (U.S. clay) with faint brownish mottles
35 - 55 2Bt2(g)	Strong brown to yellowish red, very slightly flinty clay (U.S. clay) with paler brown (7.5YR5/4) structural faces
55 - 90 2Bt3(g)	Brown and yellowish red, slightly flinty clay (U.S. clay) with common to many red (2.5YR4/6) and few to common light brownish grey to light grey mottles

Profile 27 (B.W. Avery, 1971; Profile 11 in Avery *et al.*, 1972)

Location:	Barnfield; section 3, between plots 7 & 8 (TL133134)
Land use:	arable
Soil series:	Notley
Classification:	England and Wales (1980): colluvial brown earth U.S.D.A. (1992): Typic Hapludalf (or Paleudalf)? F.A.O. (1990): Chromic Luvisol?
Horizons (cm):	
0 - 18 Ap1	Dark greyish brown (10YR4/2-3) slightly to moderately flinty, slightly calcareous silty clay loam (U.S. silt loam)
18 - 28 Ap2	Dark brown (10YR4/3) slightly to moderately flinty, slightly calcareous silty clay loam (U.S. silt loam), more compact than above
28 - 50 Bw	Brown (7.5-10YR4/4) slightly flinty silty clay loam (U.S. silt loam)
50 - 70 2Eb/Bt	Paler yellowish brown (10YR5/4) very flinty sandy silt loam (U.S. loam to silt loam) becoming redder and finer in texture in places near lower boundary; stones mainly less than 5 cm (loamy gravel)
70 - 90 3Bt(g)	Strong brown to reddish yellow (7.5YR5-6/6) stoneless silty clay loam to silty clay (U.S. silty clay loam) with pale brown to light yellowish brown (10YR6/3-4) mottles

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Profile 28 (B.W. Avery, 1971)

Location:	Stubbings Field, Scout Farm (TL114131)
Land use:	arable
Soil series:	Charity (intergrading to Notley)
Classification:	England and Wales (1980): typical argillic brown earth U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Haplic Luvisol
Horizons (cm):	
0 - 25 Ap	Dark greyish brown (10YR4/2) slightly flinty silty clay loam (U.S. silt loam)
25 - 52 Eb	Brown (7.5-10YR4/4) slightly flinty silty clay loam (U.S. silt loam)
52 - 90 Bt	Brown (7.5YR4/4) moderately flinty silty clay loam (U.S. silt loam to silty clay loam)

Profile 29 (B.W. Avery, 1971)

Location:	Stubbings Field, Scout Farm (TL114133)
Land use:	arable
Soil series:	unnamed; fine silty over clayey, on chalky drift
Classification:	England and Wales (1980): typical argillic brown earth U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Haplic Luvisol
Horizons (cm):	
0 - 25 Ap	Dark brown (10YR3/3, 4/3 rubbed); slightly flinty, slightly calcareous silty clay loam (U.S. silty clay loam)
25 - 42/55 Bt	Brown (7.5YR4/4) slightly flinty silty clay (U.S. silty clay loam); few rotting chalk fragments; fine earth mainly non-calcareous
42/55 - 90 Cu	Brown and pale brown, very slightly flinty, very calcareous silty clay loam (U.S. silty clay loam) containing many soft, weathered chalk fragments

Profile 30 (B.W. Avery, 1971)

Location:	Great Knott (TL117136)
Land use:	arable
Soil series:	Winchester
Classification:	England and Wales (1980): typical paleo-argillic brown earth U.S.D.A. (1992): Typic (or Vertic) Hapludalf F.A.O. (1990): Chromic (or Vertic) Luvisol
Horizons (cm):	
0 - 20 Ap	Dark brown (10YR4/3) slightly to moderately flinty, slightly calcareous clay loam to clay (U.S. silty clay loam); added chalk
20 - 43 2Bt1	Yellowish red (5 YR4-5/8) flinty clay (U.S. clay) with some brown (7.5-5YR4/4) faces around flints
43 - 67 2Bt2	Yellowish red (5YR4-5/8) flinty clay (U.S. clay) with common slickensided structural faces; flints include large little-broken nodules

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67 - 90 Cu	Chalk fragments in a matrix of finely divided chalk with few flints and inclusions of yellowish red clay near upper boundary

Profile 31 (B.W. Avery, 1971)

