

AGRICULTURAL RESEARCH COUNCIL

Soil Survey of England and Wales

The scope of research, 1946-67

by

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SUMMARY

A review has been made of papers published between 1946 and 1967 by members of the staff. The papers are grouped into broad categories and tabulated to indicate topics that have been given attention, and those calling for research in the future.

More work is felt to be needed on (1) geomorphology, particularly where physical factors in soil formation are involved, (2) biological factors in pedogenesis, (3) soil micromorphology, particularly to characterise drift material, (4) the morphology of Brown Earth soils, and (5) the soils of East Anglia and the East Midlands.

INTRODUCTION

In 1946 the Agricultural Research Council set up the Soil Survey Research Board to advise the Soil Surveys in the work of publishing soil maps and explanatory texts. Parallel laboratory and field studies have since been made to improve the usefulness of the maps, and many papers published by members of the staff.

In 1967, the Soil Survey of England and Wales came of age, and it was opportune to consider progress. A review has therefore been made of material published between 1946 and 1967 by the staff, in journals of scientific societies. The purpose is to identify research topics that have been given attention, and those needing research in the future.

This paper gives broad categories into which papers can be grouped, and tabulates numbers in each group. Recommendations are given on topics needing further work.

METHOD

Reprints were collected of 118 papers listed in the recent "Publications on Soil Survey" (1969) issued by the Survey. Papers out of print were excluded as were those relating to soils overseas, but twenty-six papers prepared by the Pedology Department, Rothamsted Experimental Station, were included. Until 1961 the work of both the Department and the Survey were guided by the late Dr. A. Muir, and the two bodies continue to co-operate closely.

An abstract of 250-500 words was prepared of each paper, using where possible the authors conclusions or summary to describe the main findings. To each abstract was added four key words indicating fields of interest. Where appropriate, one indicated the region of the country and another the major soil group concerned. Finally, papers were placed in groups corresponding to individual key words or major headings and the numbers in each group counted.

RESULTS (Tables 1-4)

The papers can be divided into three broad groups, concerned with pedogenesis, identification and soil fertility.

Papers on pedogenesis deal with factors, usually local which influence the present appearance and behaviour of the soil. Such information is particularly valuable in identifying and classifying soil. Papers on identification are essentially descriptive, and record soil morphology and properties. They are also valuable in enabling soils in one area to be correlated with others elsewhere. Papers on soil fertility describe crops most appropriate to different types of soil.

Table 1

General fields covered by papers

Field	Papers
Pedogenesis	109
Identification of soil	64
Soil fertility	22

The group dealing with pedogenesis can be sub-divided into those concerned with parent materials, mineralogy, chemical, physical and biological factors, micromorphology, geomorphology and time (Table 2). Further sub-division into individual topics is also possible.

Table 2

Distribution of major fields of study
in papers on pedogenesis

Field	Papers
Parent material	34
Mineralogy	24
Chemistry	18
Physics	7
Biology	4
Micromorphology	11
Geomorphology	7
Time	4

Papers dealing with chemical factors in pedogenesis are almost entirely those from the Pedology Department, Rothamsted Experimental Station. These discuss in detail the chemistry of podzolization, gleying, eluviation and of the formation and decomposition of the organic matter, and are a major contribution to our knowledge of the fundamental science of the soil-forming processes. Some of the papers on mineralogy, equally useful, are from the same source.

Physical factors in soil formation are more important in temperate than in tropical areas, and more papers would be welcome here in view of the importance of physical weathering in the formation of geological drift, a major source of soil parent material in the lowlands. The lack of papers may reflect the intermediate position of the field between soil science and quaternary geology.

Biological factors influence soil mainly in surface horizons, which are also open to the influence of management. Few papers have been published here, possibly because of the difficulty of assessing management effects. Biological studies of pedogenesis might, perhaps, be more rewarding in upland areas where disturbance has been less.

Micromorphology stands in relation to soil identification much as petrology to geology, and so is of prime importance in surveying soil. The Survey has taken a lead in this field, as the number of papers published show, and in 1968 a symposium on the subject was organized in connection with the Field Meeting. The topic is included in the current programme of supporting research, and should provide more information in the years ahead.

Although geomorphology, as a field study, would be expected to be particularly attractive to soil surveyors, many of whom are geologists or geographers, the total of papers is surprisingly low so far. In part this may be due to the considerable university research. As the Survey moves towards more county, regional and national maps, more papers on geomorphology would be welcome, and it is suggested that these might result from local co-operation with university departments.

Time as a factor in soil formation has been little studied both by the Survey and others, the main difficulty being the scarcity of experimental techniques. England is particularly blessed with archeological remains that can be dated independently, while in some cases (Romney Marsh) historical documentation is available. A dating technique for soils older than 30-50,000 years will be valuable.

The soil profile is a major tool of the soil surveyor, and understandably, the largest individual group of papers in the field of pedogenesis deals with parent materials, and these can be sub-divided into the major categories of geological drift with which they deal. The numbers of papers in each group can be compared with the proportions of land area occupied by each category (Table 3). These proportions were roughly estimated with a planimeter from the map of Superficial Deposits in the Clarendon Atlas of Great Britain and Northern Ireland.