Location:	Whittlocks (TL118143)
Land use:	arable
Soil series:	Hamble
Classification:	England and Wales (1980): typical argillic brown earth U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Haplic Luvisol
Horizons (cm):	
0 - 18 Ap	Dark greyish brown to brown (10YR4/2-3) very slightly flinty silty clay loam (U.S. silt loam)
18 - 38 Bt1	Brown (7.5YR4/4) very slightly flinty silty clay loam (U.S. silt loam)
38 - 68 Bt2	Brown (7.5YR4/4) stoneless silty clay loam (U.S. silty clay loam) with few faint paler brown mottles
68 - 90 Bc(g)	Brown stoneless silty clay loam (U.S. silt loam) with paler brown and dark greyish brown mottles

Profile 32 (B.W. Avery, 1973)

Location:	Little Knott (TL121135)
Land use:	arable
Soil series:	Hook
Classification:	England and Wales (1980): gleyic argillic brown earth U.S.D.A. (1992): Typic Paleudalf F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 20 Ap	Dark greyish brown to dark brown (10YR4/2-3) very slightly flinty, slightly calcareous silty clay loam (U.S. silt loam)
20 - 40 Eb	Brown (7.5-10YR4/4) very slightly flinty silty clay loam (U.S. silt loam)
40 - 65 Bt(g)1	Brown (7.5YR4-5/4) stoneless silty clay loam (U.S. silty clay loam) with common fine strong brown (7.5YR5/6) mottles
65 - 91 Bt(g)2	Strong brown (7.5YR5/6) and brown (7.5YR4-5/4), mottled, stoneless silty clay loam to silty clay (U.S. silty clay loam) with some paler brown (5/2-3) structural faces
91 - 136 Bct(g)1	As above, with few light grey (10YR6/2) faces
136 - 182 Bct(g)2	Strong brown stoneless silty clay (U.S. silty clay loam) with many paler brown to light grey mottles

Profile 33 (B.W. Avery, 1973)

Location:	Little Knott (TL121135)
Land use:	arable
Soil series:	Hook (intergrading to Batcombe)
Classification:	England and Wales (1980): gleyic argillic brown earth

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	U.S.D.A. (1992): Typic (or Aquic) Paleudalf
	F.A.O. (1990): Chromic (or Haplic) Luvisol
Horizons (cm):	
0 - 18 Ap	Dark greyish brown to dark brown (10YR4/2-3) very slightly flinty, slightly calcareous silty clay loam (U.S. silt loam)
18 - 37 Eb	Brown (7.5-10YR4/4) very slightly flinty silty clay loam (U.S. silt loam)
37 - 55/60 Bt(g)1	Brown (7.5YR5/4) very slightly flinty silty clay loam (U.S. silt loam) with few faint paler and stronger brown mottles
55/60 - 90 Bt(g)2	Brown and strong brown (7.5YR5/6-8), stoneless to very slightly flinty silty clay loam to silty clay (U.S. silty clay loam) with few light grey mottles mainly associated with structural faces
90 - 135 BCt(g)	Strong brown (7.5YR5/6) and brown (7.5YR5/4) stoneless silty clay loam (U.S. silty clay loam) with light grey mottles as above
135 - 300 BC(g)	As above, mainly strong brown with few grey to light grey sub-vertical veins and mottles

Profile 34 (R.G. Sturdy, 1976)

Location:	Blackhorse Field, Scout Farm (TL105130)
Land use:	arable
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic brown earth
	U.S.D.A. (1992): Typic (or Glossic) Paleudalf
	F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 27 Ap	Dark greyish brown (10YR4/2), slightly flinty, very slightly calcareous, clay loam to silty clay loam (U.S. silt loam to loam)
27 - 38 Eb	Brown (7.5YR5/4) and dark brown (7.5YR4/3) moderately flinty (including common flint pebbles) silty clay loam (U.S. silt loam)
38 - 70 Bt(g)	Brown (7.5YR4-5/4) moderately flinty (as above) silty clay loam (U.S. silt loam to silty clay loam) with reddish yellow (7.5YR6/6) mottles and pale brown (10YR6/3) inclusions extending locally to greater depths
70 - 110 2Bt(g)	Red (2.5YR3/6) moderately flinty clay (U.S. clay) with many yellowish brown (10-7.5YR5/4) mottles and brown (7.5YR5/4) ped faces
110 - 130 2BC(g)	Red (2.5YR3/6) moderately flinty clay (U.S. clay) with common yellowish brown to pale brown (7.5YR5/2) mottles

Profile 35 (B.W. Avery, 1976)

Location:	Meadow Field, Scout Farm (TL107127)
Land use:	arable
Soil series:	Carstens (intergrading to Batcombe)
Classification:	England and Wales (1980): typical (grading to stagnogleyic) paleo-argillic brown earth
	U.S.D.A. (1992): Typic Paleudalf

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F.A.O. (1990): Chromic Luvisol

Horizons (cm):

0 - 25 Ap	Dark greyish brown (10YR4-3/2) slightly flinty, very slightly calcareous clay loam (U.S. silt loam)
25 - 35/50 Eb	Brown (7.5YR4/4) moderately (varying from slightly to very) flinty silty clay loam (U.S. silt loam) with wavy lower boundary and paler brown (7.5YR5-6/4) inclusions in lower part
35/50 - 65/92 Bt1	Reddish brown to yellowish red (5YR4/4-5/6) moderately flinty silty clay loam (U.S. silty clay loam) with brown (7.5YR4-5/4) inclusions and similar colours on some ped faces; wavy lower boundary
65/92 - 120 Bt2(g)	Yellowish red (5YR5/8) to reddish yellow (7.5YR6/6-8) slightly to moderately flinty clay (U.S. clay to clay loam) with paler brown (7.5YR5/4-3) ped faces and few redder mottles

Profile 36 (R.G. Sturdy, 1976)

Location:	Osier Field, Scout Farm (TL110128)
Land use:	old grass
Soil series:	Charity
Classification:	England and Wales (1980): typical argillic brown earth. U.S.D.A. (1992): Typic Paleudalf F.A.O. (1990): Chromic (or Haplic) Luvisol

Horizons (cm):

0 - 10 Ah	Dark greyish brown (10YR4/2) very slightly flinty silty clay loam (U.S. silt loam)
10 - 25 AE	Dark greyish brown to dark brown (10YR4/2-3) very slightly flinty silty clay loam (U.S. silt loam)
25 - 40 Eb	Brown (7.5YR4/4) very slightly flinty silty clay loam (U.S. silt loam)
40 - 70/84 Bt1	Brown (7.5YR5/4) slightly flinty silty clay loam (U.S. silty clay loam), with darker brown (7.5YR4/2-3) inclusions and ped faces; wavy lower boundary
70/84 - 105 Bt2	Strong brown (7.5YR5/6) slightly flinty silty clay loam (U.S. silty clay loam) with reddish brown (5YR4/4) clay coats on ped faces
105 - 170 BC(t)	Brown to strong brown (7.5YR5/5) very slightly flinty silty clay (U.S. silty clay loam) with few paler brown (7.5YR5/2) veins and ped faces

Profile 37 (R.G. Sturdy, 1976)

Location:	Ver Field, Scout Farm (TL111128)
Land use:	old grass (made ground in 1993)
Soil series:	unnamed; fine silty over non-calcareous gravel
Classification:	England and Wales (1980): argillic humic gley soil U.S.D.A. (1992): Mollic Endoaqualf F.A.O. (1990): Gleyic Luvisol?

Horizons (cm):

0 - 18 Ahg1	Very dark grey (10YR3/1) very slightly flinty, humose sandy silt

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	loam (U.S. loam) with common fine strong brown (7.5YR4/6) mottles along root channels
18 - 36 Ahg2	Dark greyish brown to dark grey (10YR4/2-1) slightly flinty sandy silt loam to silty clay loam (U.S. silt loam) with mottles as above
36 - 50 Eg	Dark greyish brown (10YR4/2) moderately flinty silty clay loam (U.S. silt loam) with few mottles
50 - 58 Btg	Dark grey (10YR4/1) slightly flinty silty clay loam (U.S. silt loam) with many dark yellowish brown (10YR4/4) to strong brown (7.5YR5/6) mottles
58 - 95 2Btg	Dark grey (10YR4/1) very to extremely flinty sandy clay loam (loamy gravel) with many strong brown mottles
95 - 110 2BCgf	Strong brown (7.5YR5/8) very flinty clay loam (U.S. loam) with many pale brown (7.5YR4/2) mottles

Profile 38 (B.W. Avery, 1976)

Location:	Ver Field, Scout Farm (TL112128)
Land use:	old grass (made ground in 1993)
Soil series:	Tidmarsh
Classification:	England and Wales (1980): gleyic argillic brown earth
	U.S.D.A. (1992): Mollic Hapludalf (or Glossudalf)
	F.A.O. (1990): Chromic Luvisol?
Horizons (cm):	
0 - 15 Ah1	Very dark greyish brown (10YR3/2) very slightly flinty, humose clay loam (U.S. loam)
15 - 32 Ah2	Dark greyish brown (10YR4/2) moderately to very flinty clay loam (U.S. loam)
32 - 50 Bw?	Brown very flinty sandy silt loam or sandy loam (loamy gravel of subangular flints with few flint pebbles)
50 - 85 2Eb	Brown to light yellowish brown (10YR5/4) very to extremely flinty sandy loam with paler mottles (loamy gravel with inclusions of 'clean' gravel)
85 - 130 2Btgf	Prominently mottled, light yellowish brown and strong brown to yellowish red, very flinty sandy clay loam with clayey coats and inclusions