Table 3

Distribution of drift categories in papers
on parent materials

Parent material	Papers	Areal proportion (%)
Residual	7	64
Glacial	10	27
Alluvial	8	8
Aeolian	4	1
Soliflucted	5	-

The low proportion of papers dealing with residual parent materials reflects the good availability of solid geological maps for most of the country, and so the possibility of taking advantage of work already done. The larger numbers of papers about glacial parent materials reflects the (comparatively) little attention given to glacial drift in the earlier work of the Geological Survey of Great Britain, as well as their importance in the identification and classification of soils, particularly in northern and eastern England. Soliflucted drift is not separated in the Atlas, but is of considerable importance in central and southern England where peri-glacial effects have moved soil boundaries away from those suggested by the solid geology. Aeolian deposits are often thin, but can be a greater proportion of the soil profile depth than of the corresponding drift thickness, and so have been studied more by the Survey. Alluvial soils often occur in areas of agricultural interest, and have received more than their proportionate share of interest.

Table 4

Distribution of topics among papers in
major fields of study in pedogenesis

Field	Topic	Papers
Mineralogy	Clay minerals	10
	Heavy minerals	9
	Trace elements	5
Chemistry	Podzolization	8
	Gleying	5
	Eluviation	3
	Organic matter	2
Physics	Frost	2
	Drainage	2
	Aspect	2
	Altitude	1
Biology	Flora	2
	Fauna	2

The distribution of topics among papers in major fields of study in pedogenesis is shown in Table 4.

In mineralogy, studies of heavy mineral distribution are of value in identifying parent material, particularly where this may be of glacial origin and far-travelled. Identification of clay minerals is also helpful in indicating the course of chemical weathering and hence in soil identification. Experience now shows that studies of clay mineralogy are of greater importance in the industrial technology of clay than in agriculture, but recent research also indicates that the clay particles have a significant role in determining inherent fertility.

Among the chemical fields of study, those of podzolization, gleying and eluviation have arisen from studies of morphology in the field, and serve both to improve understanding of the causes of morphology and to point to objective methods of identification. More rapid, routine methods of analysis will be of value here. Much knowledge has been obtained outside the Survey on the chemistry of organic compounds in the soil, but there have so far been few studies of geographical variations in the nature of soil organic matter.

Work on physical factors in soil formation has been spread fairly evenly over frost, drainage, aspect and altitude. All lend themselves to field study, and deserve more attention than they have received hitherto. The range of altitude in Britain is not so large that it is a factor of prime importance, except through its indirect effect on climate. The influence of freezing on soil formation is of particular relevance in England owing to the wide occurrence of soft rocks susceptible to frost shattering, and an investigation of frost effects is included in the current research programme.

Biological factors have been very little studied indeed. Tree and plant roots follow closely on physical and chemical weathering, and to judge from their effects on paths and pavements, should contribute to rock disintegration. Burrowing animals and insects disturb soil structure both in

surface and subsoil horizons. Some co-operative work seems to be called for here, possibly with universities or with the Nature Conservancy and Forestry Commission.

Table 5

Distribution of papers on soil identification
among major soil groups

Soil Group	Areal Proportion (%)	Papers
Brown earth	42	16
Gley	27	11
Podzol	4	7
Calc. & Rendzina	8	5
Org. & Peat	5	5
Alluvial	3	5
Analytical Methods		9
Classification		6

The distribution of papers on soil identification among major soil groups can be compared with areal percentages of the soil groups in lowland areas of England and Wales, given in an earlier paper (Table 5). The distribution is roughly comparable, but podzols have clearly received more, and brown earths and calcareous soils, less attention than their areal importance merits. The podzol is morphologically a very distinctive profile in which the pedogenic processes are most attractively displayed. The brown earths call for more attention by sampling and analysis in the laboratory to compensate for the fewer opportunities they offer for visual study.

Table 6

Distribution of topics in papers on soil fertility

Topic	Papers
Arable agriculture	3
Horticulture	6
Grassland	6
Forestry	3
Natural vegetation	4

The distribution of papers on soil fertility among the different fields in which fertility is manifested suggests only that arable agriculture is under-represented in proportion to its economic importance. To set against this, the role of soil in arable farming is extensively studied by many people outside the Survey.

Table 7

Regional distribution of soils discussed in papers

Region	Regional index	Papers
North	22	14
South-East	15	14
South-West	13	6
East Anglia	9	2
Wales	9	32
West Midlands	8	5
East Midlands	8	2

The regional distribution of the soils discussed in research papers can be considered in relation to the Regional Index of land value, calculated in an earlier paper (Table 7). The indices were calculated from the data of the 1930-47 Land Utilization Survey which divided land into ten categories of agricultural value (1-10). The total acreage of the best land, in categories 1 to 4 inclusive, was multiplied by 3, the acreage in categories 5 to 7 by 2 and that of the poorest land of categories 8 to 10 by 1. The sum of these acreages divided by 10⁶ gives the index value for the region.

The best documented soils are clearly those of Wales, thanks particularly to one author (C.B. Crampton) who was responsible for many papers about them. The South-east region houses Headquarters and the Pedology Department, R.E.S. and perhaps understandably is well catered for. Of the remaining regions, papers are most urgently needed on the soils of East Anglia and the East Midlands.

DISCUSSION OF RESULTS

The limitations of this analysis are clear. The classification and interpretation are subjective, the sample small and many is not synonymous with good. However, it is possible to recommend certain lines of study, with the aim of providing a better balance in studies supporting the mapping programme. These lines are:-

- (1) Geomorphological studies, including particularly those in which physical factors in soil formation are examined.
- (2) Biological factors influencing soil characteristics.
- (3) Micromorphological studies, and particularly those aimed at characterizing drift parent materials.
- (4) Morphological studies of different sub-groups of Brown Earths.
- (5) Studies of the soils of East Anglia and the East Midlands.

RECOMMENDATIONS

The paper is offered to the Board for information.