Profile 39 (B.W. Avery, 1976)

Location:	Ver Field, Scout Farm (TL112129)
Land use:	old grass (made ground in 1993)
Soil series:	Binstead (phase with superficial silty calcareous alluvium)
Classification:	England and Wales (1980): typical argillic gley soil
	U.S.D.A. (1992): Aeric Endoaqualf
	F.A.O. (1990): Gleyic Luvisol?
Horizons (cm):	
0 - 12 Ah1	Very dark grey to greyish brown (10YR3/1-2) stoneless, calcareous, humose silty clay loam (U.S. silt loam to silty clay loam)
12 - 25 Ah2(g)	Dark greyish brown, very slightly flinty, calcareous silty clay loam

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	(U.S. silt loam) with common strong brown to yellowish red mottles
25 - 48 2Eg	Brown to greyish brown very flinty sandy silt loam to sandy loam (loamy gravel) with fine strong brown mottles
48 - 150 2Eg/Btgf	Pale brown, very to extremely flinty sandy loam (loamy gravel) with yellowish red to dark reddish brown ferruginous bands; matrix becoming sandy clay loam or finer below 90 cm; wet at base

Profile 40 (L. De Klerk and C. Van Beek, 1977)

Location:	Knott Wood (TL117135)
Land use:	deciduous woodland
Soil series:	Carstens
Classification:	England and Wales (1980): typical paleo-argillic brown earth U.S.D.A. (1992): Typic Hapludalf F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 15 Ah	Dark brown (10YR3/3) slightly flinty silty clay loam (U.S. silt loam)
15 - 30 Eb	Brown to dark brown (7.5YR4/4) moderately flinty silty clay loam (U.S. silt loam)
30 - 50 Bt	Strong brown (7.5YR5/6) slightly flinty silty clay loam (U.S. silty clay loam)
50 - 90 2Bt	Reddish brown to yellowish red (5YR4/5) very slightly flinty clay (U.S. silty clay to clay) with common fine red (2.5YR5/6) mottles
90 - 100 Cu	Pinkish grey (7.5YR7/2) extremely calcareous silty clay (U.S. silty clay loam) containing many chalk fragments

Profile 41 (L. De Klerk and C. Van Beek, 1977)

Location:	Little Knott (TL120134)
Land use:	temporary grass
Soil series:	Hook (intergrading to Batcombe)
Classification:	England and Wales (1980): gleyic argillic brown earth U.S.D.A. (1992): Typic Paleudalf F.A.O. (1990): Haplic Luvisol
Horizons (cm):	
0 - 24 Ap	Dark brown (10YR4/3) very slightly flinty, very slightly calcareous silty clay loam (U.S. silt loam)
24 - 40 Bt1	Dark yellowish brown (10YR4/4) very slightly flinty silty clay loam (U.S. silty clay loam)
40 - 65 Bt2(g)	Brown (7.5YR5/4) stoneless silty clay loam (U.S. silty clay loam) with common strong brown (7.5YR5/7) mottles
65 - 105 2Bt3(g)	Brown (7.5YR5/4) stoneless to very slightly flinty silty clay (U.S. silty clay loam) with common strong brown mottles
105 - 110 2BCg	Strong brown (7.5YR5/7) stoneless to very slightly stony silty clay to clay (U.S. silty clay) with common yellowish red (5YR5/6) mottles

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Profile 42 (L. De Klerk and C. Van Beek, 1977)

Location:	Bones Close
Land use:	arable
Soil series:	Batcombe
Classification:	England and Wales (1980): stagnogleyic paleo-argillic grown earth U.S.D.A. (1992): Aquic Paleudalf F.A.O. (1990): Chromic Luvisol
Horizons (cm):	
0 - 20 Ap	Dark brown (10YR4/3) slightly flinty, very slightly calcareous silty clay loam (U.S. silt loam)
20 - 40 Bt1	Strong brown (7.5YR5/6) and dark yellowish brown (10YR4/4), slightly flinty faintly mottled silty clay loam (U.S. silty clay loam)
40 - 120 2Bt(g)	Strong brown (7.5YR5/8) very slightly flinty clay (U.S. clay) with common pinkish grey (7.5YR7/2) mottles

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Appendix B: Analytical Data

Profile No.	Depth (cm)	Sand 60μm-2mm %	Silt 2-60μm %	Clay <2μm %	Loss on ignition %	Organic carbon %	$CaCO_3$ equiv. %	Extr. Fe_2O_3 %	pH (H_2O)	pH ($CaCl_2$)
1	0-20	19	58	23	7.7		0.0		4.9	
	20-45	19	57	24	4.4		0.0		5.3	
	45-69	16	50	34	4.7		0.0		5.4	
	69-90	8	53	39	4.8		0.0		5.8	
2	0-18	15	59	26	8.2		0.0		4.8	
	18-30	15	56	29	6.0		0.0		4.9	
	30-60	5	32	63	4.5		0.0		5.6	
3	0-20	28	52	20	6.4		0.1		7.1	
	20-38	22	52	26	3.9		0.2		7.5	
	38-90	14	34	52	6.4		0.0		7.5	
4	0-20	21	51	28	7.4		1.9		7.6	
	20-51	16	62	22	3.7		0.2		7.9	
5	2-10	13	57	30	13.4		0.0		4.9	4.2
	10-23	17	40	43	7.7		0.0		5.6	5.2
	23-38	17	20	63	8.9		0.0		4.9	4.3
	38-66	10	11	79	10.2		0.0		5.0	4.4
	66-76	<1	14	86	11.6		0.0		6.5	6.0
6	2-10	4	54	42	15.0	4.9	5.2		7.8	7.4
	10-23	11	44	45	10.9	2.6	3.4		7.8	7.4
7	2-13	10	66	24	5.8	3.1	0.0		4.5	3.9
	13-30	10	61	29	5.8	1.1	0.0		4.7	4.1
	30-56	10	56	34	4.9	0.5	0.0		5.0	4.6
8	0-10	14	60	26	14.6	5.6	6.6		7.5	7.2
	10-36	17	53	30	7.6	1.9	8.2		7.9	7.4
	36-61	13	51	36	4.6	0.9	39.7		8.0	7.4
9	2-10	15	59	26	9.8	3.6	0.0		6.5	6.1
	10-25	12	58	30	6.0	1.3	0.0		6.4	6.0
	25-51	13	44	43	5.9	0.8	0.0		6.6	6.1
10	2-10	22	52	26	10.2	3.6	2.3		7.0	6.7
	18-25	17	52	31	6.0	1.0	5.8		7.6	7.3
	33-41	18	58	24	4.5	1.2	0.7		7.7	7.3
	46-56	17	28	55	7.0	0.7	0.2		7.5	7.0
	76-91	9	25	66	8.5	0.5	0.1		7.4	7.0
11	2-13	19	54	27	10.4	3.4	1.6		7.5	7.2
	15-25	17	56	27	5.8	1.3	4.9		7.9	7.6
	30-41	11	42	47	6.7	0.6	0.5		7.5	7.2
	76-90	13	25	62	8.3	0.7	0.1		7.5	7.0
12	0-13	15	70	15	8.8		0.0		5.6	5.5
	20-70	19	65	16	3.8		0.0		6.1	5.9
	80-110	10	70	20	3.3		0.0		6.2	5.8
	120-160	12	56	32	4.4		0.0		6.5	6.2
13	1-6	5	72	23	11.3		0.6		6.9	6.5
	8-20	8	70	22	8.2		0.0		6.0	5.5
	22-30	7	67	26	5.1		0.0		5.4	4.6
	38-62	4	45	51	7.0		0.0		5.7	5.0
	67-92	4	41	55	7.2		0.0		6.2	5.6
	100-125	4	35	61	7.9		0.0		6.4	5.7

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Profile No.	Depth cm	Sand 60μm-2mm %	Silt 2-60μm %	Clay <2μm %	Loss on ignition %	Organic carbon %	$CaCO_3$ equiv. %	Extr. Fe_2O_3 %	pH (H_2O)	pH ($CaCl_2$)
14	2-10	12	69	19	10.9	4.5	0.0		5.5	4.7
	15-38	17	65	18	4.6		0.0		5.1	4.4
	46-53	18	66	16	3.6		0.0		5.4	4.7
	61-76	24	64	12	3.2		0.0		6.0	5.2
15	2-15	9	70	21	7.2	2.3	0.0		5.7	5.0
	20-36	8	71	21	4.5		0.0		6.0	5.1
	41-58	6	67	27	4.0		0.0		6.3	5.4
	74-89	3	62	35	4.6		0.0		6.5	5.9
16	2-8	21	61	18	11.8	5.1	0.1		6.7	5.9
	13-23	22	61	17	7.6		2.5		7.8	7.1
	51-66	32	56	12	2.7		tr.		7.7	6.9
	84-91	10	53	37	4.5		0.1		7.8	7.1
17	1-8	13	62	25	22.1	9.9	0.0		6.1	5.4
	13-23	18	57	25	13.9	5.7	0.0		6.1	5.2
	28-38	19	58	23	12.9	5.1	0.0		6.4	5.4
18	2-23	12	58	30	8.4	2.4	1.3		7.6	7.0
	28-38	9	62	29	5.0		0.4		7.7	6.9
	38-51	7	58	35	5.4		0.4		7.8	7.1
	61-81	7	62	31			80.2		8.2	7.4
19	0-20	15	57	28	5.1	1.0	1.3		8.1	7.4
	20-51	5	40	55	7.2	0.5	0.0		7.8	7.2
	51-94	7	34	59	7.2	0.3	0.0		7.6	7.0
20	0-20	8	68	24	4.2		1.5	2.6	8.1	7.6
	20-51	3	40	57	7.2		tr.	5.2	7.8	7.2
	51-96	9	20	71	8.3		0.0	6.5	7.5	7.0
	96-142	8	22	70	7.3		0.0	5.6	7.4	6.8
21	0-18	18	57	25	4.4	0.9	0.3	3.2	7.9	7.3
	18-48	12	51	37	5.2	0.5	0.0	4.1	7.6	7.0
	48-71	29	21	50	6.2	0.3	0.0	4.4	7.6	7.0
	71-102	27	30	43	5.3		0.0	4.4	7.6	7.0
	102-152	30	35	35	3.9		0.0	4.0	7.5	6.9
22	0-23	16	65	19	4.6	0.6	0.3	2.2	8.1	7.6
	23-41	10	65	25	3.8	0.4	0.2	2.9	8.0	7.5
	41-66	3	58	39	4.9	0.4	tr.	2.9	7.9	7.3
	66-94	5	55	40	4.9		tr.	3.2	7.9	7.3
	94-117	10	54	36	4.8		tr.	4.9	7.9	7.4
23	0-25	14	65	21	5.0	1.2	0.0		5.7	4.8
	25-41	14	65	21	3.8	0.6	0.0		6.3	5.7
	41-53	10	65	25	3.9	0.5	0.0		6.6	6.1
	53-71	5	63	32	4.3		0.0		6.9	6.2
	71-91	5	57	38	5.1		0.0		7.1	6.4
24	0-15	13	53	34		0.9	0.8	4.2	8.1	7.5
	18-35	4	38	58		0.6	0.1	5.4	7.4	7.1
	35-55	5	30	65		0.4	0.0	5.7	7.3	7.0
	55-90	6	20	74		0.3	0.0	6.7	7.2	6.9
25	0-15	16	62	22		0.7	1.5	3.2	8.2	7.6
	15-30	14	62	24		0.6	1.0	3.3	8.2	7.5
	30-41	12	60	28		0.5	tr.	3.8	7.7	7.2
	41-70	8	34	58		0.5	0.0	5.7	7.3	7.0
	70-90	8	33	59		0.4	0.0	5.9	7.4	6.9

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Profile No.	Depth cm	Sand 60μm-2mm %	Silt 2-60μm %	Clay <2μm %	Loss on ignition %	Organic carbon %	$CaCO_3$ equiv. %	Extr. Fe_2O_3 %	pH (H_2O)	pH ($CaCl_2$)
26	0-15	13	52	35		0.6	0.9	3.8	8.2	7.5
	20-35	3	32	65		0.4	tr.	5.6	7.5	7.1
	35-55	5	35	60		0.4	0.0	5.6	7.2	6.9
	55-70	19	22	59		0.2	0.0	6.2	7.2	6.9
	70-90	29	18	53		0.1	0.0	5.7	7.2	6.9
27	0-15	17	61	22		0.8	1.8	3.4	8.2	7.7
	15-25	17	60	23		0.7	2.0	3.0	8.2	7.6
	25-50	11	64	25		0.5	0.0	3.0	8.0	7.4
	50-70	33	51	16		0.2	0.0	5.7	7.8	7.2
	70-90	14	51	35		0.2	0.0	3.6	7.5	7.1
28	0-25	15	65	20		1.9	0.0		6.4	5.7
	25-52	12	64	24		1.3	0.0		6.5	5.8
	52-90	11	62	27			0.0		7.0	6.4
29	0-25	9	62	29		2.2	4.3		8.0	7.4
	25-49	6	57	37		0.8	0.6		8.1	7.4
	49-90	9	63	28			36		8.3	7.6
30	0-20	21	44	35		1.7	2.2		7.8	7.3
	20-43	19	20	61		0.9	tr.		7.9	7.3
	43-67	19	12	69		0.8	tr.		8.0	7.4
31	0-18	19	62	19		1.4	0.0		7.2	6.6
	18-38	13	61	26		0.7	0.0		7.4	6.8
	38-68	12	60	28		0.6	0.0		7.5	6.9
	68-90	10	64	26		0.5	0.0		7.8	7.1
32	0-20	14	64	22		1.5	tr.		7.2	6.5
	20-40	10	66	24			0.0		7.0	6.2
	40-65	4	64	32			0.0		7.0	6.4
	65-91	5	60	35			0.0		7.3	6.7
	91-136	3	61	36			0.0		7.7	6.9
	136-182	3	58	39			0.0		7.4	6.8
33	0-18	14	65	21		1.5	0.0		7.0	6.5
	18-37	10	67	23			0.0		7.1	6.2
	37-55	10	66	24			0.0		7.0	6.3
	55-80	4	61	35			0.0		7.2	6.5
	90-120	7	61	32			0.0		7.3	6.6
	150-180	5	64	31			0.0		7.1	6.3
34	0-27	20	59	21		2.0	0.5	2.7	7.8	7.3
	38-70	14	59	27		0.5	0.0	3.6	7.9	7.1
	70-110	9	36	55			0.0	6.0	7.8	7.1
	110-130	10	37	53		0.3	0.0	5.9	8.0	7.2
35	0-25	21	59	20		2.8	<1	2.9	7.0	6.4
	25-40	19	62	19		1.0	0.0	2.8	5.9	5.1
	50-72	10	58	32			0.0	3.7	5.8	5.0
	72-95	10	40	50			0.0	6.0	6.4	5.8
	95-120	18	44	38			0.0	5.2	6.6	6.0
36	0-10	12	69	19		3.6	<1	2.0	6.9	6.4
	10-25	15	66	19		1.7	0.0	2.2	6.7	6.1
	25-40	10	67	23			0.0	2.2	6.4	5.6
	40-77	6	65	29		0.6	0.0	2.9	6.1	5.2
	77-105	9	58	33			0.0	3.4	6.5	5.7
	105-145	1	63	36		0.2	0.0	3.2	6.6	5.8

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Profile No.	Depth cm	Sand 60μm-2mm %	Silt 2-60μm %	Clay <2μm %	Loss on ignition %	Organic carbon %	$CaCO_3$ equiv. %	Extr. Fe_2O_3 %	pH (H_2O)	pH ($CaCl_2$)
37	0-18	33	50	17		6.5	0.0	1.3	6.4	6.1
	18-36	20	62	18		2.3	0.0	0.3	6.7	6.0
	36-58	15	64	21		0.8	0.0	0.7	6.8	5.9
	58-95	53	27	20		0.4	0.0	1.4	7.0	6.2
	95-110	41	39	20		0.4	0.0	4.0	7.5	6.8
38	0-15	39	39	22		6.3	0.0		6.4	6.0
	15-32	40	41	19		4.5	0.0		5.6	4.8
39	0-13	12	61	27		8.9	8.8		7.5	7.1
	13-25	13	61	26		5.1	8.8		7.9	7.3
	37-55	71	18	11						
40	5-15	14	65	21		2.8	0.0	2.2	4.1	3.6
	15-30	15	64	21		1.4	0.0	2.3	4.3	3.8
	30-50	9	63	28		0.5	0.0	2.7	4.5	4.0
	50-90	8	42	50		0.6	0.0	4.7	5.0	4.4
	90-100	14	47	39		0.8	41	2.8	7.3	7.1
41	0-24	13	66	21		1.5	0.4	2.4	7.1	6.7
	24-40	5	65	30		0.6	0.0	2.8	6.6	6.1
	40-65	3	61	36		0.3	0.0	3.4	7.2	6.8
	65-105	7	54	39		0.4	0.0	4.3	7.2	6.6
	105-110	10	45	45		0.4	0.0	5.0	7.3	6.9
42	0-20	18	60	22		1.5	0.3	3.1	7.3	6.9
	20-40	12	55	33		0.6	0.0	4.1	7.4	6.9
	40-120	16	30	54		0.3	0.0	5.8	7.5	7.0

tr = trace
gaps indicate not determined

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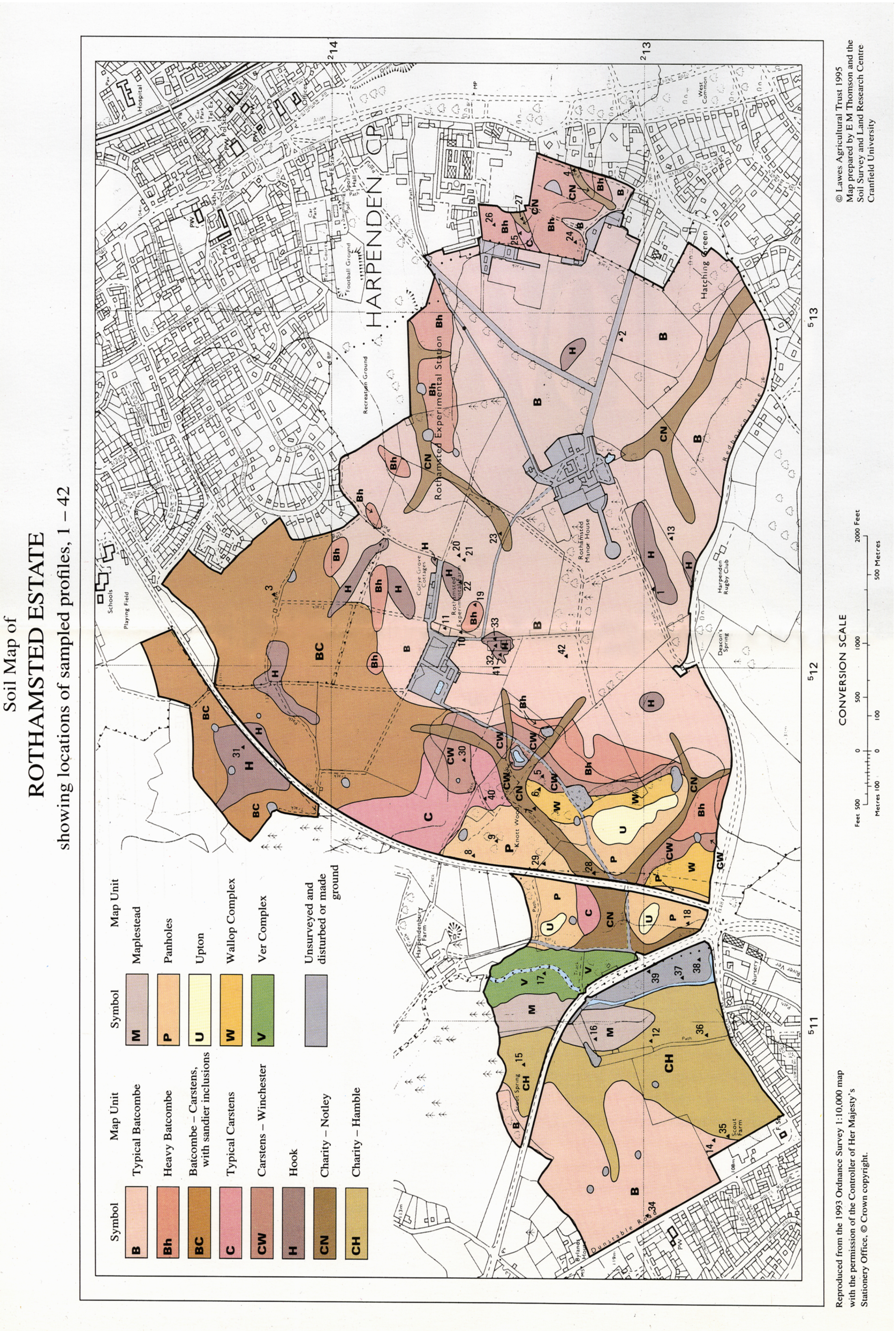
Soil Map of
ROTHAMSTED ESTATE
showing locations of sampled profiles, 1 – 42
Symbol
Map Unit
B Typical Batcombe
Bh Heavy Batcombe
BC Batcombe – Carstens, with sandier inclusions
C Typical Carstens
CW Carstens – Winchester
H Hook
CN Charity – Notley
CH Charity – Hamble
M Maplestead
P Panholes
U Upton
W Wallop Complex
V Ver Complex
Unsurveyed and disturbed or made ground
HARPENDEN
Rothamsted Experimental Station
Rothamsted Manor House
Harpenden Rugby Club
Hatching Green
Knott Wood
Scout Spring
Dunstable Road
Redbourn Lane
CONVERSION SCALE
Feet
Metres
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